

## 5.38 CONTAMINATED WATER DIVING OPERATIONS

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, based on one dive and any applicable decompression required. Increased manning levels and additional equipment may be required for any diving in excess of one dive and any decompression required. Proper pre-job planning shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

The information presented in this section has been generated as guidance material only, that must be considered when planning the conduct of contaminated water diving operations.

A primary consideration during contaminated water diving operations is to minimize the length of time during which members of the dive team are exposed to contaminants. Dives should be scheduled to require no in-water decompression so as to limit the diver's exposure to waterborne hazards.

### 5.38.1 TRAINING

- a. All personnel who are likely to participate in contaminated water diving operations should receive training consistent with regulatory requirements for the area where operations are to be conducted, such as 29 CFR 1910.120 (U.S. OSHA) – Hazardous Waste Operations and Emergency Response (HAZWOPER).
- b. Specific training must be furnished in:
  - Dry suits
  - Personal protective equipment for topside and diving personnel
  - Decontamination procedures, including preparation of the disinfectant or other solution intended for use
  - Decontamination of personnel and equipment used during operations

### 5.38.2 SITE EVALUATION

When operations will take place where the water is suspected or known to be contaminated, a site assessment must be conducted. This assessment should include:

- Any suspected contaminants and potential hazards.
- Testing of the dive environment: It is not always possible to tell whether an environment is contaminated either by sight or by smell. Any diving environment should be approached with caution and when contamination is suspected, the water tested prior to commencing operations.
- Wind: In situations where there may be toxic fumes, the dive station, compressor, and topside personnel must be situated up-wind from any source of contamination to the air.
- Current: Both on the surface and underwater, the diver should approach any known point-source of contaminant from the up-current side whenever possible. This will allow the current to carry contaminants away from the diver.

- Perimeter: Whenever possible, a perimeter should be established around the dive station and dive site to keep unprotected persons away from any possible contamination.
- Established zones: Zone management should be employed when applicable to keep unprotected personnel and equipment outside of the hot zone.

### 5.38.3 TOPSIDE PERSONNEL PROTECTIVE EQUIPMENT: EPA SELECTION GUIDELINES

To aid in the selection of complete protective ensembles, including chemical protective clothing and respirators, the United States Environmental Protection Agency's (EPA) Office of Emergency and Remedial Response has designated four levels of chemical hazards, ranging from extremely dangerous or unknown (Level A) to situations where only basic work wear (Level D) is the required protection. The OSHA Standard recommends the use of these guidelines, which can assist employers in complying with the protective equipment requirements of the Standard.

The following is a brief review of the EPA guidelines. These are explained in greater detail in Appendix B of the OSHA Standard and Table 1.

- **Level A** calls for a vapor-tight suit (total-encapsulating) that is non-permeable to the chemicals to which a worker will be exposed. Also necessary is an approved, positive-pressure self-contained breathing apparatus (SCBA) or a NIOSH-approved, positive-pressure air-line respirator with escape SCBA having no less than a five-minute air cylinder. Outer and inner chemical-resistant gloves and chemical-resistant boots with a steel toe and shank should also be used.
  - **Level B** necessitates the same level of respiratory protection and complete skin coverage. However, protective clothing does not have to be vapor tight.
  - **Level C** calls for a full-face piece, or half-mask air-purifying respirator, and splash garments used with outer and inner chemical resistant gloves and chemical resistant boots with a steel toe and shank.
  - **Level D** calls for basic work wear such as long sleeve coveralls, hard-soled shoes and face shields or goggles.
- a. Before any diving operation is conducted in contaminated water a risk assessment is vital. Personal Protective Equipment (PPE) must be selected based on its known ability to protect workers from the specific hazards present or suspected. This applies to the diver and the topside personnel. There are four different categories of topside PPE from the least protective – Level D – to total encapsulation – Level A. Requirements for these levels are set forth in Table 1.

b. The key variables that must be considered when selecting PPE are:

- Identification of the hazard(s)
- Route of potential hazard to employees, i.e., inhalation, skin absorption, ingestion, and eye or skin contact
- The performance of PPE materials, seams, visors, and all other vital components
- Matching PPE durability of materials such as seam, tear, burst, and abrasion strength to dive site-specific conditions
- Matching site environmental conditions to PPE effect on employees (i.e., heat stress, hypothermia, dehydration, duration of task, etc.)
- Equipment selection (PPE). Site specific variables must be considered and protection geared to the worst case situation if those variables are not positively identified. The more that is known about the site, the easier it will be to customize suitable PPE to ensure protection of the dive team topside members.

**TABLE 1  
GUIDELINES FOR SELECTION OF PERSONAL PROTECTIVE EQUIPMENT**

EPA Level	Respiratory Protection	Protective Clothing	Hand and Foot Protection	Additional Protection
A B C D	An approved positive-Pressure full face-piece self-contained breathing apparatus (SCBA)	Totally encapsulating chemical protective suit specifically designated to resist permeating by chemicals that are encountered	Gloves: outer and inner chemical-resistant gloves	<ul style="list-style-type: none"> <li>• Coveralls</li> <li>• Long underwear</li> <li>• Hard hat</li> <li>• Two-way radio communications system</li> </ul>
	or  An approved positive-pressure, supplied-air respirator with escape SCBA (minimum 5-minute duration)	Hooded chemical-resistant clothing made of materials resistant to the chemicals encountered (overalls and long-sleeved jacket; coveralls; one-or two-piece chemical splash suit; disposable chemical-resistant overalls)		Boots: chemical-resistant, with steel toe and shank
	An approved full face-piece or half-mask air-purifying respirators			<b>above plus:</b> Escape tank
		Coveralls	Boots: chemical-resistant, with steel toe and shank	<b>above plus:</b> Safety glasses or splash goggles  Gloves

#### 5.38.4 DIVER-WORN OR CARRIED EQUIPMENT AND ACCESSORIES

- a. Selection of the diver-worn equipment must be based on the level of contamination protection required. The following equipment configurations are only recommendations! Responsibility for selection of equipment and diving technique must be made by the persons engaged in the diving activity as identified in the Dive Plan and/or Job Safety Analysis.
- b. Equipment that supports the diver must also be compatible with the contaminants that may be encountered.
- c. There are three levels of protection for diver-worn equipment and accessories, from the most protective – Level One — to the least protective – Level Three. Requirements for these levels are set forth in Table 2.

<b>TABLE 2 DIVER-WORN OR CARRIED EQUIPMENT AND ACCESSORIES</b>		
<b>LEVEL ONE (Most Protective)</b>	<b>LEVEL TWO</b>	<b>LEVEL THREE (Least Protective)</b>
<ul style="list-style-type: none"> <li>• For diving in waters containing biological contamination, petroleum fuel, lubricating oils, and industrial chemicals known to cause long-term health risks or death</li> <li>• Helmeted surface-supplied diver with mated non-porous dry suit with attached boots, gloves, and a return line exhaust or double exhaust valve system</li> </ul> <p><b>NOTE:</b> The use of Level One protection should take into consideration the chemical compatibility of the equipment being used and the resultant permeation of waterborne contamination into the equipment. (Consult manufacturer's data). Diving in waters containing strong chemicals or nuclear contamination where even minor exposure could cause a serious threat will require special consideration and planning, equipment precaution, and training</p>	<ul style="list-style-type: none"> <li>• Biological or chemical contamination that will cause short-term health effect but will not cause lasting injury, disability, or death</li> <li>• Surface-supplied umbilical with dry suit with attached and sealed hood, gloves, and boots</li> <li>• Full-face mask that overlays the dry suit hood face seal</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended for diving in waters that are considered to pose a minimal health risk</li> <li>• Scuba/surface-supplied umbilical with half-mask or full mask, chafing overalls, hand and foot protection</li> </ul>

**Any actual or suspected breach of a Level One Diving System is cause for the immediate termination of diving operations.**

### 5.38.5 DECONTAMINATION PROCEDURES

In certain highly contaminated diving situations, the following procedures may be applied, but are not necessarily applicable for every job:

- a. The area surrounding the diving control station may be divided into three (3) zones for proper isolation of contamination. The zone immediately surrounding the point of water entry/exit is deemed "high contamination." The zone where divers and gear progress after initial decontamination is termed "low contamination." The final zone into which the divers progress after they have been decontaminated and all diving gear removed is "clean."
- b. An effective color-coding system may be employed to communicate clearly the demarcation point of the decontamination area. One system might be to use red to identify all "high" areas, yellow for "low" areas, and green for "clean" areas. If at all feasible, the "clean" zone should be positioned up-wind of the contaminated zones.
- c. **Initial Freshwater Rinse:** Spray off bulk of contaminants using high-pressure, clear freshwater rinse. If effluent does not require capture, begin hosing diver as he initially exits water to limit quantity of contaminants transferred to the dive station.
  - Take precautions to direct water flow away from potential points of leakage of diver's rig such as exhaust valves, seal junctions, etc. A high-pressure jet of water directed at such potential breach points may inject contaminants inside of the protective gear and into contact with the diver. Care should be taken to ensure the removal of the bulk of contaminants at this stage in order to afford the greatest efficacy of subsequent decontamination steps.
- d. **Oversuit:** If a reasonable expectation exists for encountering bulky, adherent contaminants in the course of a dive, the use of a disposable oversuit is strongly encouraged. Disposable hazardous material protective suits may be secured to a diver after he has been outfitted with the entire diving rig.
  - No effort to make the oversuit water-tight should be attempted. Such action could complicate the dive by creating air pockets that could affect buoyancy of the diver. As the diver arrives on the dive station, the oversuit should be cut away to allow for decontamination of the diver and equipment. At this time, removal of dive gear such as harnesses, weight belts, emergency gas supply (bailout) tanks, etc. should be performed with these items themselves being properly decontaminated.
- e. **Scrub Down:** After the diver has been initially rinsed and his equipment removed, the diver may be scrubbed with a stiff-bristle synthetic brush and a cleaning solution as applicable. Long-handled brushes may facilitate the cleaning process. Hand-held brushes may be employed for detailed cleaning of the dive helmet and the neck-dam interface.
  - Once the diver has been thoroughly scrubbed with cleaning solution applied from head to toe, he should be rinsed with fresh water. Care should be taken to ensure the diver has been cleaned of all visible contamination, most notably in the area adjacent to the neck-dam, helmet, and dry suit.
  - The composition of the cleaning solution should be appropriate for the contaminant to be removed.

- f. **Undress Diver:** Once the diver has been adequately decontaminated and moved into the “low contamination” zone, the dive gear should be removed. First, disconnect the locking mechanism from the helmet to dry suit and remove the helmet. Then, remove the dry suit and gloves, and finally, undergarments.
- If there are no indications that the diving rig has been breached during the dive, the diver may proceed to the “clean” zone and if applicable take a post-dive shower.
  - If there are positive indications of dermal exposure to contaminants, additional decontamination measures may be required.
- g. **Clean Equipment:** After removal from the diver, all equipment should undergo secondary decontamination.
- h. **Capture Effluent:** In some circumstances it will be necessary that all fluids used to rinse, wash, and re-rinse the diver and equipment must be captured for appropriate hazardous material disposal. If necessary, the above procedures will need to be altered to ensure that all decontamination procedures take place within a water impermeable capturing area.

#### 5.38.6 HAZARD EVALUATION AND IDENTIFICATION<sup>1</sup>

- a. When the threat of a chemical hazard is suspected, consider conducting a historical review of the site. Items such as spill history, known chemicals present, volume of chemicals, active discharges, air quality, present and past nature of operations, and presence of extremely hazardous substances should be examined. Facility safety officers, plant supervisors, or technicians may provide useful information.
- b. When planning Contaminated Water Diving Operations, water temperature needs to be taken into account when determining the proper equipment to be used.
- c. Check with local, state, or federal water quality agencies for current advisories on biotoxins, waterborne pathogens, microbial contamination, fish or shellfish advisories, beach closures, or storm events, any of which may indicate pollutants to be present.
- d. When hazardous contaminants are suspected, consider water or sediment sampling and analysis. The selected laboratory can provide proper containers and procedures for sample collection, handling, and shipping.
- e. If the pollutants have been identified, rapid on-site test kits for selected chemicals in sediment or water are, in some cases, available.

**If severe contamination is known to be present at the planned site of diving operations, consideration should be given to using an ROV if possible.**

- f. Hand-held detectors for monitoring a class of airborne chemicals, such as volatile organics, can be utilized for:
- Initial entry into the staging area during mobilization if the air quality is unknown
  - Continuous monitoring with alarms during diving operations to rapidly notify the participants if air quality changes
  - Scanning the diver upon water exit and after decontamination to determine if contaminants are present
- g. Lists of very dangerous chemicals that may readily penetrate diving equipment or cause substantial harm after a brief exposure can be obtained from the suit manufacturer. If a diver or topside crew member suspect's exposure, blood, urine, or other biological samples may be gathered for medical review.

**<sup>1</sup>REFERENCES OSHA 1910.120 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE STANDARD (HAZWOPER)**