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HAZARDOUS MATERIALS UNDERWATER RECOVERY DEMONSTRATION

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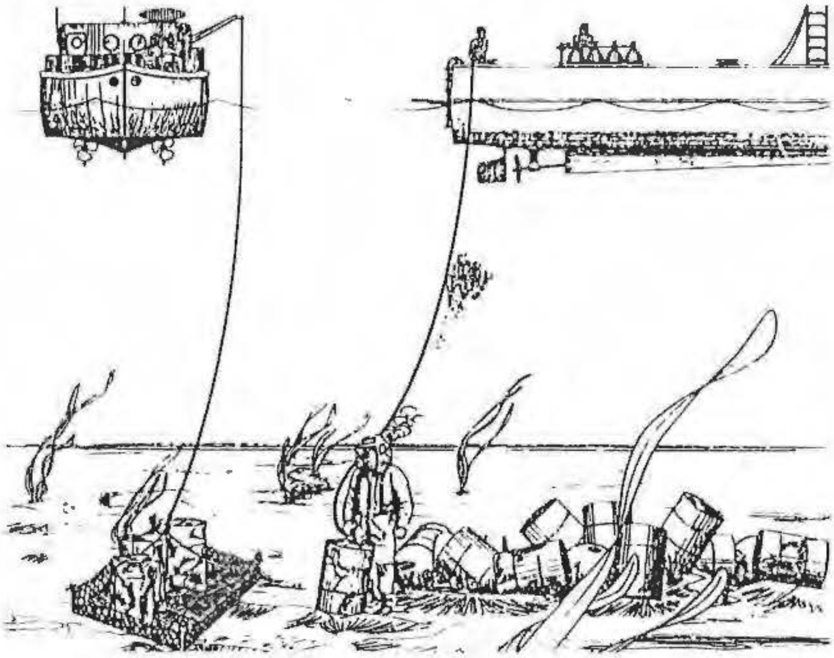

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
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INTRODUCTION

During the last decade diving operations in polluted water to support scientific commercial and military missions has increased in both frequency and the spectrum of materials to which divers are exposed. In the early 1970's studies relating to the fate and effect of sewage and chemicals introduced into the sea required the services of divers. Little consideration was given to the possible effects of these materials on the divers themselves. Immunizations against certain pathogenic microrganisms were given in some cases. Illness was reported in some divers who were exposed to sewage. Dry suits and surface supplied diving apparatus with high rates of air flow was believed to offer some protection.

Because hazardous materials are used in large volumes, many of these are transported by tankers over road, rails, and water by barges and ships. And, as with all forms of transportation, accidents are not infrequent. In this case, however, an accident can have the compounding effect of endangering human health and the environment far removed from the scene as, for example, when a tractor-trailer wrecks and spills its cargo of highly toxic material into a river upstream of a township's drinking water reservoir, In such a case the leak must be plugged and the released material contained as quickly as possible to prevent it from entering the reservoir and endangering the health of the township's citizenry. Also, the safety and health of the response personnel is a major concern and that is the purpose of this demonstration.

The equipment selection and development, and procedures developed under earlier NOAA studies for microbiological protection provided an increased level of protection for divers, but were not considered adequate protection for personnel operation in waters containing highly toxic substances and radioactive materials. Numerous government agencies and commercial companies are required to work in such water, and were thus concerned over the safety of their divers. This concern resulted in the formation of an informal working group whose purpose was to pool expertise in an effort to select or develop equipment and procedures which would protect divers in waters containing hazardous materials. The Environmental Protection Agency, U.S. Navy, U.S. Coast Guard, Department of Energy, Undersea Medical Society, University of Maryland, and the National Oceanic and Atmospheric Administration were members of this group. Considerable advice was obtained from commercial diving companies, and funds were provided by the Environmental Protection Agency, Department of Energy and the National Oceanic and Atmospheric Administration.

It has been the purpose of this Interagency Agreement to identify the problems, to locate immediate commercial solutions and to establish long and short-term goals for equipment and procedures development which will insure the health and safety of personnel who must work on, about, in, or under water when engaging in emergency or remedial response activities.

It is expected that this exercise will illustrate the groundwork which has been developed for a hazardous substance diving operations standard for both underwater and surface support activities for use by On-Scene Coordinators, and Marine Safety Officers, military diving units and commercial organizations for operations in chemically and biologically contaminated waterways. The resultant hazardous substances diving standard will allow the user community to identify the special hazards which divers would be subjected to; to determine what dress and equipment for both divers and surface support personnel should be used in a specific instance; to specify the necessary decontamination procedures; and to insure the health monitoring of the divers.

The need for such a Manual of Practice is immediate. Therefore, it is not the objective of this demonstration to recommend long-term research to develop new equipment or procedures, but rather to utilize existing commercial equipment and procedures which can be used as is, modified or mated with other existing equipment and procedures to provide immediate protection to divers working in waters contaminated with hazardous materials.

The "Manual of Practice for Marine Safety Officers and On-Scene Coordinators Involved in Chemically and/or Biologically Contaminated Underwater Operations" will be issued January 1985. This Seattle demonstration is to critique modified diving dresses and operational procedures and protocols. We need your input. We will be happy to review your comments, suggestions and observations. Please contact either/or:

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INTRODUCTION TO PERSONNEL SAFETY EQUIPMENT AND DECONTAMINATION OPERATIONS

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Evaluating the hazards associated with a toxic chemical spill incidents involves various degrees of complexities. The release of a single, known chemical compound does not represent as difficult a problem to assess as an incident involving multiple compounds. Likewise, it becomes progressively more difficult to determine hazardous effects as the number of compounds increase. The characterization of the hazards associated with an abandoned waste site, storage tanks, or lagoons with vast amounts of known or unknown amounts of chemical substances, becomes even more complicated. The most important first step though is to insure the safety of all personnel involved in the spill incident.

Routes of Exposure:

Only three pathways of chemical exposure to the body exist:

1) Through body contact (skin, including eyes and hair),
2) inhalation, and
3) by ingestion.

The primary function of the skin is to act as a barrier against entry of foreign materials into the body. However, this protective barrier can be overcome permitting chemical toxins to enter. The protective nature of the skin can be greatly diminished by lacerations and abrasions. Also, many organic solvents can greatly increase the permeability of the skin to materials that would otherwise not pass through it. Another factor is that the skin provides a large area for surface contact of the toxin.

Inhalation is the most rapid exposure route. Toxins are immediately introduced to respiratory tissue and the bloodstream. Once admitted to the blood through the lungs, these toxic chemicals are quickly transported throughout the body providing contact with all organs.

Health hazards to personnel from ingestion of materials are of minimal concern relative to skin and respiratory hazards. The number of substances that can be ingested are limited, i.e., it is difficult to swallow vapors and gases. Also, contact with ingestible materials is limited in that they only get to the mouth through hard contact. Even when ingested, toxicity by mouth is of a lower order due to subjection to acidic, alkaline, enzymatic conditions of the gastro-intestinal tract. But, these same conditions may enhance the toxic nature of a compound. It should also be noted that gum and tobacco chewers can absorb appreciable amounts of gaseous substances during an 8-hour workshift.

The establishment and execution of personnel protection programs when responding to hazardous chemical spills or releases find their basis in the letters "IDLH".

The definition of IDLH provided in 30 CFR 11.3(t) is as follows:

> "Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health."

The purpose of establishing an IDLH exposure concentration is to insure that the worker can escape without injury or irreversible health effects from an IDLH concentration in the event of failure of the respiratory protective equipment. The IDLH is considered a maximum concentration above which only highly reliable breathing apparatus providing maximum worker protction is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.

Levels of Protection:

It is important that personnel protective equipment and safety requirements be appropriate to protect against the potential or known hazards at an incident. Protective equipment should be selected based on the type(s), concentration(s), possibilities, and routes of personnel exposure from substances at a site. In situations where the type of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the personnel protective equipment required for initial safety. Level B protection is the minimum level recommended on initial entries until the hazards have been further identified and defined through monitoring, sampling and other reliable methods of analysis, and personnel protection equipment corresponding with those findings can be utilized.

The appropriate level of protection shall be determined prior to the initial entry on-site based on best available information. Subsequent information may suggest changes in the original level selected. Recommended levels of protection are:

1. LEVEL A

   Level A protection should be worn when the highest available level of both respiratory, skin, and eye contact protection is needed. While Level A provides the maximum available protection it does not protect against all possible airborne or splash hazards. For example, suit material may be rapidly permeable to certain chemicals in high air concentrations or heavy splashes.

2. LEVEL B

   Level B protection should be selected when the highest level of respiratory protection is needed, but cutaneous or percutaneous exposure to the small unprotected areas of the body (i.e. neck and back of head) is unlikely, or where concentracentrations are known within acceptable exposure standards.

3. LEVEL C

   Level C protection should be selected when the type(s) and concentration(s) of respirable material is known, or reasonably assumed to be not greater than the protection factors associated with air-purifying respirators; and exposure to the few unprotected areas of the body (i.e. neck and back of head) is unlikely to cause harm. Continuous monitoring of site and/or individuals should be established.

4. LEVEL D

   Level D is the basic work uniform and should be worn for all site operations. Level D protection should only be selected when sites are positively identified as having no toxic hazards.

Respiratory Hazards and Protection:

The lungs do not have defenses which are 100% effective against toxic gases, vapors or particulates. Such hazards may impair or destroy portions of the respiratory tract or they may be absorbed directly into the bloodstream. Those hazards in the blood eventually may affect the function of other organs and tissues. The lungs must be protected from toxic hazards. This can be accomplished by avoiding or minimizing exposure. Engineering controls such as ventilation will help decrease exposure. But, when such controls are not practical or feasible, protection can be afforded by the use of respirators.

There are respirators which filter gases, vapors and particulates in the ambient atmosphere. When concentrations are too high, respirators are available which will supply a clean source of breathing air to the wearer.

Oxygen Deficiency:

The body requires oxygen to maintain the various on-going processes. If the oxygen concentration decreases, the body will react by exhibiting various symtoms. Death will occur when the concentration reaches only 6%. The effects of oxygen deficiency are listed on the following table.

O_2 Vol % At Sea Level	Physiological Effect
16-12	Increased breathing volume, Acceleratd heartbeat, Impaired attention and thinking, Impaired coordination.
14-10	Very faulty judgment, Very poor muscular coordination, Muscular exertion causes rapid fatigue that may cause permanent heart damage, Intermittent respiration.
10-6	Nausea, Vomiting, Inability to perform vigorous movement, or loss of all movement Unconsciousness, followed by death
Less than 6	Spasmotic breathing, Convulsive movements, Death in minutes.

Aerosols

Aerosol is a term used to describe particulates in air without regard to their origin. Particulates are collected on the walls of the nasal cavities and conducting tubes. Particulates ranging in size 5-30 microns are deposited in the nasal and pharnygeal passages. The trachea and smaller conducting tubes collect particulates 1-5 microns in size. Any particulates which travel into the conducting tubes are carried by force of inhalation. For particulates to reach the alveolar spaces they must diffuse from the smallest conducting tubes into the alveolar spaces. Only particulates less than .5 microns in diameter diffuse into the alveoli. Larger particles do reach the alveolar spaces due to gravity and settling. The smallest particulates may never be deposited in the alveoli and so may diffuse back into the conducting tubes to be exhaled.

Gaseous Contaminants

Gases and vapors are filtered to some degree by the respiratory tract. If soluble, gases and vapors will be absorbed into the walls of the passages to the alveolar spaces. Not all will be absorbed and so will finally diffuse into the alveolar spaces. Here, the gases or vapors can be directly absorbed into the bloodstream.

Respiratory Protective Devices

Respiratory apparatus can be divided into two general types: Air Purifying and Atmosphere Supplying. These two categories can be further divided into groups based on their construction and operation.

All respirators are composed of two main components. The facepiece and the device which supplies or purifies air. The facepiece comes in three configurations which is directly related to the amount of protection afforded by the respirator:

1) Quarter Mask (Type B - Half Mask) fits from nose to top of chin and utilizes two or four point suspension.

2) Half Mask (Type A - Half Mask) fits under chin and over the nose. To be approved it must have four point suspension.

3) Full Facepiece - Covers all of the face from under the chin to the forehead.

The full facepiece provides the best protection because it is more easily fitted on the face than either the half or quarter mask.

A. Equipment Classification - general considerations

1) Air Purifying Respirators

The use of air purifying respirators is predicated on several factors. The atmosphere the respirator is to be used in must have at least 19.5% oxygen. The concentration of the contaminant must not be at IDLH levels.

Mechanical filters are used for particulate hazards and chemical sorbents are used for gases and vapor hazards. Respirators are approved for use up to predesignated concentrations. The respirator is also limited by its length of service which is based on the contaminant concentration.

Another important requirement is that the contaminant being filtered has warning properties which will alert the user to the exhaustion of service capacity of the respirator.

2) Atmosphere Supplying Respirators

There are four types of respirators which supply breathing air to the user. Atmosphere supplying respirators provide from five minutes to several hours of breathing air. The first type and the oldest is the oxygen generating respirator. This type of respirator has a cannister which converts carbon dioxide to oxygen. Oxygen generating respirators have been used in the military and for escape purposes in mines.

The hose mask is another type of atmosphere supplying respirator. It utilizes a remote source of a clean atmosphere. The clean air is drawn through the hose by the user or by a blower. The airline respirator is similar to the hose mask except the source of air is compressed.

Self-contained breathing apparatus (SCBA) uses a cylinder to hold compressed air or oxygen and allows the wearer to carry it with him/her without the confinement of a hose or airline. SCBA's and airline respirators operate in one of several modes, continuous demand or pressure demand.

The amount of protection an atmosphere supplying respirator gives is based on two factors: the type of face piece and its mode of operation. As was indicated earlier, the full face mask provides the best protection. Of the three modes of operation, continuous, demand, and pressure demand, the pressure demand mode provides the best protection. Airline respirators may use any one of the three operational modes. SCBA's will operate in either demand or pressure demand. Hose masks are considered to be demand operated.

An escape SCBA must have at least 5 minutes of breathing air available. From 5-15 minutes air supplies are found with escape devices. This escape supply is stored in a small cylinder or coiled stainless steel tubes.

Escape devices are not to be used for entry into hazardous atmospheres in any circumstances.

To beat the major limiting factor of SCBA's - air supply - combination airline and SCBA's have been manufactured. The SCBA may be used to enter and retreat from the site if there is enough air (greater than 15 minutes). The airline is used to supply air while the person is working on site.

This outline is not complete by any means.

Protective Clothing

The hazardous properties of chemical substances necessitates the use of protective clothing. The degree of protection required is dictated by the predominant physical, chemical, or toxic property of the material. For example, protection required for a corrosive compound is different than that of a compound which releases a highly toxic vapor. The type of activity such as work or observation around the substance must also be considered when assigning protective clothing. As with the selection of proper respiratory protective apparatus, a thorough assessment of the encountered hazards must be completed before any decision-making.

Once the specific hazard has been identified the appropriate clothing can be selected. Several factors must be considered in the selection of clothing. The most important is the safety of the individual. The level of protection assigned must match the hazard confronted. It is also very important that the individual is well-trained in the use of procedures for site activities. Other factors include cost, availability, compatibility with other equipment, suitability and most important, performance.

Performance Requirements

The primary safeguard of any protective clothing is the material from which it was manufactured. In selecting a suitable piece of protective clothing, the following characteristics of the protective material should be considered: strength, flexibility, thermal limits, cleanability, lifetime, and chemical resistence.

The strength of a material is based on four specific requirements. It must be resistant to tears, punctures, abrasions, and it must possess suitable tensile strength.

For ease of movement and to facilitate work activity in protection clothing, the material should be flexible enough to allow such activity. Dexterity is especially important in materials used in the manufacture of gloves.

The ability of clothing to maintain its protective capacity in temperature extremes is advantageous. Also to be considered is the allowance of mobility in cold temperature and transfer of heat to the wearer in hot climates.

Decontamination can be difficult and expensive if the protective clothing is not launderable. Some materials are nearly impossible to sufficiently clean under any circumstances. Because of these problems, much protective clothing is being considered disposable.

Some types of clothing are more durable than others when subjected to severe conditions over time. The ability to resist aging and the initial cost of the garment should be considered before procurement. Here again is an advantage of disposables.

The final and most important consideration is the chemical resistance of the protctive material. When clothing comes in contact with a hazardous liquid or vapor, it must maintain its structural integrity and protective qualities.

Chemical Resistance

Resisting chemical attack by a protective material is not a simple task. The material must be able to avoid degradation, penetration, and permeation by the insult chemical. Any or all of these actions may result upon contact, especially when prolonged.

A protective material may or may not be affected by a chemical agent. If the material is inert to that substance, then it will not be degraded. Yet, this does not preclude penetration or permeation of the material by the agent. Any level of degradation of the protective material may occur if it is reactive with the chemical agent. Damage to the material may be as severe as complete deterioration of the protective material. Contact with the agent and subsequent permeation may result in the swelling or shrinking of the material or a change in its structure and chemical make up. Changes such as these may serve to enhance or restrict permeation by the chemical agent.

The penetration by a chemical through a protective material is the result of design and construction imperfections. Penetration is not affected by the actual protective material. Stitched seams, button holes, porous fabric and zippers will allow a hazard to penetrate the protective garment. A protective suit with self-sealing zippers and lapped seams made of a non-porous elastomeric material will prevent penetration because of its design and construction. But, as soon as that suit is ripped or punctured its ability to avoid penetration is lost. Again, the suit with the finest design and manufacture may still be permeable and degradable while maintaining inpenetrability.

The ability of a protective material to resist permeation is a characteristic of that material. When a chemical agent comes in contact with the protctive material, a concentration gradient is established. The concentration of the agent opposing the outside wall of the material is high, and the concentration inside the material is low (or zero). Because the tendency is to establish equilibrium, diffusion and other molecular forces "drive" the agent into the material. When the agent passes completely through the material, it will condense on the inside wall and/or diffuse into the atmosphere opposing this inside wall. The process of permeation will continue as long as the concentration gradient remains greater in the outside atmosphere. The amount of time required for this sorption process to begin is the initial break through point.

The permeation rate is based upon several factors. These include the concentration of the attack chemical and the thickness of the protective material. The rate is inversely proportional to the thickness of the material while the concentration is directly proportional to the permeation rate.

The amount or degree of permeation is related to the exposure conditions which include temperature and contact time. The contact time will ultimately dictate how much of the chemical will successfully permeate the protective material. The use of protective clothing warrants a conscious effort to avoid prolonged exposure or contact with any hazardous chemical.

It is important to be cognizant of the fact that no material will resist permeating by all agents. Some degree of permeation can be expected in most cases. The various types of protective materials usually possess the ability to protect against only certain classes of chemicals. The other classes of compounds may readily permeate the material.

Once a liquid or vapor is sorbed by the material there is a need for laundering. The ability to be completely decontaminated is an advantageous characteristic of protective material. Most materials, no matter how resistant to strength loss will allow permeation. With many of these materials it is impossible to completely remove all contamination. Materials such as butyl rubber and viton, which will desorb most contamination upon cleaning are available but also expensive. This is where the use of disposable clothing may be advantageous.

Chemical Resistance Charts

In choosing protective materials based on a selected hazard various tables are available indicating relative effectiveness. It is important to recognize that such tables only reflect the materials ability to resist degradation by the agent. This is not the same as resistance to permeation. A material may be physically unaffected by a substance, but may still be very permeable to that agent. This is not to say that such charts are not useful. They can be as long as the seriousness of the hazard is properly considered. If the hazard is extremely toxic, then any activity involving that agent should be reevaluated. The potential risk involved must be weighed against the potential gain.

Table 1 provides an illustration of available data usually presented by the manufacturer (which is general and indicates effectiveness by generic classes of chemical compounds). Upon studying this table, it is apparent that materials are variable as to their protective capabilities.

1. Tyvek - a DuPont product described as a spun bonded olefin which is made of non-woven polyethylene fibers. In this form, Tyvek has reasonable tear, puncture and abrasion resistance and is excellent in holding out particles. Another desirable quality of this material is its resistance to static build-up. Once laundered it loses that property. Tyvek is inexpensive and suitable as a disposable garment. It's melting point is 270°F.

2. Nomex - This is another DuPont product. Nomex is composed of an aromatic polyamide fiber. It is non-combustible and has flame-resistance up to 220°C thus providing good thermal protection. It is also very durable and acid resistant. Nomex is easily laundered.

3. Polyethylene - This is an inert yet permeable material. It is sometimes used as a coating or Tyvek garment which gives them resistance to acids, bases, and salts. Polyethylene will absorb organic solvents.

4. Polyvinyl Chloride (PVC) - This material is used to manufacture many types of protective clothing. It is resistant to acids but will also allow permeation. Upon decontamination, PVC will retain traces of the contamination. PVC has been coated on Nomex to develop a strong protective material. Fully encapsulating suits such as the Wheeler Acid King and the MSA Rocket Fuel Handlers suits are examples of such a combination. These suits cost in the neighborhood of $600.00.

5. Neoprene - This synthetic elastomer provides very good protection against many chemicals. Keep in mind that a material which will not degrade may still be permeated. Neoprene provides better protection than PVC but as with PVC, it will retain contaminants upon decontamination. Many respirator facepieces and breathing hoses are also made of neoprene.

6. Chlorinated Polyethylene (CPE) or Chloropel - This material is manufactured by ILC Dover and used in the manufacture of splash suits and fully encapsultating suits. The U.S. Army is currently testing prototype suits as protection against nerve agents and the U.S. Coast Guard is also conducting tests with suits made of CPE. The manufacturer supplies chemical resistance information but no data on permeability. It is considered to be a good all around protective material. Four hundred dollars will be sufficient to buy a suit made of CPE.

7. Butyl Rubber - This material is especially resistant to permeation by gases. It is used in the manufacture of boots, gloves, splashsuits, aprons and fully encapsulating suits. The Army has been using butyl rubber garments against toxicological agents for many years. Butyl Rubber is resistant to many compounds except halogenated hydrocarbons

TABLE 1

CLOTHING MATERIALS CHEMICAL PROTECTION BY GENERIC CLASS

Generic Class	Butyl Rubber	Poly Vinyl Chloride	Neoprene	Natural Rubber
Alcohols	E	E	E	E
Aldehydes	E-G	G-F	E-G	E-F
Amines	E-F	G-F	E-G	G-F
Esters	G-F	P	G	F-P
Ethers	G-F	G	E-G	G-F
Fuels	F-P	G-P	E-G	F-P
Halogenated Hydrocarbons	G-P	G-P	G-F	F-P
Hydrocarbons	F-P	F	G-F	F-P
Inorganic Acids	G-F	E	E-G	F-P
Inorganic Bases and Salts	E	E	E	E
Ketones	E	P	G-F	E-F
Natural Fats and Oils	G-F	G	E-G	G-F
Organic Acids	E	E	E	E

Legend: E - Excellent F - Fair
G - Good P - Poor

Source: Survey of Personnel Protective Clothing and Respiratory Apparata..., September 1974, DOT, USCG, Office of Research and Development.

and petroleum compounds which is a common deficiency of most protective materials. One advantage Butyl Rubber does have is its ability to release all contamination upon laundering.

Chem-Pro of East Wind, Inc. manufacture's fully encapsulating suits and other Butyl Rubber garments. Their fully encapsulating suit is used a great deal by EPA and its contractors. A Butyl Rubber suit is available for nearly $1,000.00.

8. Viton - This is a DuPont fluoroelastomer which has recently been employed in a fully encapsulating suit. The suit is manufactured by Chem-Pro of East Wind, Inc. Viton has been tested for permeability and it has been shown that its overall protective capabilities, especially with liquids, surpasses that of butyl rubber and neoprene. There are chemicals which Viton is not as effective as other materials such as the ketones and aldehydes. Viton also has the ability to extricate all contaminants upon thorough cleaning which is an advantage over other materials which do not. A fully encapsulating Viton suit costs about $3,000.00.

9. Others:

   a) Natural rubber - used in the manufacture of boots and gloves. It resists degradation by alcohols and caustics.

   b) Nitrile - This material is being used in protective boots and gloves because of its resistance to petroleum products.

   c) Poly Vinyl Alcohol (PVA) - This is an excellent protective material for use against aromatic and chlorinated hydrocarbons. The major problem with PVA is the fact that it is soluble in water.

It is evident that there are protective materials available for specific chemical hazards. Yet, there is really no one material good for all types of hazards. Thus, selection can be difficult. Because protection can be limited by the protective material employed in the suit or gloves then several layers of protection should be considered. Disposable boots and gloves and PVC rain suits serve such a purpose. They can be used to provide an extra layer of protection and then discarded. This also lessens the amount of decontamination required for the inside layer of garments.

Types of Protective Clothing

As has been emphasized, the selection of appropriate protective gear is based on the protection required. Appropriate protection is achieved by assembling a complete set of gear. This includes hardhat, safety glasses or faceshield (preferably both), body covering (coveralls or pants and jacket) gloves and safety shoes (steel toe and shank). If one item is omitted the safety of the individual is compromised.

Heat Stress & Body Cooling

With any clothing which provides protection against hazardous substances, it is important to recognize the hazards created by wearing such clothing. Because the body is shielded from normal circulation of air, it is not allowed to carry out its functions normally. Perspiration generated does not evaporate, thus eliminating the body's main mechanism of cooling. With that gone the body is prone to heat stress which can be exhibited as heat stroke or heat exhaustion. This is very common as the ambient temperature rises above 65-70°F. Work schedules in fully encapsulated clothing must be regulated very conservatively as heat stress may become more of a threat than the chemical hazard itself.

The best way to combat any heat stress is to allow the body to perform its normal cooling functions. The most efficient body cooling process is by evaporation. While in protective clothing that has no ventilation, profuse perspiring occurs. If the perspiration is left in contact with the skin, it has a better chance of evaporating and cooling the body surface. When the perspiration is allowed to run off the body quickly, evaporation will not occur as much as is desirable. This will happen when only shorts are worn under a fully encapsulating suit. Another hazard when dressed minimally in a suit is the temperature of the suit itself. On a hot day the suit material can become very hot and cause severe burns to the person inside.

When wearing a fully encapsulating suit, it is advisable to wear long underwear. It will cling to the body when soaked with perspiration thus allowing the greatest possible amount of cooling by evaporation. This will also protect the body from burns from the suit itself. The best way to prevent heat illness is to limit the amount of work in the suits.

When extended periods of work in fully encapsulated suits is required, some sort of cooling must be provided to the worker. The best method is by allowing frequent rest periods. Sometimes this is not enough so a cooling device must be employed. There are effective cooling units available for use with supplied air units. The cool air is directed to all parts of the body. A vortex tube is used to generate the cool air. Actually, the vortex tube separates the supplied air into warm and cool components and releases the warm air. When self-contained air is used for breathing, the cooling device must also be self-contained. Vests have been designed to carry ice packs for cooling. There are several other commercial devices available to combat heat generated by fully encapsulating suits.

Heat stress symptoms should be observed for all levels of protection, but especially in Level A and B. For example, Army personnel wearing the military M3 toxicological suit (a two-piece butyl rubber suit) are required to follow these guidelines:

Ambient Temperature	Maximum Wearing Time (Hours
Above 90°F	1/4 hour
85-90°F	1/2 hour
80-85°F	1 hour
70-80°F	1-1/2 hours
60-70°F	2 hours
50-60°F	3 hours
30-50°F	5 hours
Below 30°F	8 hours

Worker Monitoring

Besides normal safety monitoring, the use of fully encapsulating suits require special monitoring of the wearer. Normally, monitoring is required when any respiratory apparatus is in use. But, because the use of fully encapsulating is warranted due to potential exposure to extremely toxic vapor atmospheres, it is especially important to assure the wearer is properly protected. There are two methods of monitoring an individual in a fully encapsulating suit. They are biological monitoring and personal monitoring.

Biological monitoring is useful because it indicates what the actual exposure was to the worker. Prior to going on-site, a urine sample is taken. Its contents are uncompared to a sample after activity has ceased for the work period. The analysis should indicate any absorbed exposure due to hazard permeations or penetrations through the suit.

The use of personal monitoring measures the atmospheric concentrations within the suit. This gives an indication of potential body exposure. Personal sampling pumps equipped with charcoal tubes may be used to collect organic vapors. This type of pump must be worn underneath the encapsulating suit. If cotton socks or gloves are worn their contents may be directly analyzed. This also will give an indication of potential exposure to the atmospheric hazard. This type of measurement is a qualitative indicator whereas use of the personal sampling pumps is quantitative.

Any exposure data is valuable when working with hazardous materials. Such data confirms or contradicts the criteria initially used in the decision-making for selection of protective clothing.

Equipment List by Hazard Level

The following lists provide an inventory of necessary equipment needs to function in hazardous chemical environments:

Level A
Personal Protection Equipment

- Positive Pressure SCBA (MESA/NIOSH approved)
- Totally Encapsulating Suit (boots & gloves attached)
- Gloves - Inner (tight fitting & chemical resistant)
- Boots - Chemical protective, steel toe and shank. Depending on suit boot construction; worn over suit boot.
- Gloves - Outer, chemical protection. Depending on suit construction worn over suit gloves. May be replaced with tight-fitting, chemical resistant gloves worn inside suit gloves.
- Underwear - Cotton, long-john type*
- Hard Hat* (under suit)
- Disposal protective suit, gloves, and boots. (Worn under or over encapsulating suit)*
- Coveralls* (under suit)
- 2-way Radio Communications

Level B
Personal Protective Equipment

- Positive Pressure SCBA (MESA/NIOSH approved)
- Two-piece chemical resistant suit
- Chemical resistant hood*
- Coveralls (fire resistant) under splash suit*
- Gloves - Outer, chemical protective
- Gloves - Inner, tight fitting, chemical resistant
- Boots - Outer (chemical protective heavy rubber throw-aways)
- Boots - Inner (chemical protective, steel toe and shank)
- 2-way Radio communications
- Hard Hat*
- Face Shield*

Level C
Personal Protective Equipment

- Full face, air purifying respirator (MESA/NIOSH approved)
- Chemical resistant clothing: overalls & long sleeved jacket or coveralls hooded 2-piece chemical splash suit, when applicable - hooded disposal coverals*
- Gloves - Outer (chemical protective)
- Gloves - Inner (surgical type)*
- Cloth Coveralls - Fire resistant (inside chemical protective clothing)*
- Escape Mask
- Hard Hat* (face shield, optional)
- Boots - Outer (chemical protective heavy rubber throw-aways)*
- Boots - Inner (chemical protective, steel toe & shank)
- 2-way Radio communications

Level D
Personal Protective Equipment

- Coveralls - Fire Resistant
- Boots/Shoes - Safety or chemical resistant steel toed boots
- Boots - Outer (chemical protective heavy rubber throw-aways)*
- Escape Mask
- Safety Glasses
- Hard Hat* (face shield optional)
- Gloves*

*Optional Equipment

Decontamination Procedures

As part of the system to prevent or reduce the physical transfer of contaminants by people and/or equipment from on-site, procedures must be instituted for decontaminating anything leaving the Exclusion Area and Contamination Reduction Area. These procedures include the decontamination of personnel, protective equipment, monitoring equipment, clean-up equipment, etc. Unless otherwise demonstrated, everything leaving the Exclusion Area should be considered contaminated and appropriate methods established for decontamination.

In general, decontamination at the site consists of rinsing equipment, personnel, etc., with copious amounts of water and washing same with detergent/water solution. If contaminants are known, then a specific detergent and/or solvent can be used to decontaminate. Figure No. 1 illustrates the maximum physical layout for personnel decontamination during a worst case situation. Figure No. 2 illustrates the minimum physical layout for personnel decontamination for a relatively small well-identified situation. Each site requires special consideration and the decontamination procedures should be modified from the maximum to minimum layout based on known information.

Decon and Rinse Solutions

The decon solutions should be solutions of water and chemical compounds designed to react with and neutralize the specific contaminants. The temperature and contact time should also be considered to insure complete neutralization. However, the contaminants will not always be known in a majority of cases and it will be necessary to use a decon solution that is effective for a variety of contaminants. Two of these general decon solutions are listed below:

- Decon Solution A - A solution containing 5% Sodium Carbonate (Na_2CO_3) and 5% Trisodium Phosphate (Na_3PO_4). Mix four (4) pounds of commercial grade Na_2CO_3 plus four (4) pounds commercial grade Na_3PO_4 with each ten (10) gallons of water. These chemicals are available at most hardware stores.

- Decon Solution B - A solution containing 10% Calcium Hypochlorite ($Ca(ClO)_2$). Mix eight (8) pounds of $Ca(ClO)_2$ with each ten (10) gallons of water. Calcium Hypochlorite (HTH) is available at most hardware or pool supply stores.

The rinse solutions used in decon should have the ability to not only physically remove the decon solution, but to also neutralize excess decon solution.

A general purpose rinse solution, used for both decon solutions listed above consists of a five (5) percent solution of Trisodium Phosphate. Mix four (4) pounds Na_3PO_4 with each ten (10) gallons of water.

OTHER CONSIDERATIONS

The decontamination procedure illustrated in Figure 1 are for Level A protection which more often then not requires a detailed decontamination process. Figure No. 1 illustrates the maximum physical layout for personnel decontamination during a worst case situation (i.e., Dioxin contamination, chemical fire, immediately dangerous to life or health atmospheres). Figure No. 2 illustrates the minimum physical layout for personnel decontamination during a relatively small, well defined situation (i.e., pesticide spill, solvent spill, etc.).

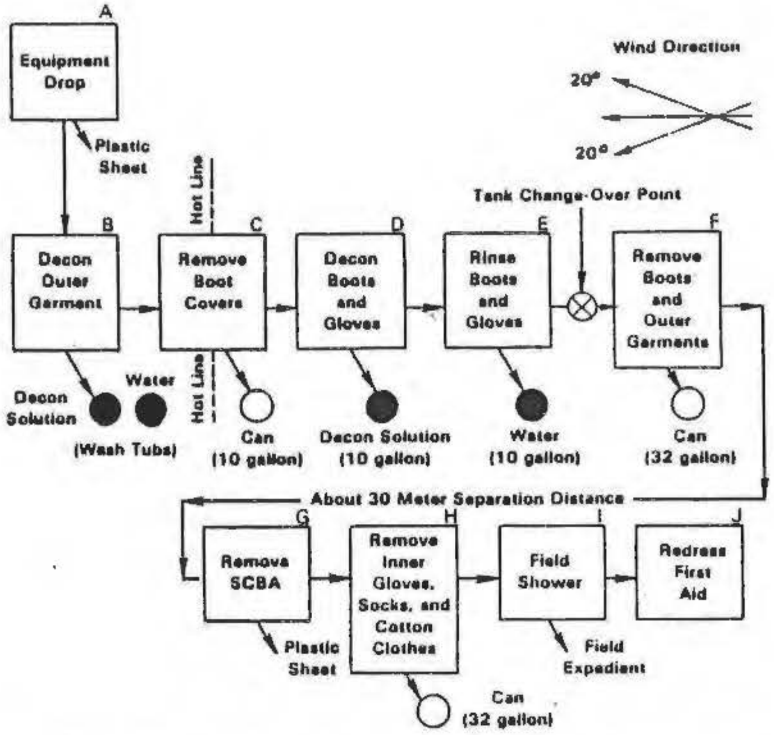

Figure 1. Maximum layout of personnel decontamination station. (Levels A & B Protection)

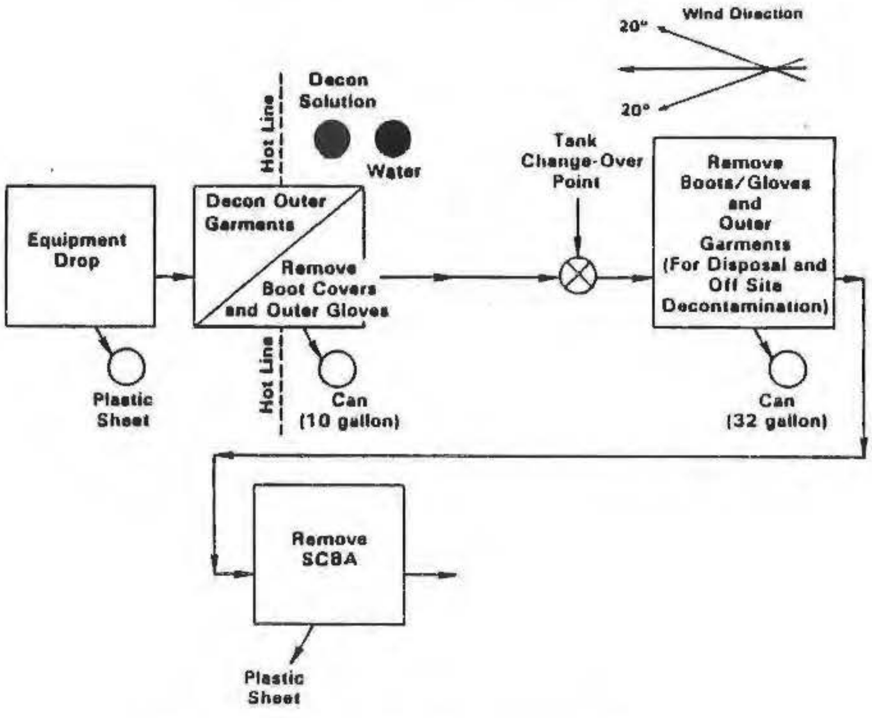

Figure 2. Minimum layout of the PDS.
(Level A, B & C Protection)

Less extensive procedures for decontamination can be subsequently or initially established when the type and degree of contamination through analysis becomes known or the potential for transfer is judged to be minimum. These procedures generally involve one or two washdowns only, and fewer precautionary measures in diffing equipment. These procedures would not involve additional decontamination of protective clothing removed. Table 2 lists general decon solutions and their applications.

In extreme situations when there may be a question of the efficacy of decontamination to known or strongly suspect substances of a highly toxic nature, protective clothing may have to be discarded after use or tested after decontamination.

Consideration must also be given to the protective equipment worn by those personnel operating the decontamination line. In most cases, chemical protective clothing, boots and gloves should suffice. Unless it is suspected and/or confirmed that personnel needing decontamination are highly contaminated, air-purifying respirators with suitable canisters can be worn (Level C Protection).

Decontamination solutions should be designed to react with and neutralize the specific, potential contaminants involved in an incident. However, since the contaminants at an uncontrolled waste site will be unknown in the majority of cases, it is necessary to use a decontamination solution that is effective for a variety of contaminants. Several of these general purpose decontamination solutions (some ingredients are available at hardware or swimming pool supply stores) are listed below:

- o Decon Solution A - A solution containing 5% Sodium Carbonate (Na_2CO_3) and 5% Trisodium Phosphate (Na_3PO_4).
- o Decon Solution B - A solution containing 10% Calcium Hypochlorite ($Ca(ClO)_2$).
- o Decon Solution C - A solution containing 5% Trisodium Phosphate (Na_3PO_4). This solution can also be used as a general purpose rinse.
- o Decon Solution D - A dilute solution of Hydrochloric Acid (HCl).

Portable Field Monitoring Instruments

Many hazards may be present when responding to hazardous material spills or uncontrolled hazardous waste sites. Explosive vapor clouds, oxygen deficient atmospheres and a variety of toxic gases or vapors can be confronted with lethal implications in such situations.

When first approaching a spill or waste site, the potential hazards must be found and evaluated. This can be in the form of a methodical preliminary site survey. Information gained will most likely be qualitative but will provide enough data to make some initial decisions. These might include respirator and protective clothing selection or further delineation of the hazard by quantitative assessment.

TABLE 2.

USES OF GENERAL PURPOSE DECON SOLUTIONS

TYPE OF HAZARD SUSPECTED		
1. Inorganic acids, metal processing wastes.	A	To 10 gallons of water, add 4 pounds of sodium carbonate (soda lime) and 4 pounds of trisodium phosphate. Stir until evenly mixed.
2. Heavy metals: mercury, lead, cadmium, etc.	A	Same as #1 above.
3. Pesticides, fungicides, chlorinated phenols, dioxins, and PCB's.	B	To 10 gallons of water, add 8 pounds of calcium hypochlorite. Stir with wooden or plastic stirrer until evenly mixed.
4. Cyanides, ammonia, and other non-acidic inorganic wastes.	B	Same as #3 above.
5. Solvents and organic compounds, such as trichloroethylene, chloroform, and toluene.	C (or A)	To 10 gallons of water, add 4 pounds of trisodium phosphate. Stir until evenly mixed.
6. PBB's and PCB's.	C (or A)	Same as #5 above.
7. Oily, greasy unspecified wastes.	C	Same as #5 above.
8. Inorganic bases, alkali, and caustic waste.	D	To 10 gallons of water, add 1 pint of concentrated hydrochloric acid. Stir with a wooden or plastic stirrer.

With such a variety of portable instrumentation available, it follows that each may serve a specific purpose. Some will give an immediate indication upon each sample taken manually. Others monitor continuously and have built-in alarms to signal a potential hazard. Many instruments are designed to sample over a time period to determine a time weighted average exposure. These may be active or passive in design. There are instruments which utilize unique components to detect concentrations.

The portable instrumentation used to evaluate hazardous materials spill or waste sites must be demonstrated as being safe to use in these hostile environments. Electrical devices, such as the monitoring instruments, must be constructed in such a fashion as to eliminate the possibility of igniting a combustible atmosphere.

Portable Oxygen Indicators

Portable Oxygen Indicators are invaluable when responding to hazardous material spills or waste sites. Depressions in the land, unventilated rooms or areas may not contain enough oxygen to support life. When used under the proper safety procedures the portable oxygen indicator will read the percent oxygen in the test atmosphere. Normal oxygen concentration required for respiration is 20.8%.

Combustible Gas Indicator

Unknown atmospheres present many hazards including oxygen deficiency, toxicity, and flammability. Combustible gas indicators are used to determine generally, the potential for combustion or explosion. Most units meter in the range below the lower explosive limit of combustible gases.

Gas/Vapor Detectors and Analyzers (Century OVA, HNU Photionizer)

The Century Organic Vapor Analyzer (OVA) is a portable total hydrocarbon (HC) analyzer with optional gas chromatography (GC) capabilities. The instrument was originally designed for use in the oil industry but it can be an effective tool in hazardous waste/spill detection and characterization: it can be used in the survey mode for the monitoring of total HC concentrations or it can be utilized as a GC for possible qualitative and quantitative analyses of a known volume of air sample. Gas chromatography is an analytical instrument method of separating a sample into its constituents for identification and quantification.

The HNU Photoionization Analyzer is a portable gas analyzer used to measure the concentration of a wide variety of species, organic and inorganic, in industrial, ambient, and hazardous atospheres. The advantages of this instrument are: portability, wide range of operation, rapid response, and ease of operation.

Personal Sampling Pumps and Collection Devices

This is another instrument which found its beginning in industrial hygiene practices. To meet OSHA Permissible Exposure, Limits, industry must sample the breathing zone of the individual for 8 hours. This requires suitable collection devices and an accurate portable pump to draw the sample.

Detector Tubes

When in the field it is sometimes necessary to know the concentration of a gas in the immediate atmosphere. These considerations are valuable before, during, and after a response to a hazardous materials spill or waste site. A relatively simple method for determining gas concentrations is the use of detector tubes. They are usually calibrated in parts per million (ppm) for easy interpretation. There are detector tubes available for grab sampling and for continuous sampling over a longer period of time.

The detector tube and pump are the two major components of the system. Detector tubes are normally species specific. In other words, there are different tubes for different gases; i.e., chlorine detector tube for chlorine gas, acrylonitrile tube for acrylonitrile gas. Some manufacturers do produce tubes for groups of gases such as for hydrocarbons in general. Pumps used for drawing air through the tubes come in two basic forms: bellows pump and piston-type (syringe). These pumps are manufactured under strict specifications so as to draw only a specified volume of gas.

Passive Dosimeters

All the instruments discussed are considered to be active sampling methods due to the energy or action required to achieve the desired results. A new development in sampling is the use of passive dosimeters or gas badges. No energy or action is required to take the sample. Currently, there are badges available to sample from 15 minutes to 8 hours. Such badges include those for sampling organic vapors, mercury vapor, ammonia, sulphur dioxide and nitrogen dioxide.

The most common passive dosimeter is the Organic Vapor Monitor. The organic vapor enters the monitor by diffusion and is adsorbed by activated charcoal in the interior of the badge. The amount of vapor adsorbed is determined by exposure time and vapor concentration present in the monitored environment. A measured volume of eluent (usually carbon disulphide) is added to the monitor to desorb and dissolve the contaminants. An aliquot of the eluant solution is analyzed via gas chromatography. The weight of contaminant is related to the time weighted average worker exposure using data supplied by the manufacturer.

Hazardous Material Detector Kit (Hach)

This Kit was developed under the sponsorship of the Oil and Hazardous Materials Spills Branch of the USEPA to detect hazardous materials from spills into inland waterways. The Kit contains basic instrumentation and wet chemical methods, and in the hands of an experienced technician, it can provide valuable information. Use of the Kit relies basically on three types of evaluation as in the table below:

Detection Procedures

1) General Assessment -

   A. Appearance
   B. Color of filtered water
   C. Color of suspended matter

2) Spot Tests -

   D. Cholinesterase Inhibitors
   E. Benzene
   F. Heavy Metals
   G. Phenols
   H. Cyanide

3) Relative Measurements -

   I. Ph
   J. Conductivity
   K. Turbidity
   L. Nitrate Nitrogen
   M. Color
   N. Sulfate
   O. Phosphate
   P. Ammonia Nitrogen
   Q. Chloride
   R. Flouride

The tests as a whole are largely non-specific and are capable of detecting a much wider range of contaminants than is indicated. General assessment procedures allow the operator to make a general evaluation of the water to be tested. Spot tests procedures indicate that a particular type of contaminant is or is not present. Figure 3 presents a detailed description of this kit's contents.

ACKNOWLEDGMENT

The material presented in this paper is gleaned entirely from the U.S. Environmental Protection Agency's "Hazardous Materials Incident Response Operations" course (165.5) manual. This paper is by no means a complete presentation of all hazardous chemical safety equipment and monitoring devices.

SELF-CONTAINED, PORTABLE, MULTI-PURPOSE

The Hach Hazardous Materials Detector Kit (HMDK) is a complete test center for monitoring toxic substance spills.

Designed* to meet the needs of government and transportation personnel, the HMDK provides a rapid means of determining the extent and severity of waterway contamination. Since in many transportation and storage accidents the identity of the spilled material is known, the detection approach used in the kit is general. Tests are of a nonspecific nature for analyzing classes of materials rather than for specific compounds. Fifteen different test methods are used to monitor over 300 hazardous materials. (Target substances are based on EPA recommendations, Federal Register, Vol. 43, No. 49, 10474-10508.)

THE INTELLIGENT APPROACH TO SPILL ANALYSIS

Investigations are carried out in a systematic manner. Evaluations begin with a visual examination of the spill site for color, turbidity and oil. Then a sample is filtered through a glass fiber disc for color assessment.

SPOT TESTS FOR ORGANICS AND HEAVY METALS

Depending on the nature of the spill, one or more spot checks for insecticides, benzene, phenols or heavy metals may be the next logical step. For benzene and cyanide tests, miniature chromatographic columns called detector tubes are used. One end of the tube is opened and the water sample is allowed to diffuse through the column. A blue, orange or green stain indicates contamination. Other checks employ similar color signals.

RELATIVE CONCENTRATION MEASUREMENTS TELL MUCH ABOUT SPILL AREA

Changes in pH, conductivity or specific ions in a body of water are sure signs of contamination. For fast and reliable pH measurements, the HMDK contains a portable pH meter with unbreakable electrode. Equipped with a separate carry case and handle, this meter detaches from the main kit for convenience.

To determine alterations in a waterway's ionic strength, a conductivity meter has been built into the HMDK. Appropriate for a wide range of acids, bases and metal compounds, conductivity measurement is probably the most versatile indicator of inorganic pollution.

Sometimes simple changes in color or turbidity give ample warning of impaired water quality. For these tests, the Hach DR/2 Spectrophotometer is included. Both tests use precalibrated meter scales with turbidity measurements based on formazin dilutions and color on APHA platinum-cobalt color units.

Or a series of chloride, phosphate or sulfate determinations may be the best approach. The HMDK contains all reagents and apparatus needed for six different spectrophotometric analyses. Tests are performed with prepackaged, premeasured reagents and slide-in meter scales for direct concentration read-out. Enough reagents are provided for 100 repetitions of each test.

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*The Hach Hazardous Materials Detector Kit was based on a study submitted to the Oil and Hazardous Materials Spills Branch of the EPA Industrial Environmental Research Laboratory. The mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

HAZARDOUS MATERIALS DETECTOR KIT PARAMETERS

Test	Results	Method	Types of Substances Detected	Approximate Minimum Detection Level	Time Per Test Minute
Cholinesterase Inhibitors	Qualitative	Enzyme Ticket	Carbamate and organophosphorus insecticides, chlorosulfonic acid	<3 mg/l	7
Benzene	Qualitative	Detector Tube	Benzene, mono and di-substituted benzenes naphthalene, isoprene, methyl mercaptan some sulfides, chlorinated herbicides	1 mg/l	2
Heavy Metals	Qualitative	Extraction/ Test Tube	Cadmium, cobalt, copper, lead, mercury, nickel and zinc compounds	<10 mg/l	1
Phenol	Qualitative	Extraction/ Centrifuge Tube	Substituted phenols, catechol, aromatic alcohols	0.01 mg/l	1
Cyanide	Qualitative	Detector Tube	Cyanide and cyanide compounds, acetone cyanohydrin	0.005 mg/l	1
pH	Quantitative	pH Meter	Organic acids and anhydrides, mineral acids and bases	0.2-14 pH units	1
Conductivity	Quantitative	Conductivity Meter	Inorganic compounds, phosgene, uranyl acetate	0-20,000 µmhos/cm	1
Nitrate Nitrogen	Quantitative	Spectrophotometric	Acetone cyanohydrin, nitrate compounds, nitrogen dioxide	0.01 mg/l	6
Color	Quantitative	Spectrophotometric	Chromium, cobalt, copper and nickel compounds, potassium permanganate, azo dyes	5 color units	1
Sulfate	Quantitative	Spectrophotometric	Inorganic sulfates	2.5 mg/l	9
Phosphate	Quantitative	Spectrophotometric	Phosphates and certain phosphorus compounds, arsenates, arsenites and bromides	0.05 mg/l	2
Ammonia Nitrogen	Quantitative	Spectrophotometric	Organic and inorganic ammonia-containing compounds	0.05 mg/l	9
Chloride	Quantitative	Spectrophotometric	Sulfides, bromides, cyanides, thiosulfates, chlorides	5 mg/l	9
Fluoride	Quantitative	Spectrophotometric	Aluminum sulfate, fluoride compounds	0.1 mg/l	2
Turbidity	Quantitative	Spectrophotometric	General appearance	0-500 FTU	1

FIGURE 3. Hazardous Materials Detector Kit (Hach)

RESPONSE EQUIPMENT

Depending on the type of hazardous materials episode encountered, the following list of equipment is provided to show the entire range of equipment available to the Response Team. It should be noted that this list of equipment is all emcompassing and that not all of this equipment may be needed on any given site investigation.

Communication Gear

- Handie Talkies

Personnel Clothing and Equipment

- See Schedule A

Field Equipment

- First Aid Kit (See Schedule B)
- Hand Tool Kit (See Schedule C)
- Reference Materials (See ScheduleD)
- Field Support Kit (See Schedule E)
- Soil Samples Set (See Schedule F)
- Water Sample Set (See Schedule G)
- Air Sample Set (See Schedule H)
- Other Field Equipment (See Schedule I)
- Emergency Oxygen Inhalator
- Portable Wash Unit
- Explosion Meter
- Radiation Detection Instrument
- Organic Vapor Analyzer (OVA)
- HNU Photoionization Unit
- Fire extinguisher
- Oxygen Indicator
- Metal Detector
- Positive Pressure Demand Self Contained Breathing Apparatus - with extra air cylinders
- Fully Encapsulated Suits
- Photographic Equipment Set
- Film Badges
- Dosimeters
- Organic Vapor Badges

SCHEDULE A - PERSONNEL CLOTHING AND EQUIPMENT

Duffle Bag:

- Hardhat, white
    - a) With Face Shields
    - b) Without Face Shields
- Cold Weather Hardhat Liner
- Safety Goggles, Soft sides for full eye protection
- Safety Glasses
- Rain Suit
- Bunker Boots (knee) Steel Shank, Steel Toe
- Safety Work Boots
- Bunker Coat
- Windbreaker
- Coveralls (Work)
- Coveralls (Nomex)
- Work Gloves
- Pants Uniform
- Shirts Uniform
- Medium Weight Jacket
- Socks
- Socks (Heavy)
- Underclothes
- Earplugs
- First Aid Kit (Car)
- Appropriate Winter Clothing - Regional Effective
- MSA Model 401 Air Mask and Unit
- Air Purifying Respirators with Cartridge/Cannisters
- Clipboard

SCHEDULE B - MEDICAL FIRST AID KIT

A Zee Medical First Aid Kit Consisting Of:

- Trail Antacid
- EEZ Lozenges
- Pain Aid
- Aspirin (5 gr)
- Ammonia Inhalants
- Cotton Swabs
- Ice Pack
- Eye Skin Neutralizer
- Eye Wash
- Burn Septic Spray
- Spray on Bandage
- Antiseptic Spray
- Blood Clotter
- Adhesive Tape
- Cohesive Tape
- Tel Fa Steril Pads
- Band Aids
- Finger Tip Bandages
- Knuckle Bandages
- Elastic Strip Bandage
- Carlisle Compress Dressing
- Triangle Bandage
- Gauze (3" x 3")
- Gauze (2" x 2")
- Gauze Bandage (1" x 6 yds)
- Blanket
- Powdered Charcoal
- Gauze Bandage (2" x 6 yds.)
- Tourniquet
- Ice Pack (Large)
- Salt Tablets
- Snake Bite Kit
- Cold Tabs
- Scissors
- Eye Drops
- Antibotic Ointment
- Butterfly Closure (Large)
- Curad Bandage (2½ x 3¼)
- Clean Wipe Alcohol Swabs
- Tweezers
- Antiseptic Swabs
- First Aid Guide
- Butterfly Closure (Medium)
- Finger Splint
- Forcepts (Dumont 5")
- Chigger/Tick Remover
- Vasoline
- Gellusil Tablets
- Ex-Lax
- Poison Ivy Treatment
- Insect Repellent
- Sting Relief
- Syrup of Ipecac

SCHEDULE C - HAND TOOL KIT

A Hand Tool Kit Consisting Of:

Wood Mallet
Rubber Mallet
Hacksaw
Heavy Duty Stapler and Staples
Ballpen Hammer
Regular Hammer
Hand Hammer, (non-spark class 2 doubleface)
Lumberjack's Knife
Pressure Gauge
Slipjoint Pliers (8")
Locking Plier Wrench (10")
Duckbill Snips (12")
Rod and Bolt Cutter (24")
Nine Screwdrivers (5 slotted, 4 phillips)
Diagonal Cutting Pliers (6")
Lineman's Pliers (8")
Curveback Wire Brush (5 oz)
Lock-Type Measure Tape
Winding Reel Tape
Electrical Tape
Pipe Wrench (non-sparking)
Wrench Set (combination)

SCHEDULE D - REFERENCE MATERIALS

Basic Reference Materials:

NFPA Guide on Hazardous Materials
CHRIS Condensed Guide to Chemical Hazards
Sax Dangerous Properties of Industrial Materials
Toxic and Hazardous Industrial Chemical Safety Manual
Matheson Gas Data Book

Support Kit:

Binoculars (7 x 35mm wide angle) (2)
Rangefinder (2)
Compass (2)
Cassette Recorder (Lanier, 1 hour tape)
Spotting Scope
Hand Level (2)
Hand Calculator (2)
Stereoscopes

SCHEDULE F - SOIL SAMPLE SET

Soil Sampling:

Soil Auger (cork screw, tube)
Auger Extensions
Power Head (electric)
Soil Sample Tubes (1 ¼ x 6 5/8)
Logbook for Soil Profile
Labels
Replacement Tips for Tube Samplers (regular)
Wet, Heavy Duty Tips
Scoops for Bottom Sediments
Stainless Steel Pipe Section (2" ID/Taper on end) (Penetrating end)
Electrical Resistivity Apparatus

SCHEDULE G - WATER SAMPLING SET

Water/Chemical Sampling:

Weighted Bottle Sampler
Pond Sampler
Glass and Polyethylene Container
Scoops and Dippers
Suction Devices (Hand Pumps)
Water Level Indicator
Cased Thermometers/Thermistors
Teflon Bailer
Dissolved Oxygen Meter
Conductivity Meter with 50' Cord

SCHEDULE H - AIR SAMPLING SET

Air Sampling:

Draeger Tubes (gas detector)
Hi Vol. Sampler
Wind Direction Indicator
Wind Speed Indicator
Barometric Pressure Indicator
Temperature Indicator
Impinger Tubes
Carbon Adsorption Tubes
Oxygen Meter

SCHEDULE I - OTHER FIELD EQUIPMENT

Rope (300', Polyprdpylene, 16-lb.) (1)
Heavy Duty Extension Cord (100') (1)
All Weather Hose (50', 5/8" ID) (1)
Scrub Brushes (4)
Plastic Buckets (4)
Large Log Books (1)
Safety Flares (Vehicle Use) (2)
Wrecking Bar (non-sparking, 30" x 3/4) (1)
Shovel (D handle, Square Point, non-sparking) (2)
Shovel (D handle, Round Point, non-sparking) (2)
Shovel (Long Handle, Round Point, non-sparking) (2)
Rechargeable Lanterns (2)
Sledge Hammer (4-lb.) (2)
Spud Bar (2)
13" Half Hatchet (2)
Machete (2)
Bolt Cutter (1)
Heavy Duty Tow Chain (15') (1)
Bow Saw (30") (2)
Grounding Rod and Set of Cables (1)
Buna N. Gloves (5)
Jasper Work Gloves (5)
PVC Disposable Gloves (5)
Neoprene Gloves (5)
Solvex Gloves (5)
Natural Rubber Gloves (5)
PVC Disposable Boots (5)
Life Vests (5)
Hip/Chest Wader (5)
Rain Suits (5)

MISCELLANEOUS ITEMS:

Redwood Plugs (various sizes)
Valve Packing
Revere Miracle Seal (Synthetic Rubber)
Duct Tape
Paper Clips and Alligator Clips
Rubber Bands
Paper and Note Pads
Extra Pens, Pencils, Markers
Scotch Tape
Kimwipes
Kleenex
Detergent (large)
Plastic Drop Sheet
Black Spray Paint
Yellow Spray Paint
Red Marking Tape (perimeter)
Yellow Marking Tape (perimeter)
Green Marking Tape (perimeter)
Color Coding Dot Security Tags
Magnetic Hangers
Clipboards
Rubber Tarp Tie Down Straps
Electric Power Outlet Strip (8 outlets)
"Registered Area" caution signs.
Nylon Twine
Air Tight Container for Sample Storage
Clean Water Supply

SUMMARY OF ON-SCENE-COORDINATOR PROTOCOL FOR CONTAMINATED UNDERWATER OPERATIONS[1]

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ABSTRACT

Under the authorities of Section 311 of the Clean Water Act, and the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), personnel from the United States Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), National Oceanic & Atmospheric Administration (NOAA), and the U.S. Navy (USN) are required at times to perform work functions in contaminated underwater environments. Long-term or chronic effects of diver exposure to these environments is not well documented; however, in many, cases these exposures have resulted in acute injury to diving personnel (1).

The EPA, recognizing the need to assess, modify, and evaluate procedures and equipment applicable to working in contaminated underwater environments, entered into an interagency agreement with NOAA. As part of this work, an "Interim Protocol on Underwater Operations" was developed and is the subject of this paper.

The Protocol was based upon preliminary field evaluations of diving equipment in controlled chemical underwater environments. Following a peer review of the document by the user community, the methods, procedures, equipment, and training will be applied at a number of sites or spills of opportunity. The resulting information will be used to prepare a "Manual of Practice (MOP) on Underwater Operations in Contaminated Waters." The final MOP is scheduled for publication in December 1984.

INTRODUCTION

A review of current requirements of various civilian, government and military agencies such as the U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), National Oceanographic Atmospheric Administration (NOAA), U.S. Navy (USN), and clearly indicates a need for response activities involving underwater chemical release incidents. Situations such as damage assessment of leaking vessels and/or pipelines, location of underwater sources of contamination, containment/cleanup of sunken pollutants, environmental assessment and evaluation of cleanup operations, recovery of containers/contents of containers, repair/maintenance of underwater equipment and structures to prevent discharges, research studies, and other activities, at times require that divers enter contaminated environments. Unfortunately, there is very limited capability available to enter these environments safely to perform the necessary tasks. Attempts have often resulted in injuries, primarily chemical burns, to divers and/or surface support personnel handling contaminated equipment. Little information is available on low-level exposure of diving personnel to chemicals; only acute or immediate effects have been reported. Chronic, long-term toxicity is only now being addressed by several government agencies.

Equipment problems in chemically contaminated water environments, primarily due to petroleum products, is well documented. Divers entering these environments have often experienced equipment failure/deterioration. This is not only costly but, even more serious, can be life threatening. Equipment deterioration has been responsible for at least one fatality (2) and is responsible for many incidents of diver exposure to contaminants.

The use of remotely operated vehicles (ROV) in response to chemical release situations has also been very limited. ROV's may be able to contribute significantly by allowing certain underwater activities to be performed without having to risk placing a diver in the water. However, the current state-of-the-art on ROV's limits their use to inspection and evaluation of underwater conditions to determine whether or not a diver is necessary. If diving is necessary, ROV's can be utilized to increase the safety and effectiveness of the diver while in these environments. Underwater visibility and entanglement are the two most serious drawbacks to effective use of ROV's in these situations (2). As ROV technology develops, there will probably be more varied and reliable uses of these vehicles in spill-response situations.

Because divers must continue to work in chemically contaminated waters, more appropriate procedures and equipment are required to safeguard their health and welfare. In addition, because no procedure or equipment is fool-proof during diving operations, divers should be warned against diving in waters containing particularly toxic substance.

Recognizing the needs in this area, the U.S. EPA and NOAA entered into an Interagency Agreement to improve and update safety capabilities involving underwater hazardous chemical cleanup responses. The work which started in August 1981 includes the assessment, testing, evaluation, and demonstration of commercial underwater protective suits, clothing, support equipment, and breathing apparatus in waters contaminated with substances that may be injurious to a diver's health.

Under the IAG, a workshop/seminar entitled "Protection of Divers in Waterways Receiving Hazardous Chemical, Pathogenic and Radioactive Substances Discharges," was held by the Undersea Medical Society (UMS), Bethesda, MD, on November 9-11, 1982 and the proceedings from this workshop are now available by contacting UMS (3). The unanimous conclusions of this meeting were: (a) no alternative currently exists for use as a substitute for divers working in hazardous environments, and (b) research and development is needed to modify commercially available diving dress and helmet assemblies to protect divers from hazardously contaminated environments.

As part of this work, an Interim Protocol has been prepared based on preliminary field evaluations of diving dress and equipment in controlled chemically contaminated underwater environments. In summary, the Protocol provides information on (a) evaluating hazards depending on the nature of substances present ("Go/No-Go" situations to determine whether diving is possible or not), (b) "when" and "how" to use divers in hazardous environments, (c) medical and physiological implications of a diver's exposure, (d) state-of-the-art protection for diving and surface suppoort personnel when performing underwater tasks in contaminated waters, and (e) decontamination operations for diving personnel and equipment.

Subsequent to a review and field evaluation of the Interim Protocol, and demonstration of modified equipment and response procedures, a Manual of Practice (MOP) will be developed to provide guidance to agencies that use divers in waters of questionable environmental quality. It must be noted that the Interim Protocol as well as the MOP are intended for guidance purposes only.

DIVING MODES AND EQUIPMENT

There are two basic diving modes: (1) one atmosphere diving and (2) ambient diving.

In one atmosphere diving, the diver is encased in a rigid suit which contains air at the surface pressure of 14.7 pounds per square inch (psi). Some development was done on suits like this in the 1930's. Recently, much work has been done with the titanium JIM Suit (Figure 1), which is capable of allowing a diver to do functional work in a one atmosphere environment at depths exceeding 1,000 feet.

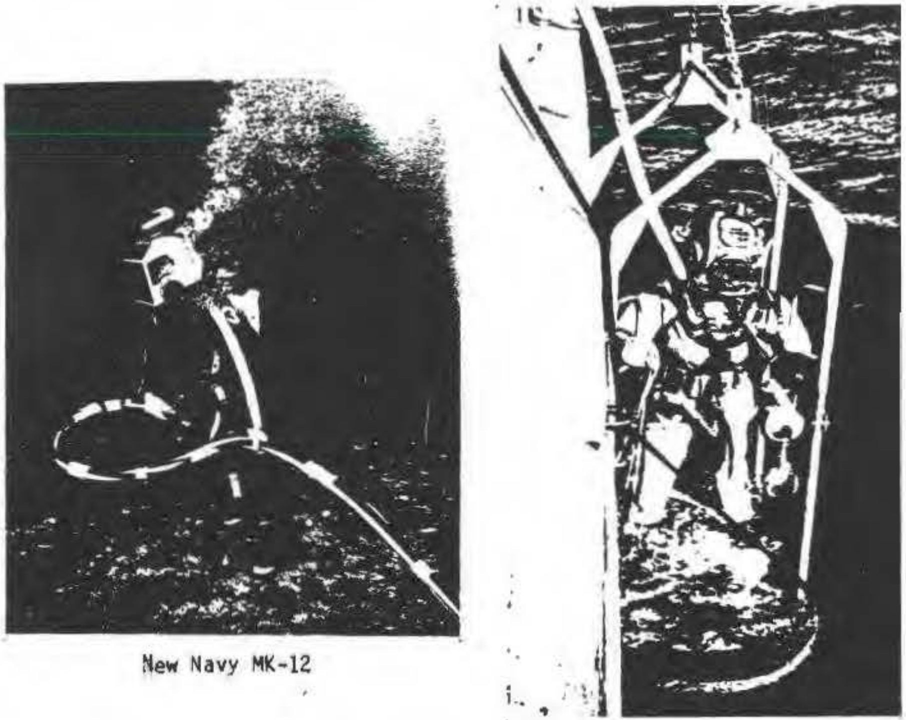
Figure 1

One Atmosphere "JIM" Suit

In ambient diving, the diver is subjected to the ambient pressure of the water at the depth at which he is diving. Ambient diving consists of two major subgroups, surface supplied diving and self-contained diving. Surface supplied diving is that mode generally used by commercial diving activities. Self-contained diving uses some form of self-contained underwater breathing apparatus (SCUBA). While primarily used as a sporting activity in terms of numbers of participants, it is widely used in the scientific community for data collection and research support and, to some extent, in the military.

Surface supplied diving is the direct descendant of the "rigid" or Siebe diving dress. Modern hard-hat rigs are similar in appearance to the original Siebe unit. Basically, they consist of a rigid helmet (made of anything from brass to fiberglass) attached to a waterproof suit. Figure 2 shows the more recently developed Navy MK-12 deep diving system and the original MK-5 hard hat rig used for decades. The suit is protected by appropriate one-way valving and is weighted to maintain neutral buoyancy when submerged. Air and communications are brought to the diver through an umbilical line. When diving in a hard-hat rig, the diver originally was considered to be isolated from his environment except for the effects of ambient pressure. These dresses do not provide adequate chemical protection due to their inability to totally isolate the diver from the aquatic environment.

In self-contained apparatus, the diver's air is supplied through a regulator mouthpiece clenched between his teeth. His mouth is constantly exposed to the water. The limitations of standard SCUBA in contaminated waters are obvious. Even if a concerted effort is made to preclude water entry into the mouth, the action of inhalation creates a slight negative pressure making it nearly impossible to keep water out. In addition, the only way a SCUBA diver can clear condensation from inside the mask is to flood it with surrounding water; consequently, the nose and eyes also become exposed to contamination. The standard SCUBA rig simply is inadequate for protecting the SCUBA diver from the effects of diving in contaminated water.



New Navy MK-12

Old Navy MK-5

Figure 2

New Navy MK-12 Surface Supplied Diving System and Former Navy MK-5 Rig

MODIFIED SURFACE SUPPORTED DIVING SYSTEMS

Numerous commercial diving suits and helmets were reviewed for chemical exclusion and material compatability. Five specific diving helmets and six dresses were modified and functionally evaluated at the Naval Underseas Weapons Tower in White Oak, Maryland. A test and evaluation program was also initiated at the existing EPA Oil & Hazardous Materials Simulation Environmental Test Tank (OHMSETT), located in Leonardo, New Jersey. Due to the various complexities of body movements during strenuous diving operations, seals and straps can fail and, thus, cause leakage of contaminants into the diving system. Accordingly, actual dive operations were used to test equipment modifications.

The helmets, which were successfully evaluated for chemical exclusion, were the Draeger Helmet System; the Desco "Pot" Diving Hat; Diving Systems International Superlite-17 Helmet; Morse Engineering MK-12 Navy Deep Water Helmet System; and Safety Sea Systems Helmax Helmet. The six different suit configurations were evaluated along with the above helmets. One diving dress was from Draeger, the remaining five were supplied by Viking Technical Rubber. The Interim Protocol describes the detailed modifications made to each diving helmet and dress. Following are highlights of some of the modifications.

The Draeger Constant Volume Suit, in combination with an undersuit, emerged as a likely candidate for providing adequate protection in polluted water. The standard, off-the-shelf, smooth neoprene Draeger Suit surface can be decontaminated more readily than other foam-type dry suits. The hood fully encloses the diver's head and has a built-in demand regulator and faceplate which seals to the suit at the neck in a simple reliable fashion eliminating the need for a water tight zipper.

Dry suits containing air have significant internal/external pressure differentials, depending on the position of the diver in the water. Since both a pressure differential and a hole are required for entry of water into a dry suit, elimination of one of these factors will preclude entry of outside water. If the inside of a dry suit is filled with water, the internal/external pressure differential can be reduced or eliminated. This same water can be used for diver thermoregulation.

Accordingly, a major modification to the standard Draeger system included a Suit-Under-Suit (SUS) (Figure 3) diving dress. A tight-fitting foam neoprene undersuit with attached feet and neck entry makes up the innermost portion of this system. The neck of the undersuit seals to the neck ring of the Draeger suit. A neck dam provides a seal between the neck ring and the diver's neck. The Draeger suit and hood seal is then worn in a normal fashion over the SUS and neck dam. Clean water is pumped into the area between the SUS and the Draeger suit via an umbilical from the surface, and exits through the exhaust valves near the ankle of the Draeger suit. The neck dam prevents entry of this water into the hood.

The modified suit is filled with water while the diver is at the water surface with his feet in an elevated position to allow the escape of air through the exhaust valves. The diver must exit the water slowly at the end of the dive to allow adequate time for water to drain from the suit. A two-way valve is provided to allow the diver to control the rate of flow through the suit and to provide rapid discharge of pumped water through the hose. The latter is sometimes necessary to maintain proper water temperature.

Test dives with this system proved to be significantly more comfortable for the diver than an air-filled dry suit. No pressure differentials exist, thereby eliminating suit squeeze. Buoyancy changes due to compression and expansion of air and air shifting within the suit are also eliminated.

The Morse Engineering MK-12 Surface Supplied Diving System (SSDS) consists of four major units: the helmet assembly, recircular assembly, dress assembly, and the support equipment (Figure 2). The helmet may be used with air or mixed gas as the breathing medium.

The standard swimming dress consists of either a wet suit or swim trunks with jocking harness, fins, scuba weight belt or outer garment, weights and the neck-dam with exhaust valve in the ambient configuration.

The standard diving dress, for "on-the-bottom" operations, consists of a crushed foam neoprene nylon drysuit, outer chafing garment, jocking harness, lightweight diving boots, and gloves. Two-, four-, and five-pound lead

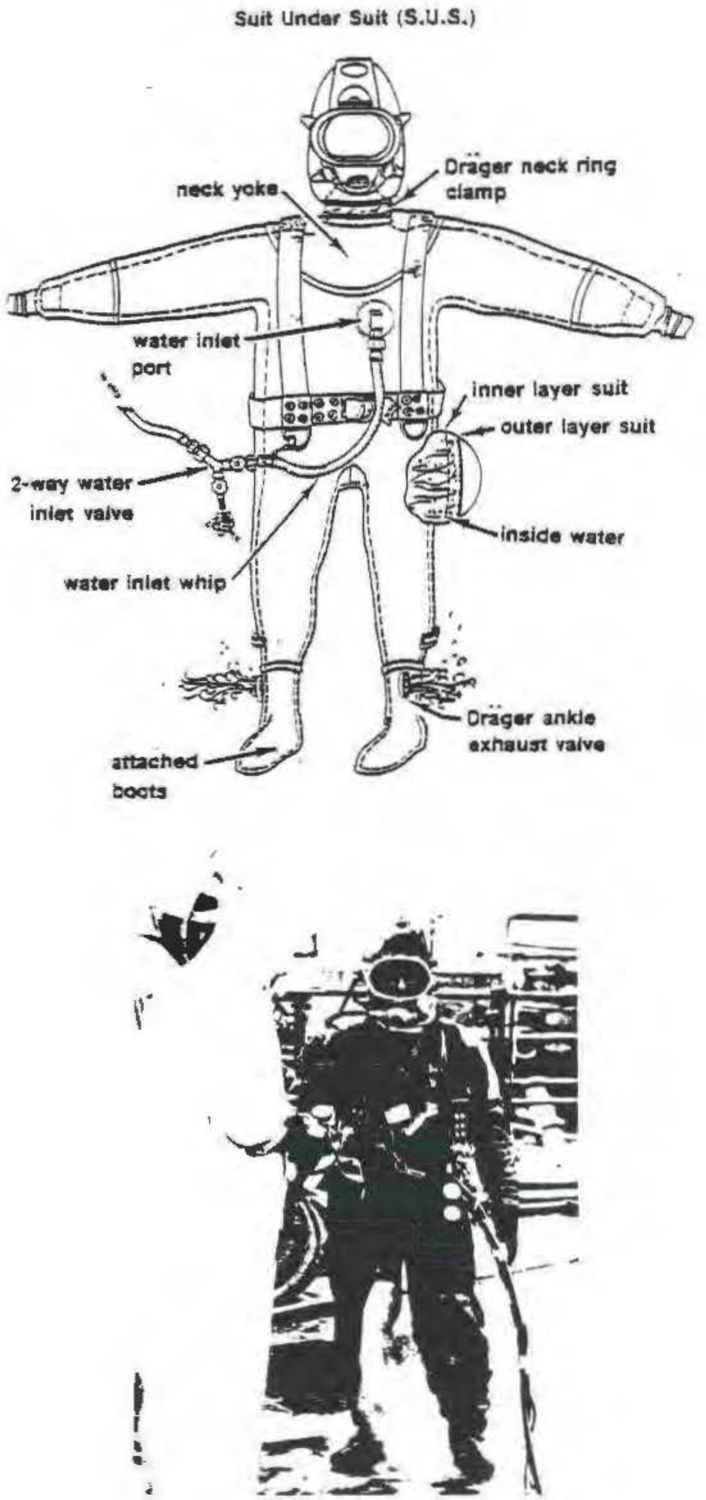


Figure 3

Draeger "Suit-Under-Suit" Diving Dress

weights (to a maximum of 60 lbs) fit into the calf, thigh, and hip pockets of the outer garment. The outer nylon chafing garment provides protection for the drysuit against snagging, tearing, and abrasion; provides inflation restraint to prevent inadvertent blow-up; has pockets for installing diver weights; and assists in maintaining the jocking harness in place for helmet stability.

The standard MK-12 SSDS diving dress is virtually impossible to decontaminate and does not provide a dry suit/glove interface. Accordingly, Viking Technical Rubber produced two variations of the dress for contaminated water operations.

--The first Viking Chemical Suit model was an exact duplicate of the standard MK-12 outer chafing garment, providing all necessary weight pockets to accept 60 pounds of lead bars, blocks, and rods required for diver buoyancy control, and including compress, calf, and thigh straps to prevent diver "blow-up" or over-pressurization.

--The second model was a smooth dress with no weight pockets or compressive straps and required use of the standard outer chafing garment.

Both Viking suits are made of very heavy weight, 1.1 mm thick, natural rubber bonded onto polyester tricot fabric. The rubber provides waterproofing but no insulation. The diver must wear clothing or insulated underwear for warmth. The wrists of the suits are sealed by stretchy latex cuffs cemented to the suit's arms and then covered with rubber tape but can easily be removed if damaged. Cuff rings made of hard rigid PVC plastic pipe material can be slipped inside the sleeve of each arm allowing for a multiple gloving system. A latex chemical-resistant glove is worn in combination with a cotton work glove to detect leakage from the outer glove and to provide warmth. Over the cotton glove a heavy neoprene rubber glove covered by another outer cotton chafing glove can be added for abrasion resistance. This constitutes a 4 glove system. A thin surgical glove can also be added to provide additional protection.

The Superlite-17 Commercial Diver's Helmet manufactured by Diving Systems International (Figure 4) is constructed of molded fiberglass and weighs approximately 24 pounds dry. Modifications to the Superlite-17 included the use of an exhaust system in which gases exit the helmet through a minimum of two in-line exhaust valves. This system eliminates small amounts of water from back-flushing into the helmet before a single exhaust valve completely closes. Isolation of the second stage diaphram with a brass cap also protects the diaphram from potential contamination. Ambient pressure reference is achieved with a tube running from the brass cap to the inside of the helmet through existing openings previously used for communications.

The Superlite-17 was mated with a specially cut Viking heavy duty commercial dry suit. The collar of the Viking was arranged so that the bottom "toilet" seat collar, or breach ring, was covered by suit material and secured by a drawstring. This created a totally dry seal between the helmet and the suit.

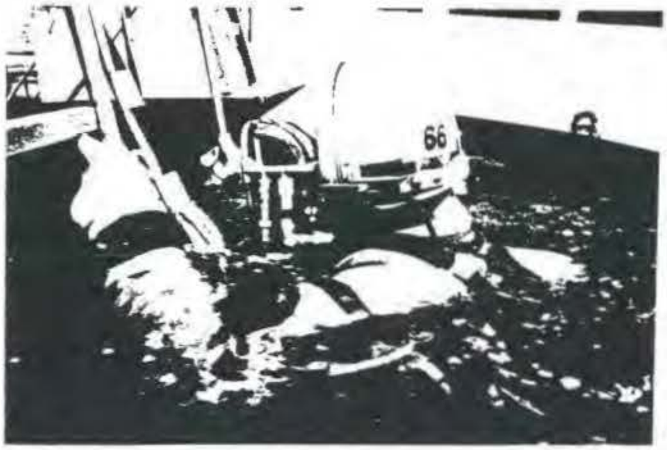
The Helmax SS-20 Model B Helmet, (Figure 4) manufactured by Safety Sea Systems, Inc., resembles a "clam shell" mask with a hinged head protector equipped with locking levers that seal a one-half inch thick stainless steel hood ring between the hull section and the head protector when in the closed and locked position. The mechanical arrangement allows very quick donning and removal of the helmet in either a standing or sitting position. The hull is manufactured from stainless steel as is the head protector frame. The view port is 3/8" thick tuffak (polycarbonate) coated with a permanent anti-fog compound. The system is intended for use with an umbilical that will supply the breathable gas and communication cable.

The Helmax helmet was tested with a specially modified Viking commercial heavy duty dry suit. The attached hood of the Viking received the Helmax helmet ring allowing for a totally dry seal.

The Desco Diving Hat (Figure 4) is simple, rugged, and all-metal. It rests on, and turns, with the diver's head. It has approximately neutral

Superlite-17

Desco Pot Helmet



Helmax SS-20

Figure 4

buoyancy under water and its low center of gravity and excellent fore-and-aft balance hold it comfortably and securely on the diver's head in all working positions.

The neck ring seal is of a new and unique design, providing two independent and complementary waterproof seals. It is designed so that the diver can put the hat on or off quickly in close quarters without assistance from a tender and even while wearing heavy gloves.

Unlike the Superlite-17, which is a demand air supply system, the Desco Diving Hat is a free air flow system. Air is continually introduced into the helmet to maintain a positive pressure. The only modification made to this system was the addition of a series exhaust similar to that used in the Superlite-17.

A specially modified Viking heavy duty commercial suit was used with the Desco Hat. The lower breach ring of the helmet provides for a totally dry seal with the Viking suit.

Chemical tank testing of the aforementioned diving ensembles included laboratory analyses of inner suits and helmets for both ammonia and flourescein dye tracer. The modified Desco Pot, Superlite-17, MK-12, Helmax SS-20, all with Viking heavy weight dry suits, and the Draeger SUS dress, successfully isolated the diver from the chemical tracers (4).

HAZARD EVALUATION

Significant contributions to chemical contamination of waterways are spills of petroleum products, hazardous materials, and other miscellaneous materials. From 1977 to 1981, 64,609 such spills were reported to the U.S. Coast Guard Office of Marine Environment and Systems. This represents a total of 75.6 x 10^6 gallons of material released into navigable waterways alone. From 1974 to 1981, 454 large spill or release incidents were reported involving a total of 20.9 x 10^6 pounds of dry hazardous and other substances (4).

The acute toxicity of petroleum products is usually related to the degree of refinement. All types are capable of causing chemical burns in prolonged contact with exposed skin. Products which come in contact with the eyes, mucous membranes, and other sensitive areas of the body (lips, ears, armpit, genital area) have been shown to cause severe burns. Inhalation of fumes will often cause headache, nausea, and stuperous effects. Aspiration of pure product can cause significant lung damage. Ingestion usually causes nausea and can burn the oral-upper gastrointestinal tract. Petroleum products are associated with several documented and suspected chronic effects such as skin irritation, skin cancer, mild aesthetic effects, chemical pneumonitis, central nervous system damage, and blood disorders. There is also a potential for fire and/or explosion with most petroleum products. The variety of hazardous chemicals far exceeds the variety of petroleum products. The properties, toxicity, and other hazards are also much more sophisticated.

Much of the standard reference toxicity data available is based upon "pure product" contact. A diver in an underwater response operation will normally have the beneficial protection of "dilution" as a buffer between him and the pure contaminant. For example, in most large waterbodies, currents, tides, and winds provide for water column "turnover" or mixing. Pure chemical product emanating from a point source, such as a drum, barge, ship discharge line, etc., will undergo dilution even as close as a few feet from its origin. This does not imply that the diver or on-scene-coordinator (OSC) should assume that "dilution is the solution" and accordingly there is no danger.

Slightly soluble and insoluble sinking compounds can accumulate in pockets or bottom depressions under low current conditions. Situations of diver response in the presence of such chemicals (Table 1) requires extra precaution due to the "pure product" condition that can be encountered underwater.

Special precautions should also be exercised by personnel operating in "naturally" polluted waterways which receive treated as well as untreated municipal and industrial waste. Hydrogen sulfide, a by-product of decomposing bottom sediment, is a slightly soluble sinking compound which will accumulate in bottom depressions. A diver can easily enter into such an area without warning. The material exhibits a very high skin penetration and an extreme systemic hazard. Full encapsulation of the diver is required in such an area while limiting exposure to as short a duration as possible.

Table 1

Slightly Soluble/Insoluble Sinking Compounds

Acetic Anhydride
Bromine
Epichlorohydrin
Turpentine
Hydrogen Sulfide
Perchloroethylene
Methyl Parathion
Trichloroethylene
Acrylonitrile
Cresol
Carbon Tetrachloride
Napthalene
Methylene Chloride
Dichloropropane
Polychlorinated Biphenols
Chlordane

Another group of compounds in which a diver could come into contact with is "insoluble or slightly soluble floating" compounds. These would be at the water surface and could coat the diver upon entry and exit from the operation site. The use of a firehose on the chemical slick will often be enough to disperse the contaminant to enable the diver to safely enter and exit the water. Examples of such compounds are shown in Table 2.

Table 2

Insoluble/Slightly Soluble Floating Compounds

Benzene
Styrene
Chromium Salts
Glycol Salicylate
Xylene
Methyl Methacrylate
Toluene
Ethyl Benzene
Methyl Ethyl Ketone

In preparing the Interim Protocol, the properties of commonly spilled hazardous chemicals were reviewed. Based upon their behavior in water they were grouped into the following categories:

a. Highly Soluble/Miscible Compounds
b. Slightly Soluble/Slowly Dissolving/Floating Compounds
c. Slightly Soluble/Slowly Dissolving/Sinking Compounds
d. Insoluble/Floating Compounds
e. Insoluble/Sinking Compounds
f. Compounds Which Could React Violently with Water

This grouping is meant to provide guidance for the decision maker on when and how to use divers/ROV's in response situations. Table 3 (4) lists commonly spilled chemicals considered to be of high priority to respective agencies and is presented as an example of the variety of materials a decision maker could be faced with.

In most instances, the use of appropriate encapsulating suits and helmets by diving personnel will allow underwater operations to be conducted in contaminated environments. However, there will be situations where the hazardous substances(s) involved will present such a risk as to preclude the deployment of diving personnel except in extreme emergencies and only for short exposure periods.

With reference to the USCG list in Table 3, and dermal toxicity data presented in the Interim Protocol, umbilical supported encapsulated diver exposure to the chemicals, found in Table 4, should be as short a duration as possible, and only in response to protection of public health (e.g., rescue of personnel), or massive environmental damage such as the possible loss of a community's only surface drinking water reservoir.

Table 3

Comparison of Priority Hazardous Substances in Waterways

**U.S. COAST GUARD
POLLUTION INCIDENT DATA BASE**

Acetic Acid
Acetic Anhydride
Acetone Cyanohydrin
Acetyl Chloride
Acrylonitrile
Aluminum Sulfate
Ammonia
Ammonium Compound (Nitrate & Sulfate)
Benzene
Bromine
Carbon Tetrachlorine
Chlordane
Chlorine
Chromium Compounds
 (Chromic Salts (CrN) & Chromous Salts (CrCl))
Chromium Salts (metals & Insolubles)
Copper Compounds (Nitrate & Sulfate)
Cresol
Dichloropropane
Dimethylamine
Epichlorohydrin
Ethyl Alcohol
Ethyl Benzene
Ethylene Glycol
Glycol Salicylate
Hydrochloric Acid
Hydrofluoric Acid
Lead Acetate
Lead Arsenate
Lead Chloride
Lead Nitrate
Lead Sulfate
Lead Tetraethyl
Lead
Maleic Acid
Maleic Anhydride
Methyl Alcohol (Methanol)
Methyl Ethyl Ketone
Methyl Methacrylate
Methyl Parathion
Methylene Chloride (Dichloromethane)
Napthalene
Nitric Acid
Nitrogen Dioxide
Perchloroethylene (Tetrachloroethylene)
Phenol
Polychlorinated Biphenyls (PCB)
Potassium Permanganate
n-Propyl Alcohol
Sodium Disulfite
Sodium Hydroxide
Sodium Hypochlorite
Sodium Sulfide
Styrene
Sulfuric Acid
Toluene
Trichloroethylene
Turpentine
Vinyl Acetate

**U.S. NAVY CONTRACT
N60921-82-B-A052**

Acetyl Chloride
Acrylonitrile
Aqueous Film Forming Foam
Benzene
1,2-Butylene Oxide
Chlorine
Carbon Disulfide
Diethylether
DS-2
Ethylamine
Ethylene Glycol
Ethyl Methacrylate
Formaldehyde
Formic Acid
Hexane
Hydrochloric Acid
Methyl Ethyl Ketone
Nitrobenzene
Oil, Gasoline
Oil, JP-4
Organo-Tin Paint
Polychlorinated Biphenyls
 (50% Solution with
 Trichlorobenzene)
Sulfuric Acid
Super Tropical Bleach
Trichloroethylene

**NOAA HAZARDOUS MATERIALS
RESPONSE PROJECT**

Acetone
Ammonia
Ammonium Nitrate
Anyhdrous Ammonia
Benzene
Butyraldehydes
Dichloromethane (Methylene Dichloride)
Ethanol (Ethyl Alcohol)
Hydrochloric Acid (Muriatic Acid)
Isopropanol (Isopropyl Alcohol)
Methanol (Methyl Alcohol, wood alcohol)
Methyl Ethyl Ketone (MEK)
Methyl Parathion
Perchloroethylene (Tetrachloroethylene)
Phenol
Phosphoric Acid
Propane (Liquified Propane Gas)
Sodium Hydroxide (Caustic Soda)
Styrene (Vinyl Benzene)
Sulfuric Acid (Oleum, Oil of Vitriol)
Tetraethyl Lead
Toluene (Methyl Benzene)
Xylenes

ENVIRONMENT CANADA

Acetic Acid
Acetic Anhydride
Ammonia
Ammonium Nitrate
Ammonium Phosphate
Benzene
Calcium Chloride
Calcium Oxide/Hydroxide
Carbon Dioxide
Chlorine
Cyclohexane
Ethylbenzene
Ethylene Dichloride
 (1,2-Dichloroethane)
Ethylene Glycol
Ethylene Oxide
Ethylene
Ferric Chloride
Formaldehyde
Hydrogen Chloride/Acid
Hydrogen Fluoride/Acid
Hydrogen Sulfide
Mercury
Methanol
Morpholine
Naphtha
Natural Gas
Nitric Acid
Phenol
Phosphoric Acid
Phosphorous
Potash (Potassium Chloride)
Propylene Oxide
Propylene
Sodium Chlorate
Sodium Chloride
Sodium Hydroxide
Sodium Hypochlorite
Sodium Sulfate
Styrene (Monomer)
Sulfur Dioxide
Sulfuric Acid (and Oleum)
Sulfur
Tetraethyl Lead
Toluene
Urea
Vinyl Chloride
Xylenes
Zinc Sulfate
2-Ethylhexanol

Table 4

Limited Exposure Chemicals

Cresol
Napthalene
Methylene Chloride
Dichloropropane
Trichloroethylene
Methyl Methacrylate
Toluene
Xylene
Carbon Tetrachloride
Hydrogen Sulfide
Perchloroethylene
Polychlorinated Biphenyls
Benzene
Styrene
Ethyl Benzene

Examples of insoluble chemical substances in which a diver should never be allowed to operate in are as follows:

Acetic Anhydride
Bromine
Methyl Parathion
Acrylonitrile
Epichlorohydrin
Chlordane

These lists are by no means complete. Classification was based upon material solubility in water and allowable concentrations as found in the EPA Oil & Hazardous Materials Technical Assistance Data System (OHMTADS). Chemicals encountered in the field should be evaluated on the same basis. In addition, the potential impact of the chemical on diving dress materials is currently being evaluated under a USN research contract.

MEDICAL MONITORING

Hazardous incidence response personnel, including divers and surface support personnel, can be exposed to conditions atypical of normal occupational conditions. Special attention should be given when developing medical surveillance programs for these personnel since they can be exposed to thousands of toxic chemicals that may or may not be identifiable at the time of response. Even if the substances are identified, potential health effects from exposure may not be known. The Interim Protocol recommends specific medical examination tests for these individuals.

PROTECTION OF SURFACE SUPPORT PERSONNEL

A major area often overlooked in contaminated underwater diving operations is the protection of surface tenders and support personnel. Previous commercial operations have shown that the recovery of sunken chemical drums and containers can lead to some degree of contamination of the ship's deck and surrounding equipment. Umbilical and line tenders handling divers' support hoses will inevitably come in contact with contaminated water. Appropriate levels of personnel protection must be defined for these special situations. Limited deck area does not allow for large "clean areas" for personnel decontamination and changing of self-contained breathing apparatus air tanks. Depending on the toxicity level of hazardous substances, this could dictate the need for airline supplied respirators for surface support personnel functioning in highly-contaminated areas. Also, appropriate considerations and procedures are required for decontamination of surface support personnel. "Clean" locations must be designated for suiting up divers, and procedures must be developed for moving divers and their gear back to decontamination stations. Specific procedures are also required for umbilical, helmet, and diver dress decontamination operations.

SOURCES OF INFORMATION AND RESPONSE ASSISTANCE

In a hazardous spill situation, the On-Scene-Coordinator or the Marine Safety Officer must quickly assess conditions to determine whether or not to deploy diving personnel into contaminated waters. Hazards to surface response workers should also be evaluated.

Numerous sources of information and organizations exist that can provide technical data and physical assistance regarding both the hazards associated with an incident and methods to deal with them. It is necessary to be aware of these resources and to know how to use them.

Information such as topography, meteorology, physical/chemical properties of the spilled material, applicable treatment methods, and available cleanup resources, can be provided by various agencies, maps, reference books, and manuals. It is advisable to get data from at least two sources and use the latest edition of any reference, especially when searching for hygienic standards or toxicological data.

Access to on-line computer files may be possible at a site if a telephone, portable terminal, and 120-volt outlet are available. Aerial photographs can also provide useful information when properly interpreted.

NOAA's Hazardous Materials Response Project (HAZMAT) is a member of one of the groups of special forces available upon request to OSC's for response to actual or potential releases of pollutants, as well as for contingency planning.

The Interim Protocol contains a listing of basic references, on-line computer systems, remote sensing and map interpretation information, and a list of technical assistance organizations.

SUMMARY

The information presented in this paper is meant to highlight some of the considerations for underwater operations involving hazardous chemicals. The Interim Protocol and final MOP address these areas as well as additional areas in much more detail.

The issuance of this "Interim Procedures" document, prior to completion of final field evaluation and demonstration of modified equipment and newly developed response procedures, is needed to serve as a reference guide to safer underwater operations. Field evaluation and shakedown of the procedures, techniques, and equipment described herein is required prior to the issuance of a complete finalized MOP.

The final MOP will cover general procedural activities related to hazard evaluation, diver deployment and recovery, surface tending operations, and equipment decontamination procedures.

Safety is the prime concern in any underwater operation, be it deep saturation diving on exotic gases or the need to effect a chemical drum recovery operation. With the help of the scientific community, military organizations and commercial industry, the justifiable deployment of diving personnel in heavily chemically polluted waters can be safely and effectively accomplished.

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HAZARDOUS SITE RECONNAISSANCE OPERATIONS

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Presented at the NOAA/EPA Workshop/Seminar for the Protection of Divers in Waterways Receiving Hazardous Chemical and Pathogenic Substances Discharges

Undersea Medical Society
9650 Rockville Pike
Bethesda, Maryland 20014

March 2-4, 1982

HAZARDOUS SITE RECONNAISSANCE & OPERATIONS

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Functions of the Environmental Response Team

The Environmental Response Team (ERT) is the EPA focal point for technical assistance to the Regions and Program Offices during single or multi-media emergency episodes involving toxic and hazardous materials including oil and hazardous wastes. When activated, in such instances by request of the Regional Offices or Departments outside the EPA, the ERT will provide assistance concerning prevention, safety, assessment, containment, control, cleanup, restoration, removal, and disposal of oil and hazardous substances spills. Response activities include providing advice and consultation as well as conceiving, implementing and coordinating novel and advanced technical approaches for solving problems associated with multi-media environmental emergencies.

In addition to response activities, ERT will plan, organize, coordinate, implement, and disseminate information on personal safety and hazard assessment to protect public health and personnel during environmental emergency situations. The "Team" will also be responsible for developing and presenting training programs for on-scene-coordinators (OSC) on the use of new practices, methods, manuals, equipment, etc., for coping with multi-media environmental emergencies, and on the use of safety equipment and safety and industrial hygiene practices as specified by OSHA.

This paper will overview procedures and operations involved in the initial surveys of both hazardous chemical spills and toxic waste sites.

In January 1981 ERT prepared "Interim Standard Operating Safety Procedures" for review and comment primarily from OSC's and EPA Program Offices. The purpose of the "Interim Standards" is to provide recommendations for selected safety procedures. Although every endeavor on or off-site involves some degree of consideration for worker protection and safety, this document outlines specific criteria for standard operating procedures primarily related to site control and entry. The omission of other safety procedures does not imply their lack of importance.

The following phases are addressed in the "Interim Standards":

1. Site Entry: General Measures
2. Site Entry: Initial Survey & Reconnaissance
3. Site Entry: Personnel Protection
4. Site Control: Site Work Areas
5. Site Control: Decontamination

A major consideration in all response activities is the health and safety of the personnel. Not only must a variety of technical tasks be conducted in a timely fashion, but they must be accomplished in a manner to protect the worker. In addition to having appropriate equipment and training, safety-oriented standard operating procedures provide another means of reducing the possibility of harm.

ERT has created and sponsors seven training courses designed for field response and operations personnel who are expected to function in hazardous chemical environments. These courses are:

1.	Introduction to Hazardous Materials Incident Response	(5 days)
2.	Personnel Protection and Safety	(5 days)
3.	Incident Mitigation and Treatment Methods	(5 days)
4.	Field Monitoring & Sampling of Hazardous Materials	(5 days)
5.	Hazardous Materials Incident Response Operations	(5 days)
6.	Hazard Evaluation & Environmental Assessment	(5 days)
7.	Respiratory Protection	(3 days)

Table 1 lists dates and locations of all the courses being presented between October 1981 through September 1982.

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF EMERGENCY AND REMEDIAL RESPONSE
ENVIRONMENTAL RESPONSE BRANCH
TRAINING COURSE SCHEDULE

October, 1981 - September, 1982

COURSE TITLE	DATE	LOCATION
Hazardous Materials Incident Response Operations (165.5)	October 19-23, 1981	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	November 16-20, 1981	Edison, NJ
Incident Mitigation & Treatment Methods (165.3)	Nov. 30 - Dec. 4, 1981	Cincinnati, OH
Respiratory Protection (165.7)	Nov. 30 - Dec. 2, 1981	Cincinnati, OH
Hazard Evaluation & Environmental Assessment (165.6)	December 7-11, 1981	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	December 14-18, 1981	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	January 11-15, 1982	Edison, NJ
Field Monitoring & Sampling of Hazardous Materials (165.4)	January 18-22, 1982	Cincinnati, OH
Hazardous Materials Incident Response Operations (165.5)	February 1-5, 1982	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	February 15-19, 1982	Edison, NJ
Respiratory Protection (165.7)	February 22-24, 1982	West Coast
Hazardous Materials Incident Response Operations (165.5)	March 1-5, 1982	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	March 15-20, 1982	Edison, NJ
Incident Mitigation & Treatment Methods (165.3)	March 22-26, 1982	Kansas City
Hazardous Materials Incident Response Operations (165.5)	April 5-9, 1982	Edison, NJ
Personnel Protection & Safety (165.2)	April 19-23, 1982	Cincinnati, OH
Hazardous Materials Incident Response Operations (165.5)	May 3-7, 1982	Edison, NJ
Advanced Respiratory Protection (165.8)	May 10-12, 1982	Cincinnati, OH
Hazard Evaluation & Environmental Assessment (165.6)	June 7-11, 1982	Cincinnati, OH
Field Monitoring & Sampling of Hazardous Materials (165.4)	June 14-18, 1982	Denver, CO
Hazardous Materials Incident Response Operations (165.5)	June 21-25, 1982	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	August 23-27, 1982	Edison, NJ
Respiratory Protection (165.7)	Aug. 30 - Sept. 1, 1982	Midwest
Hazardous Materials Incident Response Operations (165.5)	Sept. 20-24, 1982	Edison, NJ
Hazardous Materials Incident Response Operations (165.5)	October 18-22, 1982	Edison, NJ

Further course information can be obtained by contacting:

Thomas C. Sell, Training Coordinator
Environmental Response Team
U.S. Environmental Protection Agency
26 West St. Clair
Cincinnati, Ohio 45268
(513) 684-7537

Hazard Identification

The primary objective in responding to incidents involving hazardous substances is to prevent or reduce any imminent or potential deleterious effects of the released substances on the public's health and/or to protect the environment. To accomplish this objective, it is necessary 1) to identify the substance(s) involved, 2) evaluate the substance(s) behavior in the ambient environment and the effects of the released substance(s) on the public's health and/or the environment, and 3) initiate actions to ameliorate the effects of the release. Throughout the lifetime of an incident, from its inception to its final disposition, a high priority activity is obtaining the necessary information to assess and evaluate the real or potential environmental impact of the incident. This process of identifying the materials involved in an environmental episode, evaluating the materials' actual or potential impact on the public's health, the environment and response personnel; and determining the most effective methods for preventing or reducing the associated hazards is known as incident characterization.

In those incidents where the substance(s) involved are known or easily identified, the media affected clearly ascertained, and the environmental effects known, the evaluation of the hazardous nature of the situation is less complicated. The effects of a discharge of vinyl chloride in a small stream is relatively easy to evaluate. More complex are those incidents such as an abandoned waste site, in which data needed to identify the hazards and evaluate their impact on the environment is lacking.

Characterizing a hazardous substance incident is generally a two phase process. The first phase is an initial or preliminary evaluation based on information that is readily available and/or the fairly rapid collection of data needed to determine if emergency protective measures are necessary. The second phase of characterization, which may not be needed in all responses, is a more methodical environmental surveillance information collection program designed to enhance, refine, and enlarge the initially provided data base. The latter phase, if needed, would provide more comprehensive information for evaluating the environmental hazards associated with the incident, response operation, decision-making, and as a continuously operating program, reflect changes in the environs due to response activities.

The evaluation of a hazard due to a hazardous chemical spill or uncontrolled hazardous waste site is a very complex process. The purpose of such an evaluation is to establish a plan of action for mitigation and treatment of the site and protection of those persons in contact with the hazard during such operations. Only recently has the safety concern risen to the level of top priority as we have learned so much more about the toxic interations between chemicals and the body.

Protection from chemicals comes in the form of protective clothing and respiratory protection apparatus. The question arises, how much protection is necessary? Speculative guessing is not the best way to choose the proper equipment. Thus, we must use those guidelines which are the most suitable to our needs. The source of such guidelines come from Federal regulations, Federal recommendations and private organizations.

The objective of using total atmospheric gas/vapor concentrations for determining the appropriate personnel protection level is to provide a numerical criteria for selecting Level A, B, or C protection. Until atmospheric contaminates are specifically identified and personnel protection selected based on toxicological properties, total gas/vapor concentrations provide a numerical value that can be used as a guide for selecting personnel protection equipment.

Although total gas/vapor concentration measurements are useful to a qualified professional for the selection of protection equipment, caution should be used in the interpretation of this data. The response of an instrument to several gas/vapor contaminates does not provide the same sensitivity as measurements involving a single contaminant. Since total vapor field instruments see all contaminants in relation to a specific calibration gas, the concentration of an unknown environment may be overestimated or underestimated.

When carcinogens or other highly hazardous substances are suspected, the protection level should not be based solely on the total gas/vapor criteria, rather the level should be selected on a case-per-case basis weighing heavily on potential exposure and chemical characteristics of the suspected material.

In utilizing atmospheric gas/vapor concentrations as a guide for selecting a level of protection, a number of factors should be considered:

1. The uses, limitations, and operating characteristics of the monitoring instruments must be recognized and understood. Instruments such as the photoionizer and Organic Vapor Analyzer (OVA) do not respond to all substances that may be present or may respond differently to identical substances when compared to one another. Therefore, experience, knowledge, and good judgment must be used to compliment the data obtained with this instrumentation.

2. Hazards other than detectable toxic gases/vapors such as non-detectable gases (i.e., phosgene, HCN, chlorine, etc.,) liquid/solid particulates, explosives, combustibles, radiation, oxygen deficiency, and other harmful conditions may exist in the atmosphere or on the site.

3. The risk to personnel entering an area must be evaluated against the need for entering. Although this assessment is largely a value judgment, a conscientious deliberation of the variables involved and the risk to personnel must be balanced against this need for site entry.

4. The knowledge that carcinogens or other highly toxic substances are involved or suspected requires that gross levels not be the sole factor in determining the level of protection. Other factors which must be taken into consideration are exposure, chemical characteristics of known/suspected materials, instruments, weather conditions, etc.

5. Functions which need to be performed on-site must be evaluated. Based upon total atmospheric gas/vapor concentrations, Level C protection may be judged adequate. The work functions to be performed such as moving drums, opening containers, bulking of materials, and other operations that increase the probability of exposure may require a higher level of protection.

Respiratory and Personnel Protection Selection Criteria

It is important that personnel protective equipment and safety requirements be appropriate to protect against the potential or known hazards at an incident. Protective equipment should be selected based on the type(s), concentration(s), possibilities, and routes of personnel exposure from substances at a site. In situations where the type of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the personnel protective equipment required for initial safety.

The appropriate level of protection shall be determined prior to the initial entry on-site based on best available information. Subsequent information may suggest changes in the original level selected.

A. Levels of Protection

Level A - 500-100 ppm Concentration Above Background

Level A protection should be worn when the highest available level of respiratory, skin, and eye contact protection is needed. While Level A provides the maximum available protection, it does not protect against all possible airborne or splash hazards. For example, suit material may be rapidly permeable to certain chemicals in high air concentrations or heavy splashes.

Level B - 5-500 ppm Concentration Above Background

Level B protection should be selected when the highest level of respiratory protection is needed, but exposure to the small unprotected areas of the body (i.e., neck and back of head) is unlikely, or where concentrations are known to be within acceptable exposure standards.

Level B protection is the minimum level recommended on initial entries until the hazards have been further identified and defined by monitoring, sampling, and other reliable methods of analysis, and personnel protection equipment corresponding with those findings is utilized.

Level C - 0-5 ppm Concentration Above Background

Level C protection should be selected when the type(s) and concentration(s) of respirable material is known, has adequate warning properties, or is reasonably assumed to be not greater than the protection factors associated with air-purifying respirators; and exposure to the few unprotected areas of the body (i.e., neck and back of head) is unlikely to cause harm. Continuous monitoring of site and/or individuals should be established.

Level D

Level D is the basic work uniform and should be worn for all site operations. Level D protection should only be selected when sites are positively identified as having no toxic hazards.

Hazardous Work Zone Designations

An incident generally involves the escape of normally controlled substances into the environment via air, water, or land surface and response activities involve actions to minimize and prevent these discharges. Site control is preventing or reducing the transfer of hazardous substances (contaminants) from the site by workers and equipment involved in site operations.

Site control involves two major activities: 1) physical arrangements and control of the site work areas; and 2) methods for the removal of contaminants from people and equipment.

Control is needed to reduce the possibility of transport from the site of contaminants, which may be present on personnel and equipment. This can be accomplished in a number of ways including:

1. Physical barriers to exclude unnecessary personnel
2. Checkpoints with limitd access to the site, or areas within the site
3. Minimizing personnel and equipment on-site consistent with effective operations
4. Establishment of containment zones
5. Decontamination procedures
6. Conducting operations in a manner to reduce possibility of contamination.

One method of reducing the potential for transfer of contamination is to delineate zones or work areas within the vicinity of the incident based upon expected or known levels of contamination. Within these zones prescribed operations would occur utilizing appropriate personnel protective equipment. Movement between areas would be controlled at checkpoints. Three contiguous zones are recommended:

1. Exclusion area (contaminated)
2. Contamination reduction area
3. Support area (non-contaminated)

Exclusion Area

The Exclusion Area is the inner most area and is considered contaminated or "hot". Within the Exclusion Area, prescribed levels of protection must be worn by all entering personnel. An entry check point must be established at the periphery of the Exclusion Area to control the flow of personnel and equipment between contiguous zones and to ascertain that the procedures established to enter and exit the zones are followed. The Exclusion Area boundary would be established initially based on the type of the pollutant(s)/spilled materials, initial instrument readings, and a safe distance from any potential exposure.

Subsequently, the boundary may be readjusted based on additional observation and/or measurements. The boundary should be physically secured, fenced, posted, or well-defined by geographical boundaries.

The Exclusion Area could be further sub-divided into three (3) separate zones based on their known or potential levels of contamination. This would allow for more flexibility in operations, decontamination procedures, resources, etc. These zones are defined as follows and correspond to the associated Levels of Protection:

Zone A - The area of the greatest contamination potential; area requires highest level of respirator, skin and eye protection. This is a Level "A" personnel protection area. (500 ppm to 1000 ppm)

Zone B - The area of next highest contamination potential; area requires highest level of respirator protection and lower level of skin and eye protection. This is a Level "B" personnel protection area. (5 ppm to 500 ppm)

Zone C - The area where exposure potential, concentration and/or route(s) of contamination are relatively known and are assumed not greater than the protection factor associated with a full face mask air-purifying respirator. This is a Level "C" personnel protection area. (Background to 5 ppm)

Support Area

The Support Area is the outermost area of the site and is considered a non-contaminated or "clean" area. It is designated as a controlled traffic area for authorized support personnel and the location for support equipment (Command Post, Equipment Trailer, etc.). Since normal work clothes are the appropriate apparel within this zone, potentially contaminated personnel clothing, equipment, etc., are not permitted.

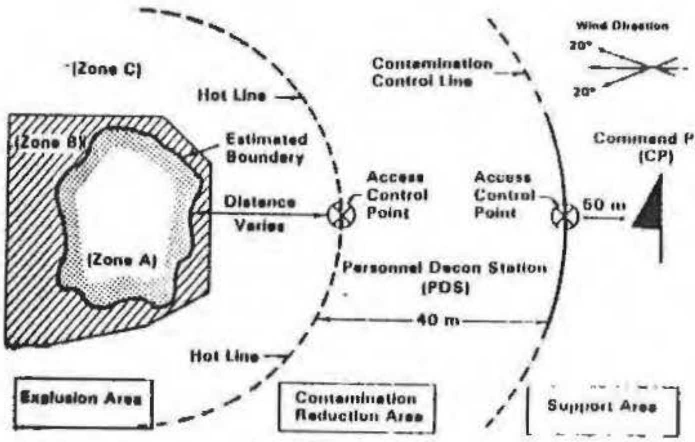
Contamination Reduction Area

Between the Exclusion Area and the Support Area is the Contamination Reduction Area. The purpose of this zone is to provide an area to prevent or reduce the transfer of contaminants which may have been picked up by personnel or equipment returning from the Exclusion Area. All decontamination activities occur in this area.

The boundary between the Support Area and the Contamination Reduction Area is the "Contamination Control Line". This boundary separates the possibly contaminated area from the clean zone. Entry into the Contamination Reduction Area from the clean area should be through an access control point. Personnel entering at this station would be wearing the prescribed personal protective equipment for working in the Contamination Reduction Area. Exiting the Contamination Reduction Area to the clean area requires the removel of any suspected or known contaminated personnel protection equipment and that appropriate decontamination procedures be followed.

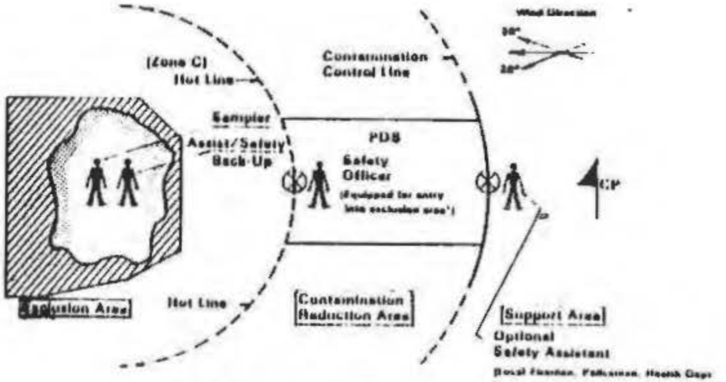
At the boundary between the Contamination Reduction Area and the Exclusion Area is the "Hot Line" and access control station. Entrance into the Exclusion Area requires the wearing of the prescribed personnel protection equipment which may be different than the equipment requirements for working in the Contamination Reduction Area. At a point close to the "Hot Line", a personnel and/or equipment decontamination station is established for those exiting the Exclusion Area. In some cases, another decontamination station is needed closer to the Contamination Control Line for those working only in the Contamination Reduction Area.

Figure 1 illustrates Site Work Area layouts while Figure 2 shows the organization and location of entry team members.



NOTE: Zone dimensions are for illustration purposes only
Zone dimensions will vary on a case per case basis.

Figure 1. Site work areas.



(Local Fireman, Policeman, Health Dept. Person, etc., with radio contact to medical treatment.)

*If a three man team is used safety officer should attempt to have radio contact with medical treatment personnel

Figure 2. Organization/location of entry team members.
(Three/Four Man Team)

Sample Acquisition

Sampling is the physical collection of a representative portion of an environment. A "representative" sample must be collected and handled in such a fashion as to keep it's original physical form and chemical composition, as well as to prevent contamination or changes in concentration of the materials to be analyzed. In other words: it is imperative to insure sample integrity and maintain quality assurance standards for a sample to be "typical" of the larger body of the material of concern.

Because hazardous incidents are so varied, no universal sampling procedures can be recommended. However, if the topics outlined in this text are employed in a sampling protocol, an acceptable degree of uniformity necessary for hazardous incident sampling can be obtained.

The purpose of developing a sampling plan is to detail a "plan of action" so as to meet the above-stated goals. It is imperative to prepare a plan prior to the actual sampling as this will eliminate confusion and save time. Only after the following questions have been answered should an attempt be made to collect samples:

- What is the objective of collecting samples?
- What types of samples are needed?
- Where are the best sampling locations?
- How many and how often are samples required?
- How are the samples to be collected and handled?

When addressing these questions, the following factors must be taken into consideration:

- the topographic, geologic, and hydrologic characteristics of the site; i.e., surface and groundwater, soil types, etc.

- meteorologic conditions; i.e., temperature, air pressure, precipitation, wind velocity, seasonal variations.

- the flora and fauna of the area; i.e., bioaccumulation and biotransformation in the plant and animal life, especially agricultural.

- geographic and demographic information; i.e., population and proximity to site, public health threats.

- physical/chemical properties and hazardous characteristics of materials involved.

These factors and their interactions make up the entire hazardous incident. They spell out the hazard and the risk of the situation. The more of this information obtained, the more that will be known about the movement, transformation, concentrations, dispersion, etc. of the compounds to be sampled, and the easier it will be to answer the questions.

A primary concern during hazardous sample collecting is personnel safety, requiring the use of protective clothing and equipment to minimize exposure to the hazard. It is the use of special collection equipment that presents a problem. There is limited information available and no universally accepted standardized methods for the collection of hazardous samples.

Sampling Equipment

This section of the paper deals with the equipment for the collection and containment of those sample classified as hazardous.

1. Criteria for a hazardous sample collector:

    a) Disposable and/or easily decontaminated. A collection device may not be used again without sufficient cleaning.

    b) Inexpensive - This is a necessity if the item is to be disposed.

    c) Ease of operation - Cumbersome safety clothing and respiratory equipment dictate the use of simple-to-use tools.

    d) Non-reactive. The device must not react with the sample in any such manner as to contaminate it.

    e) Safe. The unit must present no safety threat to the user. Electrical or mechanical tools must be approved as "intrinsically safe".

2. Selection of a Sampler

Hazardous wastes are usually complex, multiphase mixtures of liquids, semisolids, sludges, or solids. The liquid and semisolid mixtures vary greatly in viscosity, corrosivity, volatility, explosiveness, and flammability. The solid wastes can range from powders to granules to big lumps.

The wastes are contained in drums, barrels, sacks, bins, tanker trucks, vacuum trucks, ponds, and other containers. No single type of sample can therefore be used to collect representative samples of all types of wastes. Table 2 lists some of the samplers commonly employed.

Table 2 Samplers for Liquid/Solid Hazardous Materials

Category	Sampler
Liquids, Sludges, Slurries	Open Tube Pond Sampler Manual Hand Pump Weighted Bottle Sampler Kemmerer Sampler Extended Bottle Sampler
Powdered or Granular Solids	Grain Sampler Sampling Trier Trowel/Scoop/Spoon
Soil	Soil Auger

Sample containers will also vary according hto the materials being sampled. If little or nothing is known about the sample body, then glass bottles with Teflon lined caps are to be used.

3. Technique

Another important factor is consistency. Samples are to be obtained using the considerations discussed in this document, employing the same "technique" for each sample. It is also recommended that the same member of the work party collect all the samples of a particular type (e.g., member "A" collects all drum samples, member "B" collects all soil samples, member "C" collects all stream samples, etc.). These practices will ensure that data obtained from sample analyses is representative of the waste sampled, and not a result of erratic sampling.

Decontamination Rationale

As part of the system to prevent or reduce the physical transfer of contaminants by people or equipment from on-site to off-site areas, procedures must be instituted for decontaminating anything leaving the exclusion area and contamination reduction area. These procedures include the decontamination of protective equipment and also the correct method of removing personnel protective equipment to avoid transfer of contaminants from the clothing to the body. Unless otherwise demonstrated, everything leaving the exclusion area should be considered contaminated and appropriate methods established for decontamination or disposal.

Decontamination

1) Washing or a series of washings using a detergent/water solution.
2) Rinsing or a series of rinses using copious amounts of water or,
3) If the contaminating substance is known, rinsing with a solution which will react with the substance and alter its chemical composition, form or solubility. In the Hazardous Incident Response Operations Course a sample procedure and physical layout for personnel decontamination is given. This example is a general procedure assuming the contamination substance(s) is known and illustrates a possible "worst-case" situation. The procedure would be modified if the type of contaminating substance and its hazard potential was known or if the amount of contamination was minimal.

Contaminated Material

The decontamination process uses water and rinse solutions for washing down personnel and equipment. The spent solution, brushes, sponges, containers, stands, etc., used in the decontamination process must, until shown otherwise, be considered contaminated and, therefore, must be properly disposed of.

Personnel equipment that has been worn into the exclusion area and subsequently decontaminated upon leaving the area, may need to be used in subsequent operations; therefore, it should be stored for air drying in the support zone.

The decontamination of equipment, material and personnel used or working in the contamination reduction area may be somewhat less complex than "hot-line" procedures. Exact procedures would depend on the probability of these items being cross-contaminated.

In extreme situation, complete decontamination of personnel protective equipment, instruments, and small items may have to be done in a controlled laboratory situation.

Determining the presence or absence of unknown contaminating substance(s) and the identification and quantification of the substance(s) is a difficult task. To verify the initial decontamination procedures and/or the effectiveness of these procedures, contamination-decontamination testing is necessary.

Since it is virtually impossible to prevent the transfer of contaminants, if present, on protective clothing to the wearer, the mainline of defense is the thorough decontamination of the clothing. When done effectively, the amount of substance remaining on the suit is greatly reduced and the possibility of suit-to-wearer transfer is proportionately reduced.

Consideration must also be given to the protective equipment worn by those personnel operating the decontamination line. In most cases, chemical-protective clothing, boots, and gloves should suffice. Unless it is suspected and/or confirmed that personnel needing decontamination are highly contaminated, air-purifying respirators with suitable cartridges should be worn.

Acknowledgement

The author expresses his appreciation to Richard P. Traver, EPA's Oil & Hazardous Materials Spills Branch, Municipal Environmental Research Laboratory-Ci, Edison, New Jersey; Tom Sell, EPA's Environmental Response Team, Cincinnati, Ohio and EPA's, E&E, ERT-TAT, personnel, Cincinnati, Ohio for their assistance in organizing and editing this paper.

Rcd
9/14/82

United States Coast Guard
Office of the Captain of the Port
New York, NY.

Final Report

Ground Penetrating Radar Survey, Elizabeth River, New Jersey

30 January 1981

RECEIVED

SEP 12 1982

Emergency Response
and Inspection Branch
Edison, N. J.

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2 February 1981

Lt. G. A. Wiltshire
Office of the Captain of the Port
United States Coast Guard
Building 109
Governor's Island, NY 10004

W.O. No. 1157-04-01

Dear Lt. Wiltshire:

Roy F. Weston, Inc. (Weston) is pleased to submit our Final Report on the Ground Penetrating Radar Survey of the Elizabeth River near the Chemical Control Corporation, Elizabeth, New Jersey. Your critical review comments on our Draft Report were most helpful, and they have been incorporated into our Final Report. We are also forwarding to you, under separate cover, a mylar reproducible copy of the target location map.

Should you have any questions, please do not hesitate to contact me.

Very truly yours,

ROY F. WESTON, INC.

Walter M Leis

Walter M. Leis, P.G.
Vice President and Manager
Earth Sciences Department

WML:d

Enclosures

FINAL REPORT:

GROUND PENETRATING RADAR SURVEY,
ELIZABETH RIVER, NEW JERSEY

Prepared for:

United States Coast Guard
Office of the Captain of the Port
New York, NY

INTRODUCTION

The U.S. Coast Guard has engaged Roy F. Weston (Weston) to provide geophysical services to assist in the location of sunken drums in the Elizabeth River adjacent to the Chemical Control Corporation site in Elizabeth, New Jersey. These services consisted of the use of Weston's Ground Penetrating Radar (GPR), Geophysical Survey Systems, Inc., System 8, outfitted for over-water use. The field operations began on Monday, 20 October 1980, were completed by Thursday, 24 October 1980 and were followed by data analysis, report preparation and a project summary map.

The GPR survey consisted of a series of 123 detailed continuous radar traverses run perpendicular to riverflow and shoreline at five-foot intervals. Eleven additional traverses were run parallel to river flow and shoreline at 10-foot intervals. The resultant grid network was laid out on a map of the study area which was then used to map the locations of the drums (or other large submerged metallic objects). The final products are a project summary map (location map) and this report. The report outlines the project background, description and use of the GPR, data analysis and results.

BACKGROUND

Location

The study area was that portion of the Elizabeth River adjacent to the Chemical Control Corporation property in Elizabeth, New Jersey (see Figure 1). The Elizabeth River at this location is tidal with a mean tidal range of 5.2 feet. During the survey the depth ranged between 13 feet at high tide and nine feet at low tide. The river is approximately 120 feet in width, has steeply sloped banks and soft bottom sediments ranging from three to five feet in thickness.

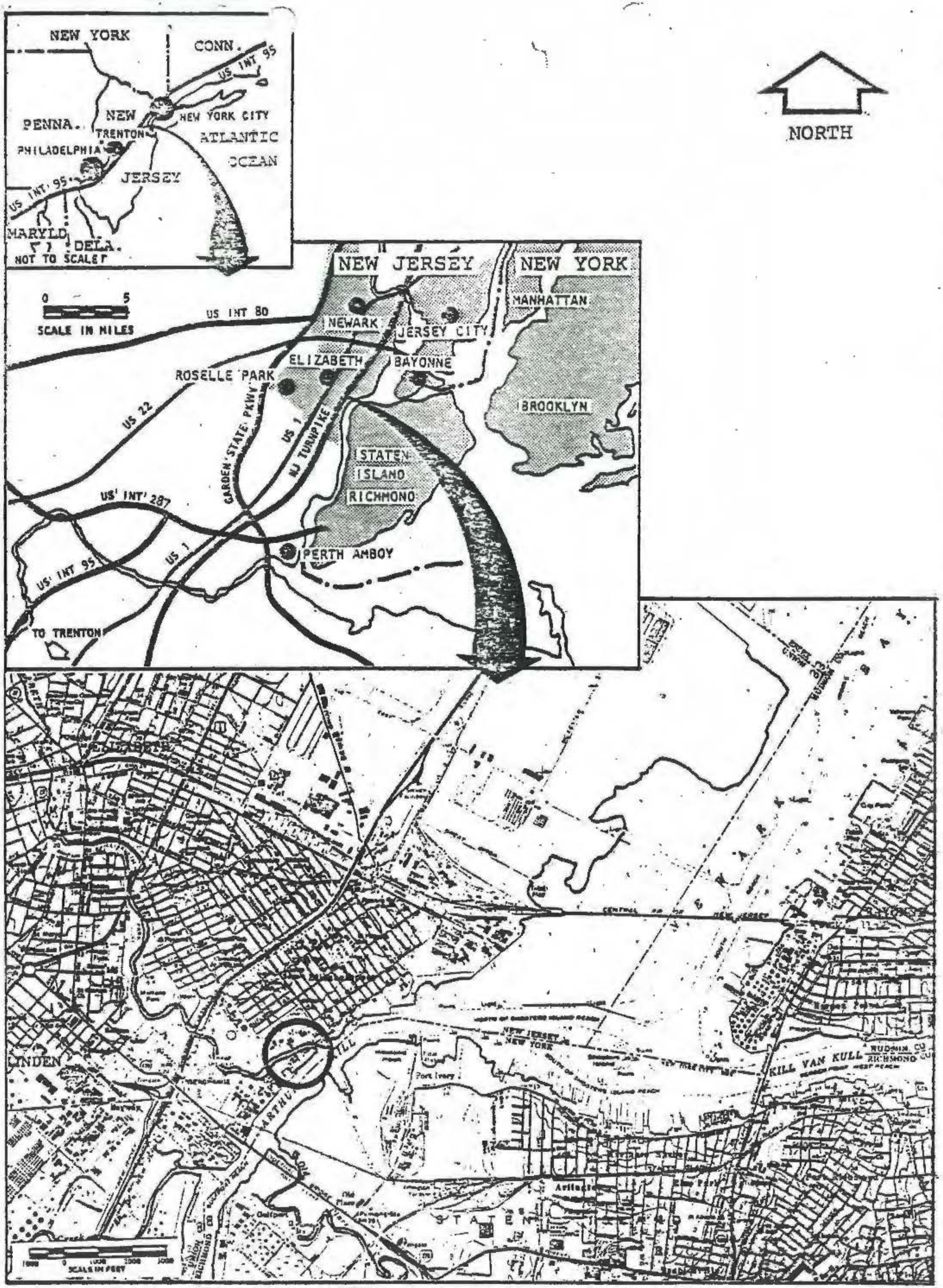

FIGURE 1 LOCATION MAP OF THE STUDY AREA
ELIZABETH RIVER, ELIZABETH, NJ.

Chemical Control Corporation

The Chemical Control Corporation was engaged in the collection, storage and disposal of chemical wastes, some of which were considered toxic and hazardous. The majority of these wastes were stored in drums on the plant site. A spill resulting from leaking drums lead the New Jersey Department of Environmental Protection (NJDEP) to cite the corporation. Cleanup operations were underway under the direction and supervision of the NJDEP when fire broke out in April 1980.

The fire resulted in an explosion which caused the total destruction of the plant and a massive chemical spill from ruptured drums. There were indications that some drums were blown into the river or slumped into the river as a result of the explosion and subsequent fire fighting. Cleanup of the site is underway. However, recovery of the drums blown into the river has not yet begun due to the complications of such an operation and uncertainty as to their locations.

Drum Location Techniques

The first step in the recovery operation is to locate the drums. The only attempt to date to locate the submerged drums was an underwater survey on 18 June 1980 using side-scan sonar. This survey was unable to detect the presence of drums on the river bottom due to the shallow depth of the river. Two alternative recovery techniques were then proposed:

a. The underwater survey using divers. This would necessitate using a totally enlcosed and dry diver's dress. However, the poor visibility in the river would require the divers to work strictly by feel, which could result in puncture of the diving suits and contamination of the divers. The danger to divers posed by working in zero visibility in an environment containing unknown quantities of drums in questionable condition is high, and was, therefore, discouraged.

b. Isolation of the affected area with cofferdams in order to pump out the contained water and then recover the missing drums. This would require two large cofferdams and the pumping of a substantial amount of water, plus the complete disruption of barge traffic on the navigable waterway.

Before either of these alternatives were carried out, other options were sought. GPR was identified as a viable alternative for locating the submerged drums.

For this particular project, GPR is well-suited because it can locate drums or any other strong target, even though they may have been completely covered by sediment, as was strongly suspected in this case.

The one limitation of GPR which was of concern in this project was that high conductivity water would cause the radar signal to be rapidly attenuated. This condition would seriously limit the effectiveness of GPR for this survey. The details of GPR operation are presented in Appendix A.

ELIZABETH RIVER SURVEY

Introduction

The GPR was outfitted for over-water use by placing the antenna in a raft which would allow it to be towed along the traverse lines. The remaining GPR equipment was placed on a boat, provided by the U.S. Coast Guard, which also provided the power source for the equipment. All data was tape-recorded not only for the sake of more rapid data acquisition, but also to provide a permanent record of the data.

Survey Grid System

Before the surveying operation began, a grid system was laid out over the area so that the position of any subsurface targets could be related precisely to fixed reference points. The U.S. Coast Guard had survey stakes placed every 10 feet along both shorelines, not included in USCG rpt.

as shown in Plate 1. These stakes served as fixed reference points for traverses run both perpendicular and parallel to the shoreline.

Perpendicular traverses were run from the southern shoreline to the corresponding stake on the north shoreline. A traverse was made at each stake and between each stake, resulting in a five-foot interval between traverses. A total of 123 perpendicular traverses were made. The position of the antenna along each traverse was marked every three feet using the GPR's internal electronic signal (see Figure 2).

The parallel traverses began on the south shoreline and were made along the entire line of survey stakes. These traverses were made at 10-foot intervals for a total of 11 parallel traverses. The survey stakes acted as antenna position markers along each traverse.

The data acquisition was completed in four days. Playback of the recorded data and the analysis of the data for targets proceeded immediately thereafter.

Data Analysis

Profiles were made of each transect by playing back the recorded data. Data analysis required the review of each transect profile several times. Each review refined the data until all targets were defined. Once identified, the target position was noted on the project summary map. The data was then reviewed for other possible observations and these also were noted on the map.

Results

As a result of this survey, a series of from 150 to 200 submerged targets were identified and are located on the project summary map (Plate 1). Some of the targets displayed the typical signature of a drum which has been passed over perpendicular to the traverse line. Other targets were much more difficult to identify as drums. Some of these could ultimately be identified only as targets. Targets were concentrated near the bank of the Elizabeth River adjacent to the Chemical Control Corporation site.

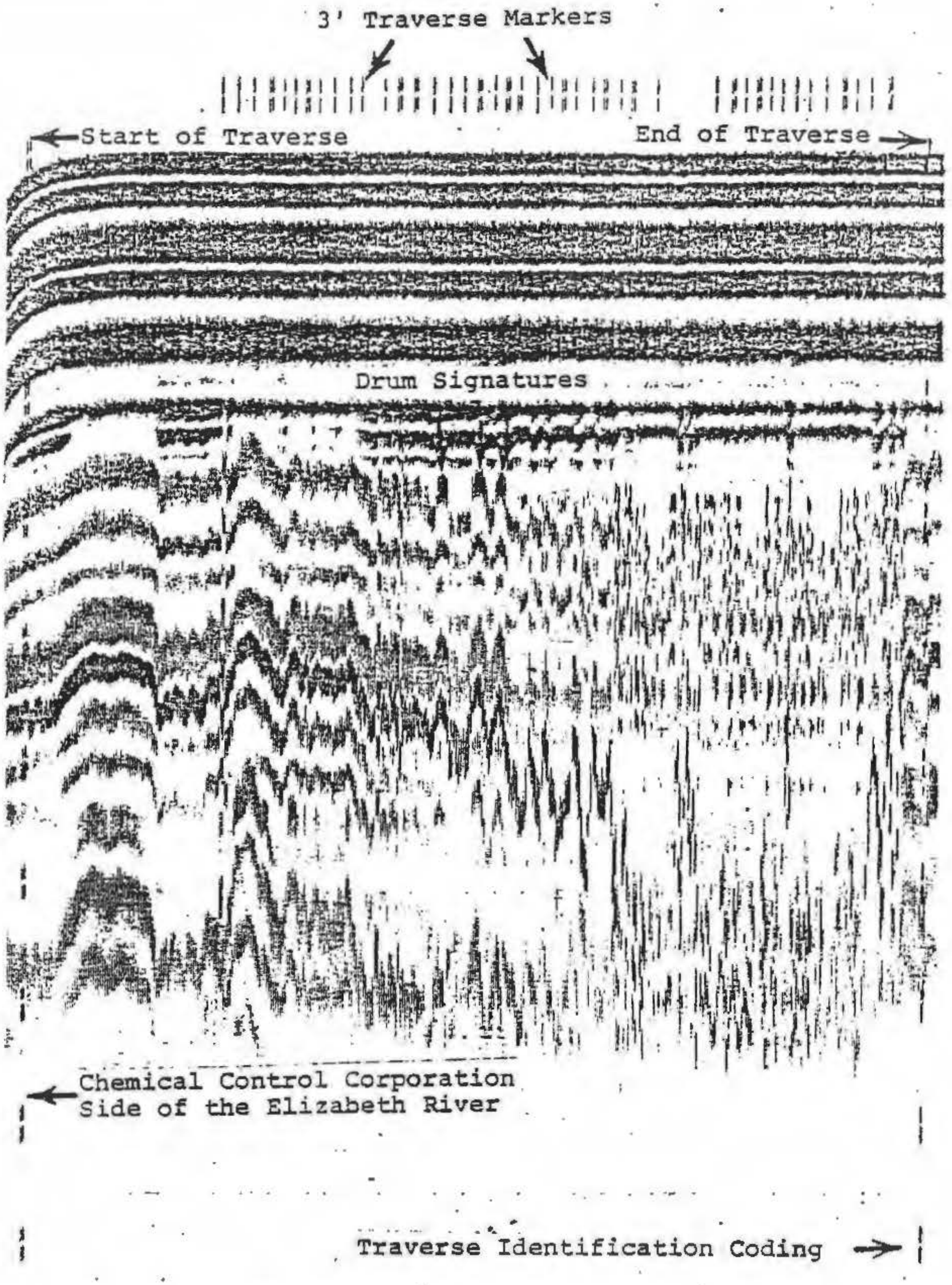

Figure 2: Ground Penetrating Radar Printout for Traverse No. 39.

September-October 1982

Marine Resources
Information 123

A Bimonthly Newsletter of the University of Rhode Island Sea Grant Advisory Service

What Are the Risks of Diving in Polluted Water?

While the rest of the world may think of water pollution in terms of what man has done to our rivers and oceans, professional divers have a different and more personal view. They are increasingly concerned about what working in polluted water may be doing to them.

A recent headline in The New York Times justifies their concern. "City Divers in Hudson Contract Infectious Disease," the headline reads and the article relates that last July, 25 Fire Department scuba divers contracted amebiasis, an infection associated with sewage wastes, while they were practice-diving in the river. Earlier in the year, a sewage plant worker in Queens, New York, died of the disease.

Bacteria-laden sewage is the most obvious but not the only contaminant encountered by those who work under water. Solvents, herbicides, heavy metals, PCBs and radioactive water are a few of the others. In addition to these introduced pollutants, many pathogenic microorganisms, known and unknown, are natural to the marine environment. Six years ago, a virulent marine bacterium, *Vibrio vulnificus*, was identified for the first time.

Because the number of divers working under water is increasing, as are the number of bodies of pollůted water, the health risks to divers are expected to multiply.

"We are obviously on a collision course here with our uses of the marine environment," says University of Maryland Sea Grant director Rita Colwell. "The problem is that this is an unknown area. We simply don't know yet how great the risks are or how best to protect divers against them. We are looking at a totally new field of research."

Among the unknowns are what changes human pathogens undergo in water, how they are affected by temperature, salinity and [illegible] whether toxic

U.S. Navy photo

Oil-smeared diver illustrates one of the hazards of the profession.

chemicals have a synergistic effect on pathogenicity and what drugs are most effective against waterborne diseases.

For the past few years, a number of government agencies and university researchers have been working to pull together what information is available and to produce more. Next month experts from NOAA, EPA, the Coast Guard and the Navy will meet with scientists to assess the hazards of diving in water polluted not only by microorganisms but by chemicals and radioactivity. This is a follow-up of sorts to be the first workshop of its kind, "Microbial Hazards of Diving in Polluted Waters" held at the headquarters of the Undersea Medical Society in Bethesda last year. Proceedings of that workshop, wich was jointly sponsored by NOAA and NIOSH (National Institute for Occupational Safety and Health), Sea Grant Publication UM-SG-TS-82-01, are now available from the University of Maryland.

For those who direct diving operations, one of the greatest vexations is that there are no existing criteria for determining whether an area is in fact polluted to a hazardous degree. William Phoel, a biological oceanographer and dive master at the Sandy Hook, New Jersey, Laboratory of the National Marine Fisheries Service, says "At this point a dive master has nothing to go by but his gut feeling as to whether an area is safe for scuba gear or whether his divers should use a closed system." The latter term describes a completely sealed "dry" suit and surface-supplied air. Because scuba allows considerably more mobility, divers are likely to choose this less cumbersome gear unless they are convinced a real risk is involved. New York City police divers, according to Phoel, still use scuba primarily, even though they dive frequently in polluted waters.

Another problem researchers face is that no one really knows how many diseases have been contracted by divers or how many deaths have occurred as a result of water pollution. Every diver a reporter spoke with knows of at least a few cases, but to date they have not been documented. "I have been following the morbidity and mortality reports of the Communicable Disease Center for the last fifteen years," one scientist says, "and I don't recall any reports pertaining especially to this subject."

William Phoel adds, "It has been observed that people who work with sewage sludge have a high incidence of warts and infected cuts, but most of the information on this is anecdotal." Phoel himself ran a high fever and was ill for several weeks after diving for research in a sewage-polluted area of the Baltic Sea.

Water-borne contaminants are most likely to invade a diver's body through the ears, nose, mouth or skin. "The three main concerns," says Phil Sharkey, dive training instructor at the University of Rhode Island, are to prevent ear and skin infections, prevent aspirating polluted water through the air regulator and making sure that divers are properly cleaned off when they come out of the water."

continued on page 2

continued from page 1

As a result it has become standard practice in well managed operations for divers to plug their ears with cotton, tape their gloves to their suits and stay out of polluted water if they have any skin lesions.

Aspirating even a minute amount of polluted water can be hazardous and preventing it is not easy, according to Dr. J. Morgan Wells, Director of the NOAA Diving Office. "Every regulator we tested permits at least a small amount of splashback which the diver inhales. At NOAA we have developed a series exhaust valve to deal with that."

The importance of completely disinfecting a diver's suit is well recognized but crudely accomplished. NOAA divers use paint sprayers filled with disinfectant. A commercial diver from Marblehead, Massachusetts, takes even greater precautions. "A lot of my work is in sewers," says Jerry Frongillo, "and hosing down the suit with detergent isn't good enough. So I tried taking it to a car wash after I'd scrubbed it, and you should have seen the color of the water that came off. It worked great."

Like other professional divers today, Frongillo has to rely on his own ingenuity in many instances to protect himself from the health risks associated with the job. "Working divers," says microbiologist Rita Colwell, "are today more or less in the category of 'experimental animal' when they enter polluted waters."

But this will not always be the case. Experts from a variety of disciplines have teamed up to develop a set of practical guidelines that will help professional divers protect themselves in a little known environment.

Scientists learn about diving into chemically polluted water

By Bernadette Hearne
Staff Writer

Drums of hazardous wastes buried at sea sometimes leak. Tankers carrying oil and other toxic chemicals sometimes have accidents that release their cargoes into the sea.

When disasters such as these occur, it often is necessary to examine the situation up close and plan the best way of stopping the leak, of cleaning up the hazardous chemicals. Often, those up-close looks require divers to lower themselves into the polluted waters and examine the leaking drums or damaged tankers.

Because diving in waters polluted with hazardous materials is a relatively new field, little equipment has been developed specifically to protect divers from the poisons in which they must swim. So last week, a group of 25 government scientists from across the country converged on Wilmington for a two-week program aimed at training them in advanced diving techniques and helping them pinpoint some of the shortcomings of conventional diving equipment when applied to hazardous waste situations.

"Now that the federal government has new laws — Superfund (for cleaning up hazardous spills) and the Clean Water Act — which commit the government to respond to spills, we find we know very little about diver safety for cleanup," said Michael Heeb, chief scientist for the project.

"We're beginning to ask what do you do with a diver where the chemical can permeate the skin, the rubber of a diving suit, the breathing apparatus itself?" Heeb said. "Inhalation of an aerosol is the second most effective way to inoculate a human (with an infection), next to injection."

Conventional diving gear employs a piece of equipment known as a regulator that allows the air exhaled by a diver to escape into the water. Exhaled air is let out into the water by a tiny diaphragm that opens just enough for the air to escape.

Each time the diaphragm opens, however, tiny droplets of water from outside adhere to the inside of the diaphragm. The next time the diver breathes in, these droplets, and any contaminants mixed with them, are pulled into the diver's lungs as a vapor. Therefore, if a diver is in water polluted with a toxic substance, he can breathe in the toxin and be poisoned.

Clearly, Heeb said, new styles of breathing equipment must be developed specifically for hazardous waste situations.

By bringing some of the nation's top water research scientists together and training them to use the most advanced diving equipment available, Heeb said, it is hoped that they can pinpoint the dangers in existing equipment and recommend improvements.

Beginning about a week ago with two days at the University of North Carolina at Wilmington's diving facilities and continuing for the following two weeks on board the U.S. Environmental Protection Agency's *Ocean Survey Vessel Antelope*, Heeb said, scientists and divers with the U.S. Navy, U.S. Coast Guard, EPA, UNCW and the National Oceanic and Atmospheric Administration are starting that work.

Wilmington was chosen as the departure point for the *Antelope*, Heeb said, because the university's outstanding diving facilities on campus and proximity to the ocean gave divers a chance to practice with their equipment in a controlled environment before diving in the open ocean.

Antelope was tied up at the N.C. State Ports dock for three days before setting sail for Miami, Fla., early Tuesday morning.

Jim Patrick, diving officer for the EPA Gulf Breeze (Fla.) Laboratory said the six participants from that facility are particularly interested in conducting research in contaminated waters.

"Using divers is the only way you can properly take certain kinds of samples — for example, for determining the levels of oxygen content in sediments," Patrick said. "We're being trained for hazardous waste water diving, decompression chamber operations, diver accident response and use of mixed gases. Some of the people here actually will be responding to accidents, but we're being trained for research.

"This is really a good thing, a pretty incredible thing. Those of us who are here feel really lucky to be a part of it."

Staff photo by Dan Sears

Aboard the 'Ocean Survey Vessel Antelope,' Jim Patrick explains how underwater gear works.

Mobil Technical Bulletin

Toxicity of Petroleum Fuels

Petroleum fuels* are not classed as highly toxic materials, but certain precautions are recommended in their handling to prevent adverse physiological effects. Human exposure to petroleum fuels can take place in three ways:

1. Inhalation of vapors or mists,
2. Skin or eye contact with the liquid product, and
3. Ingestion of the liquid product.

Inhalation

The vapors of petroleum fuels are less toxic than most of the solvents used in industry. If, however, the vapors are inhaled for a sufficient length of time and in sufficient concentration, they are capable of causing symptoms of mild intoxication, anesthesia and, in some cases, more serious symptoms. Even short exposures to high concentrations frequently result in headache, dizziness, and nausea.

Exposure to vapors of gasoline has been well investigated, and the Threshold Limit Value (TLV) for a daily 8-hour exposure has been proposed by the American Conference of Governmental Industrial Hygienists at 300 parts per million (ppm) parts of air. The Threshold Limit Value is the time weighted average concentration for a normal 8-hour workday or 40-hour workweek to which, it is believed, nearly all workers may be repeatedly exposed without adverse effects.

Some localities have adopted exposure limits other than the 300 ppm TLV and it is advisable to become aware of local requirements when using petroleum fuels in the workplace. For safe handling, therefore, as regards human exposure to vapors, the exposure of the worker should be maintained below 300 ppm on a time-weighted average over an 8-hour workday. If large quantities of petroleum fuels are used, it may be necessary to install adequate local exhaust ventilation to maintain a safe working environment.

Other fuels — such as heating oil, diesel fuel and residual fuels — are much less volatile and, usually, there is little or no vapor exposure at room temperatures. However, if end use results in the generation of vapors or mists where inhalation is possible, care should be taken to prevent overexposure.

Skin Contact

Petroleum fuels can dissolve the natural oils from the skin and, on repeated and prolonged contact, may cause skin irritation. Persons sensitive to petroleum hydrocarbons may develop dermatitis on exposure to petroleum fuels. The composition of petroleum fuels varies among products. Fuel oils, including residual fuels, may contain polycyclic aromatic hydrocarbons (PAH), some of which have been shown to cause skin tumors in laboratory animals.

To prevent adverse skin effects, good personal hygiene practices usually are adequate, such as avoiding contact as far as possible and, where contact is unavoidable, washing the exposed parts with mild soap and warm water and thoroughly cleaning contaminated clothing before reuse. If prolonged and repeated skin contact is unavoidable, the use of gloves is recommended. If gloves are impractical, solvent-resistant barrier creams may provide some protection.

A type of skin contact resulting in serious injury, but which fortunately occurs infrequently, is a penetrating injury caused by fuel oils under high pressure. High pressure injection of a petroleum product into the flesh causes serious tissue destruction, infection, and foreign body reaction. Such injuries require immediate hospital treatment.

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*Includes gasoline, kerosine, naphtha, heating oil, jet fuel, diesel fuel, and residual fuels (No. 4, 5, 6, and Bunker C).

copy in Scrapbook

Eye Contact

All petroleum fuels are somewhat irritating to the eyes on contact with the liquid or mist. If contact occurs the eyes should be washed out promptly with copious amounts of lukewarm water for at least 10 to 15 minutes. Should irritation persist, medical treatment is advised.

Ingestion

Ingestion of petroleum fuels is not common and the few cases experienced usually have been in young children. The acute oral toxicity (in the stomach) of petroleum solvents is relatively low, on the order of 5 to 15 g/kg of body weight as determined through experimentation with rats. However, the toxicity of low viscosity, liquid hydrocarbons aspirated directly into the lungs is many times greater than the acute oral toxicity — some 200 times more toxic. Aspiration into the lungs may cause serious pneumonitis with extensive pulmonary edema and hemorrhage, and may be fatal.

Accordingly, vomiting should not be induced. Vegetable oils diminish the rate of absorption of low viscosity petroleum products from the gastrointestinal tract and also tend to prevent aspiration. Other suitable diluents are ice cream, butter, or cream. Passage of stomach tubes for gastric lavage should be performed only by physicians if large quantities of petroleum fuels have been consumed.

Summary

In view of these facts, it is recommended that the following precautions be observed in the handling of petroleum fuels:

1. Avoid prolonged and repeated contact with skin.
2. Where contact is unavoidable, use protective clothing when practical (solvent-resistant aprons, gloves, etc.).
3. After contact with skin, wash thoroughly with mild soap and water.
4. Remove all clothing wet with fuel, thoroughly clean before reuse.
5. Avoid prolonged breathing of vapors or mists.
6. Petroleum fuels splashed into eyes should be flushed out with copious quantities of water.
7. If swallowed, do not induce vomiting — give vegetable oil, ice cream, butter, or cream and seek immediate medical treatment.

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Ocean-dumping protests put heat on industry

DEP reviewing plant discharges after Greenpeace demonstration

By GORDON BISHOP

Public protests this past week over pipeline discharges of chemicals into the Atlantic Ocean just off the Jersey Shore have prompted state environmental officials to start pressing industry to reduce and eventually eliminate hazardous wastes generated at their plant sites.

A demonstration by Greenpeace, a marine activist group, at a Toms River chemical plant is resulting in a review of ocean discharges by the State Department of Environmental Protection (DEP), The Star-Ledger has learned.

Dennis Hart, the DEP manager responsible for reviewing the operations of the Ciba-Geigy plant, said his office is "thoroughly examining" the permit that allows the company to discharge four million gallons a day of waste water containing traces of various chemicals and heavy metals into the ocean 2,500 feet from the beaches of Ortley and Lavallette.

The ocean disposal permit technically expired in 1980, but the U.S. Environmental Protection Agency (EPA) has been approving the application on a year-by-year basis.

"So far, Ciba-Geigy has been substantially within its discharge limits for those substances listed in its permit," Hart disclosed.

"What we're striving for, however, is a reduction in the amount of materials discharged through the pipeline and, eventually, their elimination," the DEP official said.

The department is examining the application as part of the annual review. Hearings on the draft permit are being scheduled for September.

Hart said the thrust of the review will be the development of a "toxicity reduction program." The ideal situation, he said, is "to reduce—or eliminate" the sources of the problem.

State and federal environmental authorities, he noted, have been satisfied that Ciba-Geigy had been complying with standards for that method of ocean disposal.

A manufacturer of chemicals for medical and general industrial uses, Ciba-Geigy has invested more than $30 million in the Toms River plant during the last two decades to comply with changing environmental regulations, according to Jack Harvey, a company spokesman.

In 1966, a 3,500-foot-long, 28-inch diameter pipeline was installed by the chemical company to clean up the Toms River. That pipeline, however, became the focus of a Greenpeace protest lask week.

The pipeline was designed by Dr. James Carpenter, an oceanographer with Johns Hopkins University, to prevent disruption of the marine environment from 2,500 to 3,500 feet from the Ocean County shoreline. Toms River is the seat of Ocean County.

Carpenter designed the pipeline with 50 "discharge ports" along the last 1,000-foot stretch of the line. The four million gallons a day of liquid wastes flowing through the pipeline are dispersed through the four-inch ports, allowing greater assimilation by the moving ocean currents, according to Harvey.

"There is no hole at the end of this pipeline," Harvey noted.

Greenpeace divers tried to plug up the dispersion holes last week. They managed to plug two of the holes, which were later unplugged by Ciba divers.

In addition to the dispersal pipeline, a multi-million dollar advanced treatment plant was built by the company to treat the industrial wastewater before discharge. The plant, which employs 1,100 persons, treats at an efficiency of 95 percent, which is 5-10 percent higher treatment than that provided by the best public sewage systems, state records show.

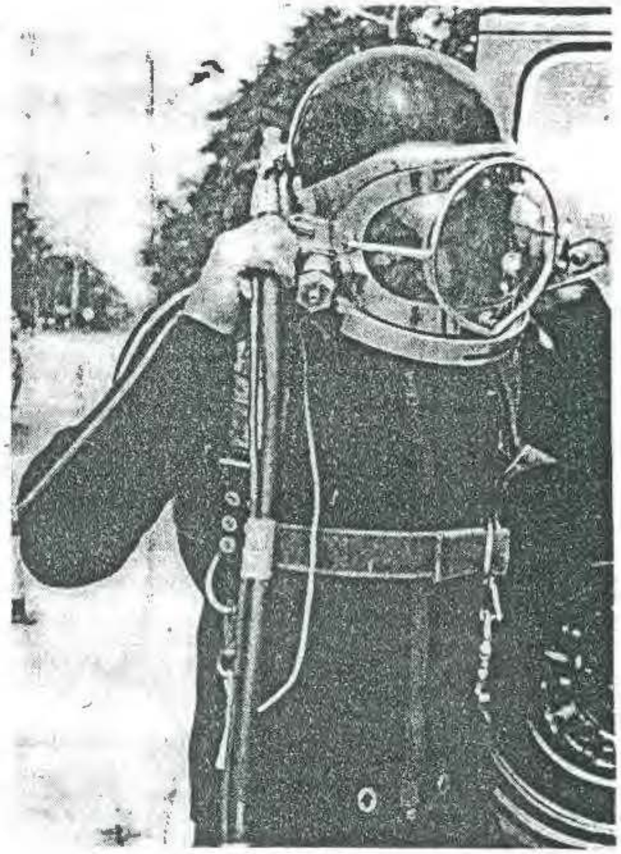


Photo by Harvey L. Bilker

Jeff Bushenell suits up in diving gear as he prepares to descend into a manhole at the Ciba-Geigy plant in Toms River

Among the wastes discharged into the pipeline are copper, chromium, mercury, lead, nitrobenzene, chlorinated hydrocarbons and other synthetic substances. The DEP permit contains about 200 substances, some of which are highly toxic.

Records reveal that the discharges are within one-third to one-half of the maximum allowable under the law.

Company officials maintain the treated effluent entering the ocean is "not harmful."

"We do marine biological studies and take daily samples," Harvey said. "We do weekly analyses of the samples and submit reports regularly to the Department of Environmental Protection."

Since Congress enacted the 1981 Ocean Dumping Ban, EPA has been phasing out disposal of industrial wastes at sea. The federal agency is currently working with industry to recycle their wastes and end ocean dumping permanently by the early 1990s.

THE PULSE OF THE SEA

A Monthly Letter From Jacques-Yves Cousteau,

president, The Cousteau Society

Time Bomb in the Mediterranean

In the passageway between the Adriatic and Mediterranean seas, three miles from the Italian shoreline, rests a sunken freighter and its cargo of deadly tetraethyl and tetramethyl lead. These compounds—if swallowed or even absorbed through the skin—prey on the nervous system, causing delirium, insanity, and death. Ever since the ship sank two years ago, Italy and Yugoslavia have bickered over their responsibilities and have discussed—but have yet to take—corrective action. Meanwhile, only 320 feet below a buoy that marks the wreck, 900 drums of lead toxin are slowly corroding aboard the ship. Others list freely on the ocean bottom, ready to be tossed or carried along to shore by the ominous swell raised in winter during the impetuous *Libeccio* storms.

The story is not just one more instance of environmental carelessness. Nor is the issue one of mere conservation. The controversial drums are filled with death asleep . . . an exemplary case of delayed murder where the self-indulging criminals are blessed with scandalous immunity.

The *Cavtat*, a Yugoslavian freighter, had left England in the summer of 1974 loaded with 600,000 pounds of poisonous—and combustible—cargo. When the ship reached the entrance to the Adriatic, bound for Rijeka, Yugoslavia, it was rammed by a Panamanian freighter about five times heavier. All 30 *Cavtat* crewmen were saved. The ship itself and its deadly cargo, however, settled to the bottom. There it rests, 404 drums of lead compounds stored in the hold, and another 496 drums trapped under rigging, lashed to the deck, and tossing about on the ocean floor just three miles off the coast of Otranto, an Italian resort and fishing town.

What these poisons will do to the sea life and to the people of Otranto—or, for that matter, to the people of all Italy, Yugoslavia, Greece, and Albania—we can only guess. Lead tetraethyl and tetramethyl, used as anti-knock additives in gasoline, are the pollutants present in automobile exhaust. Both the U.N.'s Intergovernmental Maritime Consultative Organization and the National Academy of Sciences in the United States have ranked these compounds among the most lethal of chemical poisons. When dispersed in seawater and metabolized in the fish we eat, the lead compounds can cause insomnia, emotional instability, and hallucination. Severe poisoning—should a drum leak in the hands of a diver or should children play close to a barrel washed up on the beach—will cause convulsions, insanity, coma, and death. The most effective treatment is repeated doses of barbiturates for sedation.

The compounds are stubborn as well; nature and her seawater can do little to change their biological structure. They are insoluble in water. Although heavier than water, they can be carried away by currents. Their deadliness cannot be neutralized by sunlight, which only changes the compounds to triethyl lead, also poisonous.

The extent of damage this cargo will do, then, depends greatly on the hydrodynamics of the Strait of Otranto. Officials of Associated Octel, Ltd., the British manufacturer of the compounds, hopefully say that the zinc-sprayed steel drums will corrode so slowly that the toxins will leak out little by little, only to be swept away by currents and lost in the "magnitude of the seas." They say free-swimming organisms, sensitive to deadly changes in their environment, will leave the vicinity quickly . . . as if planktonic creatures could make such decisions!

Such statements, based only on wishful thinking, are aimed at reassuring the public; but to reassure the public in the case of serious threats of lead, mercury, or radioactive poisoning is to conceal direct attacks on the very life of future generations. It is the most hypocritical, revolting kind of murder I can think of.

This kind of false assurance ignores the fact that currents that can scatter toxins can also scatter whole barrels of toxins—washing them only three miles to Otranto; or, worse, conveying a stream of death thousands of miles to some unsuspecting shore. The sea is a capricious magician; not long ago, pesticides originally sprayed in Africa turned up in waters in northeastern India, more than 4,000 miles away.

Should the poisons remain on the bottom, they could infect an area with toxins fatal to marine creatures—an especially gruesome prospect in only 320 feet of water. Although this depth is difficult for divers, it is shallow, considering aquatic life and food production. The danger area is part of the continental shelf, the most fertile portion of the seas, which represents less than 8 percent of the ocean surface and only 1/200 of all our waters. The ruin of even a little aquatic farmland is a very serious matter.

After killing off life on the ocean floor, the lead compounds, in low concentrations, would be metabolized by algae, whether growing on the bottom or drifting by as part of plankton. The poison would then progress right up the food chain, from tiny crustaceans, worms, and larvae to fish, every link concentrating the poison until it ends up on our forks.

The amount of time we are left with to eliminate the eventuality of tragedy depends on the corrosion of the drums. An official of the Environmental Protection Agency in the United States estimates that the barrels could corrode in less than 10 years.

Whether metabolized by fish or washed into the ocean, the lead compounds are little less than a poisonous time bomb, its detonator delayed but still set to go off.

WHAT HAS BEEN DONE about it? When the *Cavtat* sank in July 1974, Italian authorities claimed that the ship was in international waters and, therefore, was not their responsibility. The Yugoslavian ship owners—the Atlatska Ploridba company—claimed that the cargo was only a potential pollutant, not an interference to navigation, and thereby not in violation of international law. Since that time, the two nations have agreed to work together in deciding whether the cargo should be lifted. In October 1975, they sent a Yugoslavian research ship to inspect the wreck. The governments are now studying the results.

Trying to find out what those results are is almost as nerve-racking as trying to retrieve the poisons. An official of the Italian Embassy Commercial Office in the United States says, "Nothing has been ascertained. The Italian authorities are looking to see what they should do. We do not know what they will do." The press attaché at the Italian embassy in Washington had never even heard about the wreck, much less about the results of the inspection.

GESAMP, a group of expert scientists and engineers that advises the United Nations, was unofficially asked, in the summer of 1974, about the severity of the situation. One of the toxicologists thought that tapping the barrels was much too dangerous; others wondered whether the vessel should be left alone because of the unstable nature of lead and the hazard to divers. The group never gave an official recommendation, and the matter was left pending.

Now, however, almost two years later, one GESAMP expert declares that the Italian government has had enough time to minimize the dangers and is "sitting on its hands." One EPA official suggested that the materials could somehow be chemically gelled, then skimmed off the waters. Another scientist said the drums could be retrieved by workhorse submersibles—machines that can thread a needle under water by remote control, according to one oceanographer. However farfetched these elucubrations may seem, says an expert at Texas A&M, solutions are well within the reach of science. They call only for an expenditure of human brainpower and money.

Neither brainpower nor money seems to have been applied in two years' time. Blaming these particular governments, blaming the ship owners, blaming the manufacturers, or otherwise finding fault for a *fait accompli*, however, provides us with no answer at all. The *Cavtat* is not the first ship to go down, nor will she be the last. Only recently, the *Berge Istra*, a mammoth ship designed to carry ore and oil, vanished in an instant after several explosions on board—even though she had won a 100 A1 certificate of seaworthiness, the highest rating by the Norwegian insurance companies. That she was carrying no oil was a matter only of circumstance, not of environmental wisdom or forethought. Accidents cannot be avoided; the pollution they cause could be.

The lead compounds of the *Cavtat* will be "swept away," not to vast, bottomless waters, but to a sea bounded on all sides—a sea with a floor and without an outlet. There, the compounds will mix with the arsenic, the tar, the oil, the DDT, the sodium chloride, the nuclear wastes, the obsolete war gases, and all the other refuse we dump into what is becoming our international septic tank. The water we all depend upon for life itself is, ironically, becoming a deadly poison.

THE ONE PERVASIVE, almost wistful question in the *Cavtat* case—to whom do we turn?—cannot yet be answered by internationally enforced regulations. Such global restrictions have only been outlined. In 1973, participants in an International Convention for the Prevention of Pollution by Ships discussed dangerous-goods codes. Those codes are not in effect; our countries have yet to ratify them. Authority on the seas remains nebulous. Working documents of understanding are not binding. We rationalize and minimize the dangers of polluting our water. And the most aberrant event of our times is that the so-called Law of the Sea Conference is about to surrender its responsibilities to the caprice of dozens of "sovereign" nations, just when the vital necessity of a single set of rules for all the waters of the world has become obvious.

In the meantime, executives of the Club Méditerranée, which has a resort in Otranto, have asked about potential dangers posed by the sunken *Cavtat*. "We had to reassure them," said an Italian official, "and last summer we had our best tourism season yet." His statement is chilling when compared with a comment made by a chemical engineer with extensive experience in the field of hazardous chemical transportation. "Tell me where the *Cavtat* sank," he said. "I'm not going within a mile of that wreck."

I wonder how long it will be before the mothers of the world will revolt against the lightness with which the fate of their children is dealt. Let us hope that the drums of the *Cavtat* will not soon beat an Apocalyptic march.

The Cousteau Society

- Lakeland, Fla., March 28, from 10 A.M. to 10 P.M.: the first "Involvement Day" for the Alabama, Georgia, and Florida members of The Cousteau Society, an event filled with informative activities and important discussions, as well as continuous entertainment. Next "Involvement Day": in California, at the end of May!

- The Board of Advisors of the Society met for the first time in New York on February 26. Board members attending included Prof. H. Kendall, MIT; Dr. K. O. Emery, Woods Hole; Prof. H. S. Thayer, CUNY; Roger Caras; John Denver; Prof. E. Wenk, U. of Washington; Dr. H. Edgerton, MIT; Dr. G. Nahas, Columbia.

- The Society's research ship, *Calypso*, has made important undersea archeological discoveries in the waters of Greece. It has located antique wrecks and a submerged harbor along the desert island of Dia, off Crete, probably the main commercial harbor of Knossos. Undersea and land excavations are planned to determine the extent and the origin of the various human settlements that existed on the island for 5,000 years.

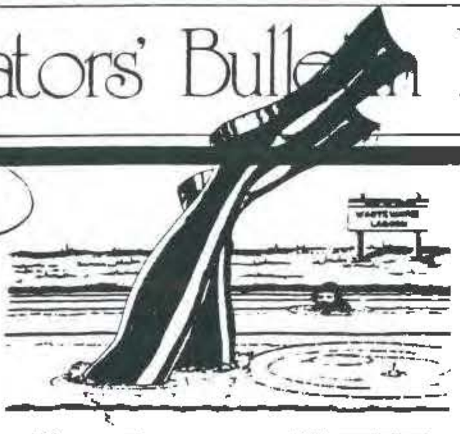
The Society's seaplane, a PBY Catalina piloted by Philippe Cousteau, has made extensive diving explorations around the island of Coco and in the lagoon of Clipperton Island, both in the Pacific. An expedition to Easter Island is also planned.

A new color videotape system is to be installed inside the Society's exploration submarine, the well-known *Diving Saucer 350*. ☐

5/10/83 To: Wilder/Freestone
From: Ron Hill 5/5/83

From: WATER POLLUTION CONTROL FEDERATION
HIGHLIGHTS April 1983

Operators' Bulletin Board



Divers in the Lagoon

Most folks find it hard to believe that Northwest Underwater Inc., a successful commercial diving operation, is located in Whitefish, Montana. These divers obviously don't dive in the ocean much, and, surprisingly enough, they don't spend a lot of time in lakes or streams either. "About 80% of our jobs involve repairing aerated lagoon systems for towns and companies . . .," according to Shag Scheidecker, senior dive officer for the company.

Shag operates the business with two other divers, John Hereen and Diann Ferris. Diann is one of the few working woman divers in the country. The three divers together boast over 40 years of diving experience, and they are skilled in many aspects of commercial diving including underwater bridge construction, dam inspections, welding and cutting, pipe laying, salvage, and so on.

The interesting thing about these divers, is the water in which they do the majority of their work. It turns out that they are among a very few people who find it reasonable to swim in wastewater. It is amazing that they are able to work in the total darkness at the bottom of a lagoon and get the job done.

You probably know of someone who has taken an unplanned dip in a clarifier or a wastewater lagoon, but these divers' swims are planned, very well planned. The divers wear astronaut-like dry suits that completely protect them from the hostile wastewater environment. They go through an extensive decontamination process after each dive and they are given frequent physical exams. "No one has ever been sick," explains Shag. "We've had jobs diving in fluids that are a lot more offensive psychologically than wastewater."

Last winter, the town of Eureka was having problems with the aeration equipment in their lagoons. Ice on the lagoons was causing the problems and someone was needed to go below the surface and fix the equipment. This summer another lagoon, in Polson, was clogging up with algae. They also needed a crew to pull out part of the aeration system and make necessary repairs. In each case the crew was Northwest Underwater. The latest lagoon sytem repair completed by these adventurous divers was done under the ice in the Whitefish lagoons. Shag describes how he got cramps in his arms pulling himself along the air lateral pipes in the bottom of the lagoon. "The sludge was so thick that we couldn't get a bucket full of lead to sink in it."

There's a certain amount of snickering when Shag tells people what he does for a living, but making better than $40.00 an hour, he can swallow a lot of ridicule and laugh all the way to the bank. "It usually runs about $1000.00 a day for services of all three divers," according to Shag. "Most jobs take about 4 to 5 days. In many instances, folks have found that it is much less expensive to have us troubleshoot, retrofit, or repair a system, than the traditional pumping and refilling methods used."

Northwest Underwater Inc. has been providing its unique services for Montanans for about 3 years now. They work at diving full-time. For futher information contact: Northwest Underwater Inc., P.O. Box 1773, Whitefish, MT 59937; telephone (406) 862-5931.

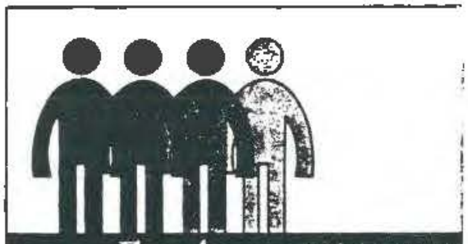
This article originally appeared in the Winter 1982/1983 issue of the Big Sky Clearwater, published by the Water Quality Bureau of the Montana Department of Health and Environmental Sciences in cooperation with the Montana Section AWWA and the Montana Water Pollution Control Association.

Quiz Answers

1. (*d*); **2.** (*a*); **3.** (*a*); **4.** (*a*); **5.** (*a*); **6.** (*a*); **7.** (*b*); **8.** (*b*); **9.** (*c*); **10.** (*c*); **11.** (*d*); **12.** (*d*).

POSITIONS AVAILABLE

MAINTENANCE TECHNICIAN. An upstate New York municipality seeks aggressive, hard-working individual with experience in electrical and mechanical equipment maintenance and repair. Ability to repair large pumps, motors, controllers, and compressors is a must. The person qualifying for this position will be responsible for the supervision and maintenance of all electrical and mechanical systems within the municipality's wastewater department. Excellent fringe benefits program. Salary negotiable depending on qualifications. Send resume, in confidence, to: William Szawranskyj, Commissioner of Public Works, Town of Webster, 1000 Ridge Road East, Webster NY 14580.



Employment Service

DEEDS & DATA offers this free listing of positions available or wanted and limits it to openings in the field of treatment plant operations only. (Paid ads for other jobs are accepted by the WPCF Journal; write to the Advertising Manager for rates.) If desired, listings can be run as blind ads with assigned box numbers; replies will be forwarded unopened. Ads will be run in the order received on a space available basis and will run once only unless otherwise requested. Closing date is the 1st day of the month preceding issue. Send ads to DEEDS & DATA, Water Pollution Control Federation, 2626 Pennsylvania Avenue, N.W., Washington, D.C. 20037.

POSITIONS WANTED

Operations/Surveillance. W.Va. Class I-S certified operator with operator training. Seeking position in education, regulatory, or consulting/planning. MS degree with 5+ years experience in planning, construction, and operator training. Considerable experience with small flows. Numerous published papers and manuals. Richard G. Weigand RS/MS; 817 17th St., Vienna, WV 26105

Wastewater Department Supervisor. Seeking department supervisor with minimum Class B Oklahoma certification, 5 years extended aeration plant experience, and 3 years supervisory experience. Population 15 000. Salary $14—18 000. Reply to: City of Miami Utility Department, Box 309, Miami, OK 74354.

OPERATOR. Iowa Grade 3 operator seeks operator position. Experience in Bio Spiral plant, knowledge of anaerobic sludge operation. Familiar with chlorine equipment. Willing to obtain other state equivalent grades. Dennis Betken, RR 5525, Spirit Lake, IA 51360.

OPERATOR. Certified wastewater treatment plant operator (Md.) with continuing education credits from Cal State and WSSC seeks work in the D.C., Maryland, or Virginia area. Experience with 5-mgd trickling filter plant with sludge removal. Also in activated sludge. Duties included O&M. Winner of individual safety awareness award. Charles C. White, Jr., 844 51st St., S.E., Washington, DC 20019

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NEW YORK TIMES
JULY 25, 1982

Bug nips training of scuba firemen

By VINCENT LEE and DON SINGLETON

Fire Commissioner Charles J. Hynes has halted the training of a scuba team because 15 of 42 firefighters who swam in the Hudson River last month fell ill with a disease that has been identified in four cases as amebiasis—a potentially dangerous infection caused by an intestinal parasite found in polluted water, the Daily News learned yesterday.

It also was learned that the disease claimed the life of a city sewer treatment plant worker last winter.

As a result of that death, the Environmental Protection Department has begun a program of testing 800 to 1,000 workers in its 12 sewage treatment plants, officials acknowledged.

MEANWHILE, TWO cops from the Police Department scuba team who participated in the Fire Department's training sessions reportedly have come down with symptoms similar to those suffered by the 15 firefighters.

The cops, the 15 sick firefighters and the remaining 27 firemen have been placed on sick leave and ordered to undergo testing.

The Fire Department's exercises were held July 14-16 off Pier A in the Hudson not far from the World Trade Center, department officials said.

Although sewage from the center is carried to a treatment plant, raw sewage is discharged into the Hudson from Canal St. to the northern tip of the island. River currents carry the sewage out to sea.

THE DEPARTMENT of Environmental Protection denied that the apparent cluster of cases of amebiasis is a cause for great concern. "By the time the raw sewage gets down to the Trade Center, it is so diluted that it's probably not dangerous," said spokesman Andrew McCarthy. "We regularly test the water off the World Trade Center, and the bacterial levels are low, indicating that the sewage has been diluted."

The DEP employe who died of amebiasis was identified as Anthony Pino, 49, who was assigned to the Jamaica Sewage Treatment Plant. Sources in the DEP said Pino fell sick in June of 1981 and succumbed in late December.

When the firemen began falling sick with vomiting, diarrhea and rashes, and several of them were diagnosed as having amebiasis, Hynes was notified and issued his order.

For Divers, A New Suit To Work In

By David Kishiyama
The Los Angeles Times

LIKE AN OLD SOLDIER who fades away, the Mark V hardhat diving equipment is slowly being phased out of the Navy. And with it is going a whole breed of "death-defying, hairy-chested deep-sea divers."

The last Navy class to be trained with the venerable Mark V, familiar even to those who will not go near the water, graduated in April. Those 20 eager young divers, newly qualified at the Naval Amphibious School in San Diego, represent the end of an era.

Weighing in at 198 pounds and as cumbersome as it is heavy, the Mark V gear often required a sailor with more brawn than brain, someone with a "Size 2 white hat and a Size 65 chest," according to diver Wes (Lurch) Seals, a tall and sinewy machinist mate and senior chief diver at the Naval Station.

"If you can dive in the Mark V, you can dive in anything," said Lt. Jim Cosper, head of the Navy diver school in Coronado, across the bay from downtown San Diego. "But now we've got the new technology, including new diving rigs, hydraulic-operated tools and equipment. And there's even a new class of salvage ship, the ARS-50, which is now under construction. We have to improve and go with the times."

"The days of the death-defying, hairy-chested deep-sea diver are gone," said Jimmy Medley, an amply tattooed instructor diver on his second tour of teaching. "Until a few years ago, the Mark V was the only piece of equipment with the necessary depth capability. Now we've got all this new gear," Medley, an engineman chief from Port Angeles, Wash., said.

Some of the old-timers at the diver school lamented the passing of a glorious era of deep-sea diving represented by the Mark V. With its distinctive bubble helmet and four small portholes, the Mark V has been the symbol of deep-sea diving since the turn of the century.

"The Mark V was like an old Ford," said diver instructor Jerry Henson, a boiler technician senior chief and the master diver of the school. "It's like a car you've lovingly taken care of for years, driven for years, repaired for years, grown up with for years, and then your wife sells it."

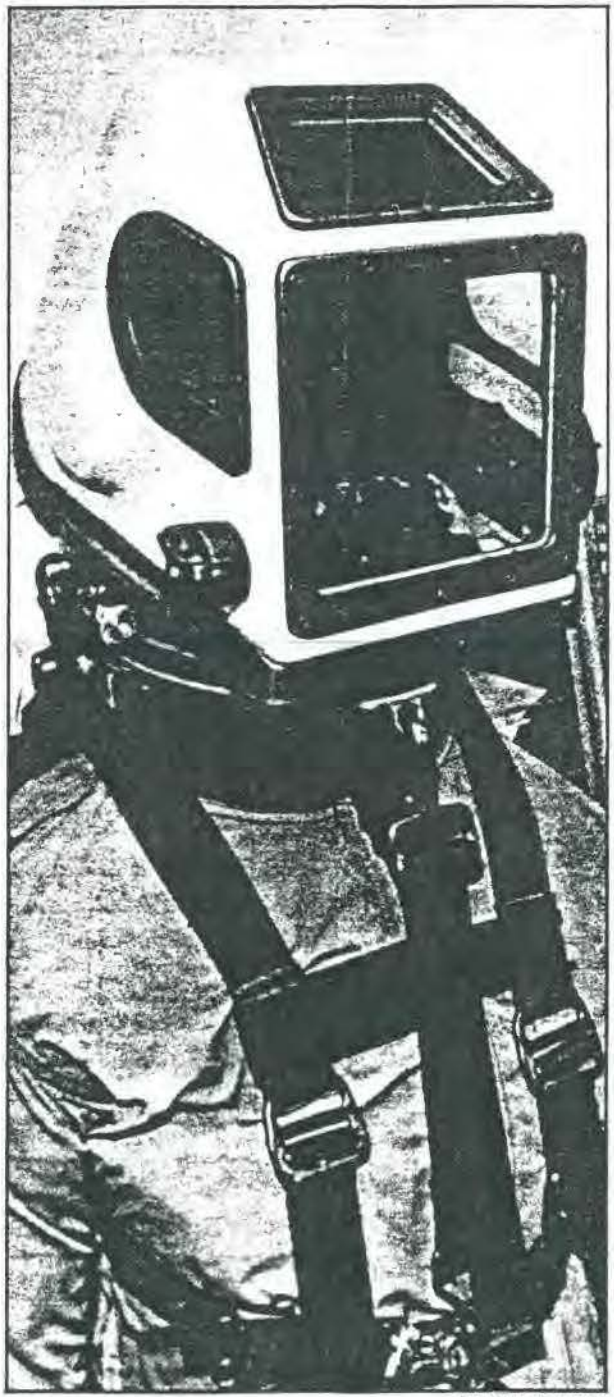
"The Mark V was like a pair of comfortable old Levis," said Dave Lidell, a hull technician senior chief from Spokane, Wash.

"In the old days of diving, we were looking for people who were strong and mechanical, in that order," said Lidell, who is responsible for all the support equipment at the diver school. "Now, because we are teaching five years of knowledge in 12 weeks, we want people who are intelligent and in good physical shape."

The San Diego school turns out 60 per cent of the Navy's second-class divers, who are qualified to 190-foot depths with surface-supplied compressed air diving gear. Six classes a year graduate about 120, who join their 2,000 fellow Navy divers in a select fraternity of the deep.

Although that fraternity has recently gone coed, the physical training is no less rigorous. At one time Navy divers were not required to swim, but today's students learn everything from scuba to drownproofing.

But the ultimate test of the Mark V diver, according to Lidell, was climbing the ladder to safety after work that at times was exhausting, difficult or dangerous — and sometimes all three. There are 14 ladder steps in the training tank at Coronado and three on the training barge, any of which proved to be the undoing of many a student diver.


Los Angeles Times Photo

The sleek new Mark 12 diving suit weighs in at only 127 pounds, compared to 200 pounds for its predecessor.

"Especially when it is standard operating practice for the diver to shut down his air as soon as his helmet breaks the surface," Lidell said. Without the air, the stiff canvas and rubber suit collapses, somewhat akin to a deflated inner tube. "Now the student must climb using the correct procedure, or the instructor makes the student go back down and start all over," Lidell said. "No one needs to be reminded there are only seven minutes of air in the suit."

In the last Mark V class, 20 of 27 would-be divers made it up the steep ladder of success. About average, according to Lidell, although there have been times when the 12 instructors outnumbered the class due to the attrition rate.

Practicing in the Mark V, which originated before World War I, Bill MacIntire, 22, of Raymondville, N.Y., recalled his first dive: "It was quite an experience, kind of heavy and awkwardly bulky." MacIntire, a hull technician fireman apprentice, stands but 5 foot 2 and lists his weight at 120 pounds.

Tethered to the surface with air hose, communication line, depth indicator hose, 2,200-pound test stainless-steel safety cable and sometimes a hot-water heating hose, the Mark V diving gear — with few modifications — has been the mainstay of the Navy diver program since the beginning. Some of the oldest existing helmets have stamped nameplates with dates reaching back to the early 1900s.

"It's been around forever," said Bill Gholson of the Office of the Superintendent of Diving in Washington, D.C. "For years there was only the Mark V and it was essential that all divers learned with it," Gholson, 47, a torpedoman master chief, said.

The Mark V is based on Augustus Siebe's "closed" dress, perfected in 1837, in which the diver is fully enclosed in a continuous air- and water-tight dress, except for the hands. (The Mark V does have tri-sectioned gloves, with the fingers separated into pairs opposing a thumb.) The exact origin or date that the Mark V was introduced into the Navy has been lost in antiquity.

Gholson's career typifies what has happened to today's Navy diver. In 1953 Gholson, then a teenager from Albuquerque, N.M., made his first dive in the Mark V at the divers' school in Newport, R.I. He went down 15 feet. His most recent dive was with the new Mark 12 equipment. Gholson, a master diver, went down 300 feet, breathing a mixture of helium and oxygen.

Instead of a clumpy near-200 pounds, the sleek new Mark 12 weighs 127 pounds. Instead of boots weighted with 15 pounds of lead each, the Mark 12 uses less weight distributed more evenly on legs, thighs and hips.

Instead of a balloon-like canvas, rubber and leather costume, the Mark 12 diver uses a close-fitting canvas suit over a quarter-inch neoprene dry suit.

The most frequently cited improvements of the Mark 12 over the Mark V are clarity of voice communications and visibility through the faceplate. "The Mark 12 has less space in the helmet and fits a lot closer to your head," said student MacIntire, who after graduation was headed for the salvage ship Edenton in Little Creek, Va. "The communications are a lot clearer and, because of the bigger viewport, you get a better field of vision."

But the most apparent change is in the helmets themselves.

Soon to be only artifacts are the Mark V's distinctive spheres of zinc-plated spun copper and brass. The new Mark 12 is a boxish affair made of aluminum and plastic, colored international yellow, with large rectangular ports of clear Lexan. Much of NASA's outer-space technology developed for the astronauts' suits went into the inner-space design of the Mark 12. /■

June 4, 1983

Part II/3

EPA

Environmental
Emergency
Response
Unit
Capability

April 1982

EPA

RICHARD P. TRAVER, P.E.
Staff Engineer/Unit Diving Officer

U.S. Environmental Protection Agency
Municipal Environmental Research Lab.-Ci
Oil and Hazardous Materials Spills Branch
Edison, New Jersey 08837

(201) 321-6677
(FTS) 340-6677

Introduction

The Environmental Emergency Response Unit (EERU) is the U.S. Environmental Protection Agency's (EPA) hazardous material spill response and control organization for situations where the use of complex cleanup equipment and techniques are required. EERU is engaged in the shakedown and field demonstration of prototypical equipment and techniques that have been developed under the direction and sponsorship of EPA's Municipal Environmental Research Laboratory (MERL).

The concept of EERU involves a cooperative effort among spill response research personnel at MERL's Oil and Hazardous Materials Spills Branch in Edison, NJ, EPA's Environmental Response Team and operational personnel (of the Hazardous Response Support Division, Washington, DC), and contractor personnel, to provide the most effective use of the technologies under development. EPA efforts through EERU include the use of government owned equipment during emergency response and hazardous waste site cleanup activities, as well as the operation of a pilot plant facility and a mobile analytical chemical laboratory.

During the past several years, the Environmental Emergency Response Unit has supported EPA Regional and Headquarters personnel at a variety of emergency incidents involving contamination of groundwater, surface waters, and potable water supplies by spills of hazardous materials and oils, as well as at emergency responses to uncontrolled chemical waste sites.

The cooperative effort between EPA and contractor personnel enables EERU to bridge the gap between "research" and "commercially usable" equipment. This effort is intended to inspire enterprising commercial development and application of spill control and cleanup technology.

For further information on EERU activities and capabilities, contact:

James J. Yezzi, Jr.
Oil & Hazardous Materials Spills Branch
Municipal Environmental Research Laboratory-Ci
U.S. Environmental Protection Agency
Edison, NJ 08837

Telephone: (201) 321-6703 FTS: 340-6703

or:

J. Stephen Dorrler, Chief
Environmental Response Team
U.S. Environmental Protection Agency
Edison, NJ 08837

Telephone: (201) 321-6740 FTS: 340-6740

Hazardous Materials Detection Kit

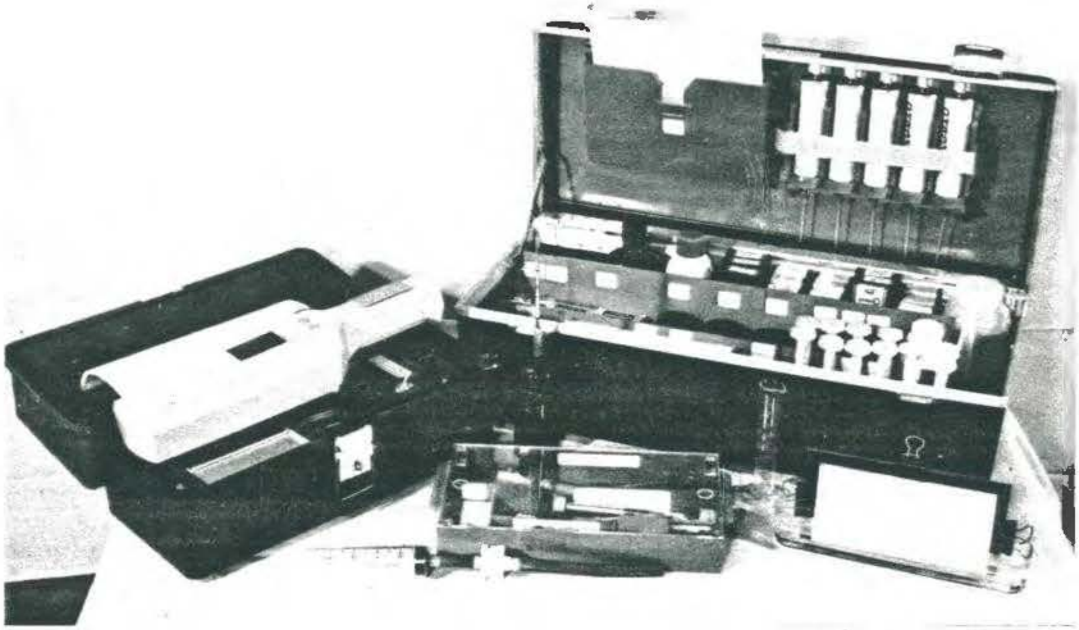
Over 3,000 spills of hazardous polluting materials (other than oil) enter the waterways of the United States each year. These spills often result from accidental releases of hazardous materials during in-plant operations and storage, as well as from accidents that occur during transport by barge, tank truck, railway tank car, and pipeline. Additionally, large amounts of pollutants reach rivers, streams, and lakes from agricultural use of chemicals.

Effective response to a spill frequently requires the ability to detect hazardous materials in waterways. In order to facilitate rapid detection, a Hazardous Materials Spills Detection Kit for performing non-specific tests with a broad response to many contaminants has been developed (IAG-D4-0546). The kit is designed for use at spills when the identity of the contaminant is known and the important consideration is tracing the spill plume until countermeasures can be taken.

The Hazardous Materials Detection Kit can be carried by one person and is versatile enough to be modified for special applications. It contains a pH meter, conductivity meter, spectrophotometer, filter assembly, effervescent jar, miniature chromatographic columns, enzyme "tickets", and data sheets. The instrument components are battery-powered for field use, although the spectrophotometer and conductivity meter can be modified for 120- or 240-V a.c. operation using the adapter and cable that are provided. The kit has all the necessary instrumentation, equipment, and reagents that may be needed by a field investigator to detect and trace contaminants in waterways.

Hazardous Materials Detection Kits, which are commercially available, have been used during emergency responses to hazardous materials spills. Additional information about the kits may be found in the EPA report, EPA-600/2-78-055.

Hazardous Materials Identification Kit



During the response to hazardous chemical spills and uncontrolled hazardous waste sites, the identity of contaminants is often unknown. Compact, portable analytical equipment for rapid pollutant identification is critical to effect efficient emergency response activities. However, nearly 300 materials are classified as hazardous substances by EPA (Federal Register, 16 February 1979), and a field kit capable of rapidly and accurately identifying each of these substances would be too unwieldly to be practical. Thus, thirty-six representative hazardous materials (toxic metals, anions, organic compounds) were selected and a field kit was designed to identify these and related substances (IAG-D6-0096).

The identification (ID) kit consists of two major components: (1) an inverter/shortwave UV lamp unit for photochemical and thermal reactions and (2) a package with reagents and auxiliary equipment, including test papers, detector tubes, spray reagents, spot test supplies, and thin-layer chromatography apparatus. Equipment to facilitate the recovery of contaminants from water and soil is also included. The field identification kit contains detailed operating instructions and data cards for each of the 36 representative hazardous substances.

Identification of groups of contaminants, rather than quantification of specific substances, is the intended use of the identification kit. The ID kit can be used in conjunction with the Hazardous Materials Detection Kit, which contains a pH meter, spectrophotometer, conductivity meter, and other analytical equipment. Utilization of both kits can improve identification capability, particularly for inorganic materials. For example, cyanide and fluoride cannot be distinguished by the ID kit alone; however, when the kits are used concurrently, identification becomes possible.

Pesticide Detection Apparatus

Spills or discharges of toxic pesticides in waterways pose a serious threat to the aquatic environment and municipal water supplies. With the increased use of organophosphate pesticides, which are toxic at very low levels, precautions are needed to reduce this threat. Because of the stability of toxic organophosphate pesticides under "normal" environmental conditions, it is imperative to rapidly detect these hazardous compounds.

Automatic systems have been developed to monitor water for the presence of organophosphate and carbamate insecticides. The principle used for detecting these cholinesterase-inhibiting toxic substances is based upon: (1) the collection of enzyme inhibitors on immobilized cholinesterase, (2) the chemical reaction of immobilized cholinesterase with a substrate, butyrlthiocholine esterase, in the presence of enzyme inhibitors, and (3) the electrochemical monitoring of substrate hydrolysis products.

CAM-1

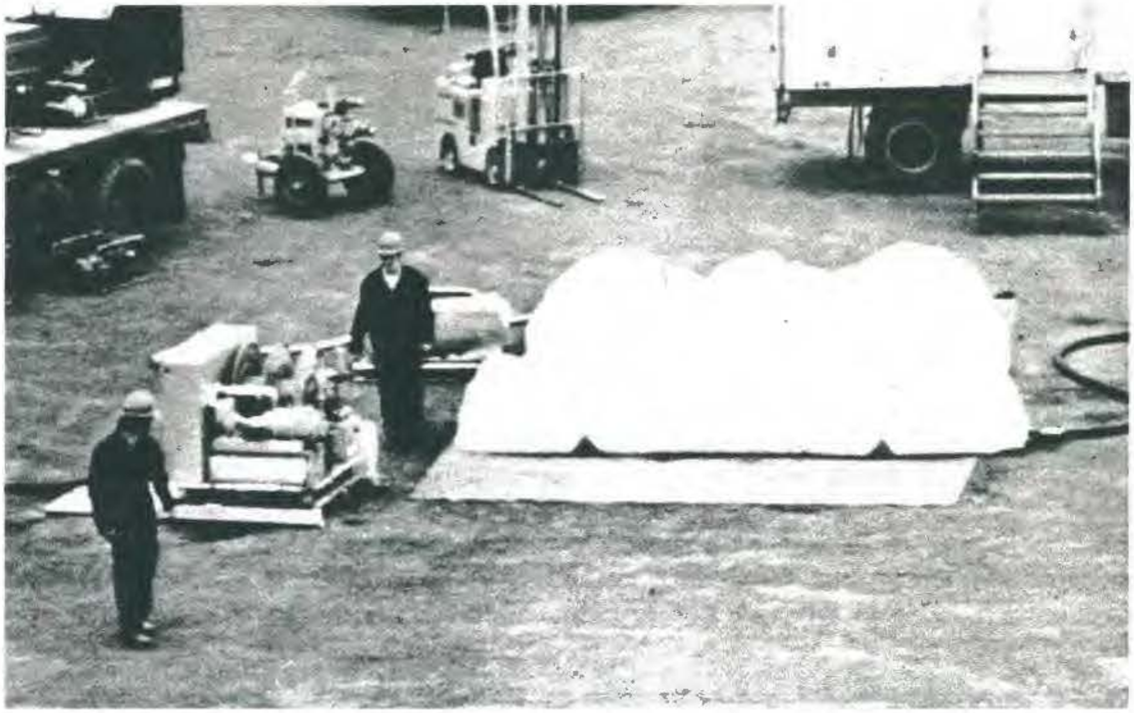
The Cholinesterase Antagonist Monitor (CAM-1), developed under EPA Contract No. 68-01-0038, is an automatic pesticide detection instrument. CAM-1 is intended to be used in a laboratory environment for monitoring potable water supplies and effluents from pesticide manufacturing facilities. An alarm signal is produced when cholinesterase antagonists are detected above a pre-set level.

CAM-4

The Cholinesterase Antagonist Monitor (CAM-4), developed under EPA Contract No. 68-03-0299, is a more rugged instrument that is designed for rapid detection of toxic materials in a river, stream, or pond. The portable apparatus can be used from alongside the banks of a stream or from a boat. An operator is needed to note the presence of enzyme inhibitors when the baseline voltage increases 10 or more millivolts in one sampling cycle, as indicated on the printout of a strip chart recorder. The CAM-4 can operate continuously—with little maintenance—for an 8-hour period when using a 12-V automobile battery or a 110-V a.c. power source.

A complete description of the pesticide detection apparatus, including design specifications as well as results of laboratory and field tests, may be found in the following EPA reports: EPA-R2-72-010, EPA-600/2-77-219, and EPA-600/2-80-033.

Portable Collection Bag System



Frequently, a first step in a hazardous material spill response is containment of the spilled material (e.g., by foam dikes or gelling agents). Emergency collection and temporary storage of spilled hazardous materials is vital for hazardous liquids that are temporarily impounded in a diked area or sumped pool, or are leaking from a damaged transportation vehicle.

A pre-packaged system for collection, containment, and temporary storage of spilled hazardous materials in a group of large, interconnected, flexible plastic bags has been developed (EPA Contract No. 68-03-0206). The system is mounted on a 1.2 - by 1.2-m (4 - by 4-ft) reinforced plastic pallet for transporting by pickup truck or van. Components include: a self-priming centrifugal pump, two 15-m (50-ft) lengths of 5-cm (2-in) hose, and four furled, self deploying plastic bags (a header with three fingers) with a total capacity of 26,500 l (7,000 gal). The collection bags are made of a puncture-resistant plastic material that has sufficient mechanical strength to be minimally affected by most hazardous substances during short-term storage periods.

Two models of the Portable Collection Bag System are currently available. One model is powered by an explosion-resistant, gasoline engine and has a nominal pumping rate of 300 lpm (80 gpm). A single tank of fuel provides 2 hours of pumping time, which is generally sufficient to fill the bags. The other model, which is explosion-proof, is battery-powered. It has a nominal pumping rate of 200 lpm (50 gpm) and will operate for 2 to 2½ hours without requiring a battery recharge.

An 8 - by 6-m (25 - by 20-ft) area is needed to assemble the system. The collection bags must be placed on level surfaces, or on inclines no greater than 30°, in order to prevent sliding as they are filled. Where static electricity may build up, as with low conductivity fluids, a cable should be used to ground the pump chassis.

The Portable Collection Bag System has been successfully used to contain materials from leaking tank trucks. Details of the system, including operating manuals for the battery-powered and gasoline-powered models, are contained in EPA-600/2-77-162.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

OFFICE OF EMERGENCY AND REMEDIAL RESPONSE

HAZAROOUS RESPONSE SUPPORT DIVISION

ENVIRONMENTAL RESPONSE BRANCH

HAZARDOUS MATERIALS INCIDENT RESPONSE TRAINING PROGRAM

The Office of Emergency and Remedial Response is responsible for the U.S. Environmental Protection Agency's program for responding to the release or potential release of hazardous materials. To prevent or reduce the impact of the release on public health and/or the environment, emergency actions and longer-term remedial activities are often necessary.

As part of a comprehensive program for protecting the public and the environment from chemical incidents resulting from vehicle or train accidents, spills, discharges from industrial operations, and hazards associated with uncontrolled waste sites, the Hazardous Response Support Division, Environmental Response Branch, develops and presents training courses in safety and technical operations related to hazardous material responses. These courses are available to response personnel from federal, state, and local agencies at no charge. Private industry may also attend on a space available basis and payment of tuition.

The courses presented by the Environmental Response Branch last from 3 to 5 days. They provide participants with fundamental information about the subjects covered. Although each course is tailored to cover technical material relevant to the course title, no course will provide participants with exhaustive treatment of any subject. Complemented by work experience and individual effort, they do provide a foundation for developing expertise in a variety of response activities. All courses emphasize the practical use of lecture information through class problems, outdoor exercises, and indoor and outdoor use of equipment, methods, and procedures.

There are no prerequisites for attending any courses with the exception of Response Safety Decision-Making (165.8) which requires that attendees have experience in response safety. Persons wishing to attend both Personnel Protection and Safety (165.2) and Hazardous Materials Incident Response Operations (165.5) should discuss this with the Registrar as there is some redundancy.

Questions concerning the courses, applications to attend, or inquiries concerning the availability of space in courses scheduled in the states should be directed to the listed Regional Contact.

Applications to attend and inquiries about courses scheduled in Region II, Edison, New Jersey, Cincinnati, Ohio, or requests for general information about the Hazardous Materials Incident Response Training Program should be directed to:

Registrar
OERR Training Program

Or

Thomas C. Sell,
Training Coordinator

Or

Ellery D. Savage,
Training Officer

U.S. Environmental Protection Agency
26 West St. Clair Street
Cincinnati, OH 45268
Commercial Telephone: 513/684-7537
FTS Telephone: 8-684-7537

SUPERFUND TRAINING REGIONAL CONTACTS

Rick Leighton
U.S. EPA - Region I
JFK Federal Building
Boston, MA 02203
(617) 223-5775
(FTS) 223-5775

Fred Rubel
U.S. EPA - Region II
Woodbridge Avenue
Edison, NJ 08837
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(FTS) 340-6658

Robin Aiken
U.S. EPA - Region III
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(FTS) 597-9328

Larry Hyde
U.S. EPA - Region IV
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Atlanta, GA 30365
(404) 881-4101
(FTS) 257-4101

Steve Ostrodka
U.S. EPA - Region V
111 W. Jackson Street
Chicago, IL 60604
(312) 886-7571
(FTS) 886-7571

David Lopez
U.S. EPA - Region VI
1201 Elm Street
Dallas, TX 75270
(214) 767-9796
(FTS) 729-9796

Bill Longston
U.S. EPA - Region VII
25 Funston Road
Kansas City, KS 66115
(913) 236-3888
(FTS) 926-3888

Floyd Nichols
U.S. EPA - Region VIII
1860 Lincoln Street
Denver, CO 80295
(303) 234-6069
(FTS) 234-6069

Richard Taft
U.S. EPA - Region IX
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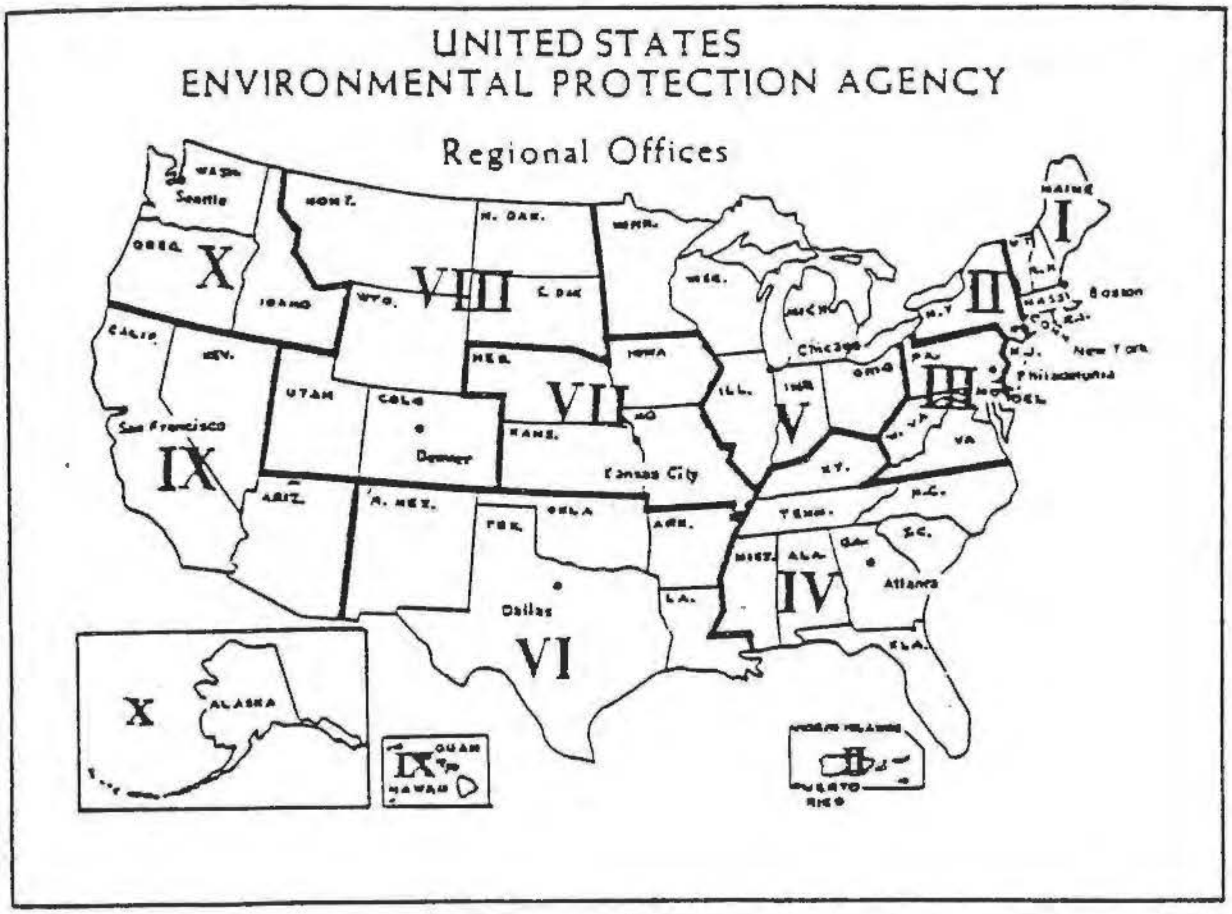
San Francisco, CA 94105
(415) 974-7422
(FTS) 454-7422

Ron Blair
U.S. EPA - Region X
P.O. Box 549
Manchester, WA 98353
(206) 442-0370
(FTS) 399-0370



UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

Regional Offices

PERSONNEL PROTECTION AND SAFETY (165.2)

5 Days

This course is for relatively inexperienced personnel who respond to accidents involving hazardous substances or investigate uncontrolled hazardous waste sites. It provides basic instruction on the protection and safety of personnel engaged in field operations dealing with hazardous substances.

After completing the course, attendees will be more familiar with general concepts, principles, and procedures for protecting themselves from the harmful effects of toxic materials, and the acceptable practices for minimizing danger to response personnel.

The training consists of classroom instruction, group problems, and discussion. Approximately 1/2 of the course is the hands-on use of personnel protective equipment, monitoring instruments, and practical exercises.

Course topics include: the fundamentals of respiratory protection, types of respiratory protection apparatus, use and limitation of equipment, selection of respiratory protection equipment, protective clothing, air monitoring and sampling, and safety procedures for conducting response operations.

Portions of this course and course 165.5 are redundant. Persons considering application to both courses should confer with the Registrar.

Continuing Education Units: 2.6
Tuition: $110.00

HAZARDOUS MATERIALS INCIDENT RESPONSE OPERATIONS (165.5)

5 Days

This course provides attendees with practical knowledge concerning incident response operations. The course focuses on response team function, methods, procedures, and safety in responding to hazardous substances spills or abandoned waste sites.

After completing the course, attendees should be more familiar with: selection, use, and limitation of respiratory protection apparatus and protective clothing; site entry, control, and decontamination procedures; the use of field instruments and equipment; and response organization and management.

Approximately 1/3 of the course is classroom instruction. The remaining time is hands-on use of monitoring equipment, personnel protective apparatus, and other applications of classroom topics. Decision-making in incident response operations is practiced by responding as teams to a simulated vehicular accident and an abandoned waste site.

Course topics include: respiratory protection apparatus, protective clothing, field instruments, hazard analysis, response organization, and standard operating safety procedures.

Portions of this course and 165.2 are redundant. Persons considering application to both courses should confer with the Registrar.

Continuing Education Units: 2.3
Tuition: $110.00

HAZARD EVALUATION AND ENVIRONMENTAL ASSESSMENT (165.6)

5 Days

This course provides participants with techniques to assess the potential environmental impact of released hazardous materials. The course emphasizes methods and procedures for estimating the dispersion of air-borne and water-borne materials, pathways for contact with surrounding populations, and guidelines for the protection of public health.

Upon the completion of the course, participants will have a knowledge of: the properties of hazardous materials and basic toxicology; use and interpretation of various guidelines for the protection of response personnel as well as the public; the dispersion and behavior of hazardous materials in air, water, and soil; and techniques for the assessment of environmental impact.

Instruction methods includes lectures, group discussions, case studies, and group problem-solving sessions.

The following topics will be discussed: fundamentals of toxicology; principles of meteorology; dispersion pathways in air, water, and soil; basic calculations and mathematical models for dispersion of contaminants in air, water, and soil; guidance and standards for the protection of public health; and principles of bioassessment.

Continuing Education Units: 2.3
Tuition: $110.00

RESPONSE SAFETY DECISION-MAKING WORKSHOP (165.8)

5 Days

This workshop is for persons developing, implemeting, or managing safey programs for chemical emergencies or cleanup at abandoned hazarrdous waste sites. The workshop complements other EPA basic safety courses and provides participants with more detailed guidance and information for making effective safety decisions. It is intended as a forum for workshop participants and the staff to exchange information and ideas on response related safety topics.

Individuals applying for the course are expected to be knowledgeable in basic personnel protection, safety, and response operations. As a minimum, applicants must have attended Personnel Protection and Safety (165.2) or Hazardous Materials Incident Response Operations (165.5), similar courses, or demonstrate they are experienced in response safety.

After this workshop attendees will: better understand the responsibilities and liabilites of a response safety officer; be more familiar with the requirements for an overall health and safety program; be more knowledgeable in risk assessment and its impact on safety planning; be better trained in technical areas of response safety; and be better able to develop and implement site specific safety plans.

The workshop includes classroom instruction, group problem-solving, and class discussions. Workshop topics include safety guidance and regulations, risk assessment, air monitoring, respiratory and protective clothing selection, special problems, and safety plan development.

Continuing Education Units: To be determined.
Tuition: $110.00

SAMPLING AT HAZARDOUS MATERIALS INCIDENTS (165.9)

3 Days

This course provides attendees with practical knowledge and understanding required for an effective sampling program at hazardous materials incidents. The course focuses on the types of equipment suitable for hazardous materials sampling and the practices and procedures for safely and effectively collecting samples. Air sampling procedures are specifically treated in course 165.4, and are not covered in this course.

After completing the course, attendees should be more knowledgeable about: the design of sampling programs, the equipment and procedures for sample collection; sampling safety; and the regulations on transporting samples.

Instructional methods used are classroom lectures, group discussions, demonstrations, and laboratory and field exercises with an emphasis on hands-on use of multi-media sampling equipment.

Topics to be discussed include: sampling plan development; the statistical basis for sampling; equipment and procedures for sampling containerized materials, surface water/lagoons, sediments/sludges, soils and groundwater; compatibility testing; sample shipment; safety in sample collection; and the legal considerations for sampling.

Continuing Education Units: To be determined.
Tuition: $66.00

HAZARDOUS WASTE SITE INSPECTIONS (165.10)

5 Days

This course teaches participants the procedures used in making site inspections. Components of the course include: waste site activities, hazard evalution and personnel safety, hazardous sample collection and handling procedures, and waste evaluation and ranking.

Students will gain hands-on instruction in field monitoring equipment, protective clothing, and respiration equipment use. Field exercises also provide attendees experience in field sampling and waste site inspection and evaluation.

Upon completion of the course, participants will gain an understanding of the various elements of conducting a hazardous waste site inspection safely and effectively.

Continuing Education Units: 2.9
Tuition: $110.00

Form Approved
OMB No. 158-R0005

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

APPLICATION FOR TRAINING

1. NAME OF APPLICANT *(First, middle, last)*
MR.
MRS.
MISS.

2. TITLE OF COURSE DESIRED	3. COURSE NUMBE
4. PLACE WHERE GIVEN	5. DATES
6. SPONSOR OR EMPLOYER *(Name, address)* City State Zipcode Phone no.	7. MAILING ADDRESS OF APPLICANT *(If different from item 6)* City State Zipcode Phone no.
8. PROFESSION OR OCCUPATION	9. TOTAL YEARS EXPERIENCE IN PROFESSION

10. POSITION TITLE

11. BRIEF DESCRIPTION OF YOUR PRESENT POSITION

12. PREVIOUS HAZARDOUS MATERIALS TRAINING COURSES ATTENDED

TITLES	DATES	LOCATION

13. HIGH SCHOOL GRADUATE ☐ YES ☐ NO	14. NUMBER OF YEARS EDUCATION COMPLETED BEYOND HIGH SCHOOL

15. COLLEGE OR UNIVERSITY EDUCATION

NAME OF INSTITUTION	DATE ATTENDED	MAJOR	DEGREE

16. SIGNATURE OF APPLICANT		17. DATE
18. SIGNATURE OF APPROVING OFFICER *(Where applicable)*	19. TITLE	20. DATE

21. AGENCY USE ONLY

AMT. REC'D. ____________ DATE ____________ BILLING INFO. ____________

TUITION FEE SHOULD ACCOMPANY COMPLETED APPLICATION.
Checks should be made payable to: U.S. Environmental Protection Agency.

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Checks should be made payable to: U.S. Environmental Protection Agency.

HAZARDOUS MATERIALS INCIDENT RESPONSE TRAINING PROGRAM

PRELIMINARY COURSE SCHEDULE

October, 1984 thru September, 1985

(Issued August, 1984)

COURSE TITLE/NUMBER	DATE 1984	LOCATION
Air Surveillance for Hazardous Materials (165.4)	October 1-5	Region V
Hazardous Materials Incident Response Operations (165.5)*	October 15-19	Edison, NJ
Personnel Protection & Safety (165.2)	October 15-19	Region X
Hazard Evaluation & Environmental Assessment (165.6)	Oct 29-Nov 1	Region III
Hazardous Materials Incident Response Operations (165.5)	Oct 29-Nov 2	Edison, NJ
Personnel Protection & Safety (165.2)	Oct 29-Nov 2	Region IV
Hazardous Materials Incident Response Operations (165.5)	November 5-9	Edison, NJ
Air Surveillance for Hazardous Materials (165.4)	November 5-9	Region IX
Hazardous Materials Incident Response Operations (165.5)	November 26-30	Edison, NJ
Personnel Protection & Safety (165.2)	November 26-30	Region VI
Sampling for Hazardous Materials (165.9)	November 27-29	Region VIII
Incident Mitigation & Treatment Methods (165.3)	December 3-7	Region II
Air Surveillance for Hazardous Materials (165.4)	December 3-7	Region IV
Hazardous Materials Incident Response Operations (165.5)	December 10-14	Edison, NJ

*These are closed courses, applications are not being accepted.

JAMES L. OBERSTAR
8th District, Minnesota

COMMITTEES:
PUBLIC WORKS AND TRANSPORTATION

CHAIRMAN:
SUBCOMMITTEE ON ECONOMIC DEVELOPMENT

MERCHANT MARINE AND FISHERIES

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231 Federal Building
Duluth, Minnesota 55802
(218) 727-7474

March 16, 1983

Dr. John W. Hernandez, Jr.
Acting Administrator
Environmental Protection Agency
401 "M" Street, S. W.
Washington, D. C. 20460

Dear Mr. Administrator:

As a Member of the Public Works and Transportation, and Merchant Marine and Fisheries Committees, both of which have jurisdiction over Superfund, and especially releases of hazardous substances in water, I have followed with keen interest the Protection of Divers in Chemically Contaminated Water program conducted by EPA's Office of Research and Development under an Interagency Agreement with NOAA in cooperation with the US Coast Guard and the Navy.

I understand this program may be curtailed short of its final goals. I would hope that it would be permitted to continue to its conclusion at the end of this fiscal year.

I have been concerned, from my earliest involvement with response, first under Sec. 311 of the Clean Water Act, then under Superfund, with safety-related problems of the people involved in in-water chemical releases. I know that remotely operated vehicles are not sufficient to assess, or to clean up, such releases; and that human divers will remain the primary means of response.

I have also been aware of the dangers such activities entail to divers as they work in an environment far more immediately hostile than the most hazardous site, as well as to their tenders and other members of the clean-up crew. Yet, while great care has been devoted to protection and decontamination of workers at sites, little attention has been devoted to their in-water counterparts.

I was therefore pleased to learn that EPA has initiated the interagency Agreement with NOAA, under which EPA divers would receive the most advanced diving training, and NOAA's considerable expertise would be brought to bear to upgrade equipment, and to improve safety procedures not only for government clean-up crews, but for the commercial diving industry as well, which will be conducting most

response activities. One of my own staff has been actively involved in this program both as participant and observer, and has provided me and the Committee with highly favorable reports on the activities conducted so far.

The ultimate goal of this program, the "Field Operations Handbook and Manual for Chemical Diving," will be a major contribution to commercial and government diving safety, and has elicited the interest of not only NOAA, the Coast Guard and Navy, but OSHA, the Department of Energy, the commercial diving industry and the Cousteau Society as well. This is a unique program, something that has not been, and will not be, undertaken without EPA.

I also understand, however, the EPA may be considering cancelling the IAG, and reducing the scope of the program to an interim protocol alone, one to be released without the benefit of full scale evaluation and peer review.

Such a protocol, it seems to me, would gain little confidence or credibility among those who need such a manual, and who would rely heavily on an adequate, thoroughly reviewed, tested and evaluated final product.

Divers have been hurt and killed in the past while engaging in response to in-water releases of hazardous substances. There is little likelihood of this situation changing unless the Interagency Agreement is permitted to reach its full scope and conclusion at the end of this fiscal year.

It would be foolish as well as a waste of the time and fine interagency cooperative effort to cease this work now.

I urge you to support the keen good sense the Agency has shown so far in developing this modest, but very much needed counterpart to the elaborate procedures being established for on-land clean-up. It is a credit to the Agency, as well as a major contribution to safety of those engaged in Superfund.

With warm best wishes.

Sincerely,

James L. Oberstar

JAMES L. OBERSTAR, M. C.