PROTECTING SUBCONTRACTOR PERSONNEL DURING HAZARDOUS WASTE SITE CHARACTERIZATION

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CONF-871075--25

DE88 001728

Background

Oak Ridge National Laboratory (ORNL) is a research and development institution operated for the United States Department of Energy (DOE) by Martin Marietta Energy Systems, Inc. Current activities range from basic research in physical sciences through such diverse programs as energy and renewable resources, nuclear fission, magnetic fusion, and biological and environmental research. Such a wide variety of programs has resulted in an equally varied array of waste products.

During the previous decade, an increased awareness of the environmental impact of past waste disposal practices has resulted in the enactment of legislation to control environmental pollution. The approach is two-fold: control current pollution sources and clean-up previous disposal sites. To this end, ORNL has established the Environmental Restoration and Facilities Upgrade (ERFU) Program. One element of the ERFU Program is the Remedial Action Program (RAP), designed to identify, characterize, assess, and correct situations at hazardous waste sites.

The preliminary Site Characterization Program, a sub-program of the RAP, began in late 1985. These preliminary investigations are to provide baseline data for future phases. The primary component is a groundwater monitoring network of water quality wells, but it also includes deep boreholes, shallow exploratory auger holes, and occasionally, surface trenches. With the development of the program came the need for a health protection program for workers involved in these site characterization activities.

This paper will cover Industrial Hygiene involvement in the Site Characterization Program, focusing on the field oversight responsibilities. It will also discuss the different types and levels of protective equipment, give an example of the type of situation that can arise from field characterization efforts, and give a brief summary of health protection program elements.

*Operated by Martin Marietta Energy Systems, Inc., for the United States Department of Energy under Contract No. DE-AC05-84OR21400.

Planning

The Site Characterization Program is designed as a project team concept. The Program Coordinator is an environmental scientist with an academic background in hydrology and research expertise in aspects of subterranean waste disposal. This individual receives input and guidance from a technical advisory group consisting of representatives from Geology, Environmental Compliance, Operational Safety, Remedial Actions, Waste Management, and Purchasing (see Figure 1). A coordinator is selected to oversee well installation projects, and becomes the focal point for Industrial Hygiene input.

Based on professional knowledge and experience, and on counsel of these technical advisors, the Program Coordinator selects areas to be characterized. After well locations have been decided upon, the sites are surveyed and staked by the field survey team. The engineer in charge of survey coordination then contacts Industrial Hygiene so that an Industrial Hygiene classification number can be assigned to each well. The classification number is a numerical ranking of the sites based on the probability of encountering hazardous materials. A site with a projected low probability of encountering such materials is classified as an Industrial Hygiene Category 1 site; a moderate probability is a Category 2, and if a high probability exists, the well is listed as Category 3. Health Physics also reviews the sites and assigns a rating based on the alternate probability that radioactive materials will be present. This means that each well carries a dual rating, one for Industrial Hygiene concerns and the other for radiation concerns. Whenever the two ratings are different values, the higher rating takes precedence insofar as health protection measures are concerned. These numbers are then used as operational guidelines.

Several mechanisms are used to establish these operational guidelines. First of all, maps exist for outlining the waste trenches at many of the solid waste storage sites. These maps are particularly accurate for the newer burial grounds. Secondly, certain individuals may have knowledge of areas which can be useful. Various other information utilized in assigning a category number includes the proximity of the site to known waste handling areas, the composition of nearby waste, and the elevational location of the site relative to known waste sites. If other wells have been drilled nearby, the experiences encountered there are considered. When soil or water samples have been analyzed from nearby sites, this information is consulted and taken into consideration. Finally, a visit to the proposed site is useful if there are questions about the terrain or other factors. These visits may involve only visual inspection, or they may involve use of a scanning device, such as a photoionization instrument.

When the Industrial Hygiene rating has been assigned, it must be entered on a special form and a signature is required of the Hygienist who makes

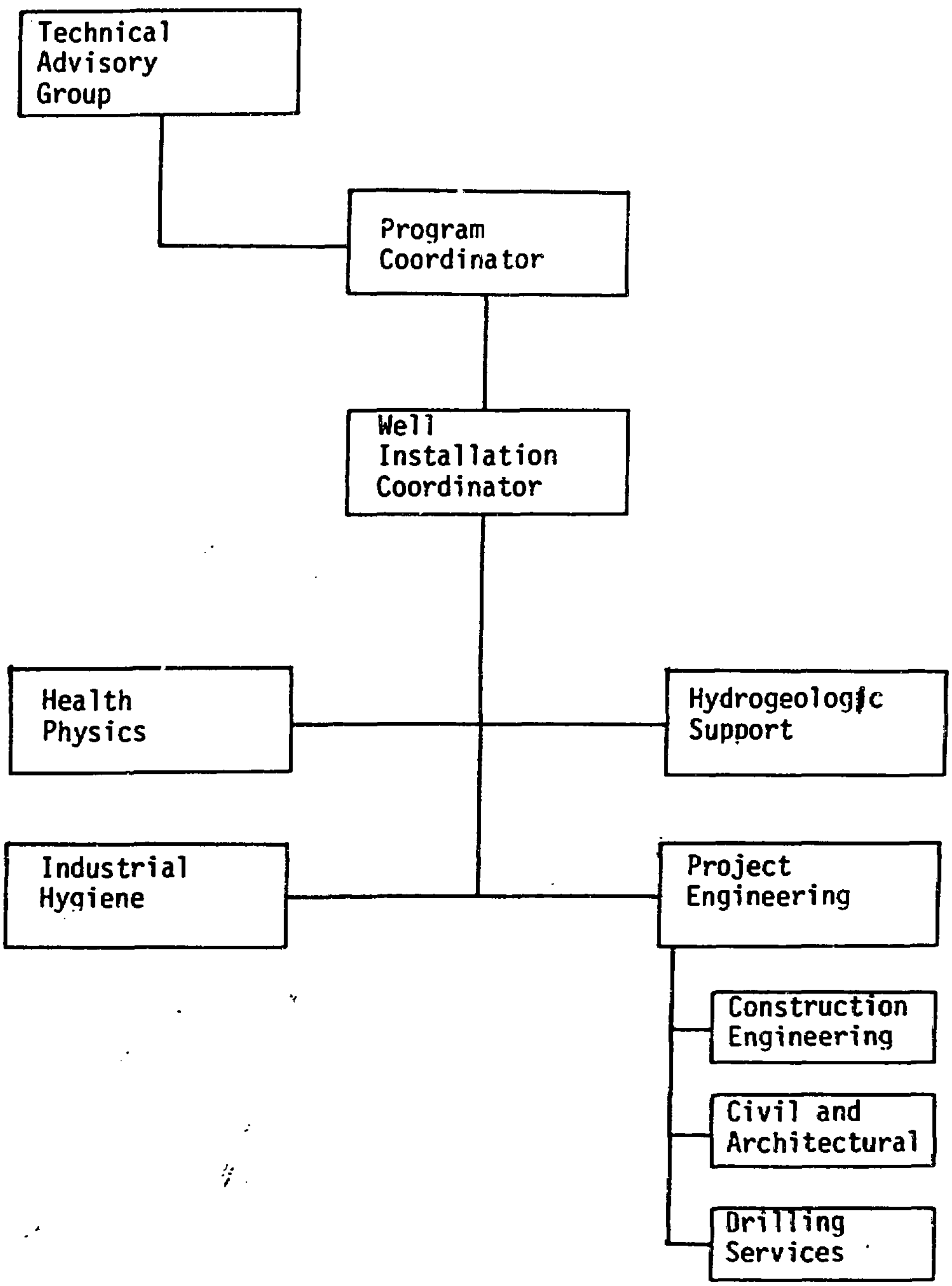

Figure 1

Project Team Structure

the determination (see Figure 2). This form is a "Construction Excavation/Penetration Permit," Note that Industrial Hygiene is one of several departments that must sign off before excavation begins. The other groups check to make sure that electrical utilities, water and drain lines, and natural gas lines are not encountered.

A kick-off meeting is held shortly before each phase of a drilling project begins. The scope and time-frame of the project are covered, and Industrial Hygiene has the opportunity to provide last-minute input at this point. Field liaison/communication channels are identified, and the contractor is advised of functional responsibilities of the different groups.

Prior to starting work on-site at ORNL, all well-drilling personnel must receive training in radiation safety, industrial hygiene, and environmental regulations. The degree and detail of training has been affected by the recent OSHA Standard for Hazardous Waste Operations and Emergency Response, 29 CFR 1910.120, which in turn was mandated by section 126(b) of the Superfund Amendments and Reauthorization Act of 1986 (SARA). Although ORNL has had elements of the required program in place since the inception of the Remedial Action Program, other items, such as the provision for training certification, have been incorporated into our current program.

Weekly, or routine, project status meetings are held by the well-installation coordinator to maintain communication among the diverse group of individuals involved with each project. Discussion of problems, concerns, schedules, individual well status, and upcoming work is held among the participants.

Protective Equipment

One of the key program elements which was in place early in the site characterization effort is the Industrial Hygiene respiratory protection program. This program assures that individuals are medically qualified and trained in the proper selection, use, maintenance, and care of respiratory protective equipment, and are properly tested and fitted for the correct size respirator. It is a written program which is in compliance with current DOE guidelines. Each sub-contractor must send all of his employees who will be on-site during drilling operations through this program. Only individuals who are medically qualified to wear a respirator will be tested and fitted.

Personal protective equipment (PPE) will be selected to protect personnel against known or anticipated chemical hazards (see Table 1). The selection is based on the initial classification of the site and on subsequent information. If no chemical hazards are encountered during the drilling of a well, the site becomes a Category 1 well for purposes of follow-up activities such as screening, grouting, etc.

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CONSTRUCTION EXCAVATION/PENETRATION PERMIT

Issued to (Contractor or Seller):	Contract No./CPFF Account No.		E. S. O. (W. O.) No.:
Project (Job, Subproject) Title:	Plant:	Building:	Floor:
Scope of Work:	Location:		Issue Date:

THIS PERMIT IS ISSUED ON THE BASIS OF AVAILABLE INFORMATION AND MAY NOT BE A COMPLETE DESCRIPTION OF ALL OBSTRUCTIONS. STOP WORK IMMEDIATELY AND CONTACT THE CONSTRUCTION ENGINEER IF OBSTRUCTIONS OTHER THAN THOSE DEFINED ARE ENCOUNTERED.

The following utilities are known to exist in the penetration area and a sketch or drawing defining the same must be attached to validate this permit.

Drawings:

#	NORTHING	EASTING	#	NORTHING	EASTING

REACTOR DIVISION

Special Hazards and/or Precautions:* COMMENTS:

SITE:	ELEC:	W.O.:

#	HP	IH	#	HP	IH	HP:	IH.:

NOTE:

*All drilling and cutting tools shall be grounded in accordance with Engineering Standard ES-1.2-6.

The following approvals are required as determined and circled by the Construction Engineer 1 2 3 4 5 6

1 Civil & Architectural Engineering	2 Site Engineering
3 Electrical Engineering	4 Engineering Mechanics
5 Other	6 Other

THE FOLLOWING APPROVALS ARE REQUIRED ON ALL CONSTRUCTION EXCAVATION/PENETRATION PERMITS

Construction Engineer	Foreman or Job Superintendent

Figure 2

TABLE 1

PERSONAL PROTECTIVE EQUIPMENT

Category 1:	Low Probability Of Encountering Chemical Contamination	
Required:		+ Normal work clothes + Work gloves
Recommended:		+ Eye protection + Hearing protection near drilling rig
Optional:		+ Dust mask (for protection against nuisance dust and pollen)
Category 2:	Moderate Probability Of Encountering Chemical Contamination	
Required:		+ Cotton overalls + Work gloves + Eye protection + Respiratory protection on standby, i.e., half-face respirator, combination cartridge to be readily accessible
Recommended:		+ Hearing protection near drilling rig + TYVEK suit
Category 3:	High Probability Of Encountering Chemical Contamination	
Required:		+ TYVEK suit over cotton coveralls + TYVEK head cover + Half-face respirator with combination cartridge and splash goggles or full-face respirator with combination cartridge + Leather gloves, rubber liner + Shoe covers
Recommended:		+ Special gloves, depending on specific chemical suspected + SCBA on standby + Hearing protection near drilling rig

Whenever chemical contamination is encountered, Industrial Hygiene field measurements will determine required protective equipment. Samples will be taken for on-site real-time analysis whenever possible and for rapid laboratory determination otherwise. A discussion of sampling methods is provided in the following section.

Whenever excavation into known burial trenches or sites becomes a reality, personnel may be required to fully dress out in chemical resistant suits and self-contained breathing apparatus (SCBA). Likewise, any work involving penetration of asbestos disposal trenches will require that an asbestos monitoring, protection, and record-keeping program be in place. This program is a written Industrial Hygiene procedure that meets current requirements cited in the OSHA Standard for Occupational Exposure to Asbestos, 29 CFR 1910.1001.

Drilling equipment does generate a certain amount of noise, and the sound levels will differ somewhat from rig to rig. Typical sound level measurements are shown in Table 2. Based on time spent in the various zones, as well as the often intermittent nature of the work, these levels should not present a problem, especially since rig operators and assistants are so mobile with regard to task flexibility. It is recommended that hearing protection be worn.

Table 2

Typical Noise Levels
Generated by Air-Rotary Drill

Distance from Drill	dBA
± 18 ft	89
± 12 ft	92
± 6 ft	97
± 6 ft	88 (idling)

Measurements taken with Quest Model 215 (Type II) SLM

When work begins on Category 3 sites, closer attention must be given to worker compliance with recommendations for the wearing of personal protective equipment. However, increasing the level of protection is not done without a penalty. Most workers on site are used to normal outside work, and are fully acclimatized to summer weather conditions, but the added heat load of full protective clothing may create heat stress if conditions are not closely monitored. A greater level of protective clothing may also produce potential problems due to a more limited range of vision, a reduction in worker postural flexibility, and a condition of altered physical balance. Depending on the specific PPE, communication may become impaired. While these are not specific industrial hygiene problems, they are of concern from the overall view of worker protection.

Surveillance

Industrial Hygiene will visit sites after work is underway, although in the case of Category 1 wells, it is optional unless there is a specific request or concern. Industrial Hygiene's presence at Category 2 sites is desirable at least during initial ground penetration and drilling of the first several feet of soil. Since there is, by definition, a moderate probability of encountering chemical contamination, appropriate monitoring instruments need to be on-site. The Hygienist also needs to be prepared with respiratory protection, etc. When Category 3 wells are drilled, an Industrial Hygienist will be required to be on-site, and will be prepared to dress out and monitor the area, until the well is proven to be uncontaminated.

In the event there is concern about a specific well or site, regardless of how it is categorized, the designated field liaison gets in touch with Industrial Hygiene. This person is usually the Construction Engineer assigned to follow the project. The liaison also advises Industrial Hygiene of imminent Category 2 work, since he is also in daily contact with the drillers. If anything out of the ordinary occurs on site, such as an unusual odor or unusual debris in the well cuttings, the field liaison has instructions to immediately contact Industrial Hygiene.

For on-site, real-time analysis of chemical contaminants, the instrumentation now available is less than ideal. Satisfactory state-of-the-art equipment for hazardous waste monitoring is still a thing of the future. The more common methods used are shown in Table 3, along with their limitations. No one method has the capability to supply all the answers. The question then becomes what to do to compensate for the lack of a comprehensive field analytical tool.

In the absense of a mobile field laboratory, the best approach is to utilize a combination of available techniques. The crux is knowing what instrument will give the best results within the time frame allowed. Generally speaking, this becomes a matter of experience. There are means of narrowing the field of candidates. There may be historical data to identify chemicals by site. There may be previous analytical data from adjacent or nearby sites. The odor may be unique enough to identify the

TABLE 3

COMMON MONITORING METHODS USEFUL
IN HAZARDOUS WASTE SITE EVALUATIONS

Method	Example	Comments
Infra-Red	Miran 1-B	1. Must know specific chemical suspected
		2. Pathlength mirrors can be misaligned by vibration/shock
		3. Subject to cross-interferences, i.e., false-positive readings
		4. High concentrations can damage analyzer optics, as can dust
Photoionization	TIP	1. Non-specific; measures "total" pollutant burden
		2. Measures only those compounds having an ionization potential of less than 10.6 eV
		3. Variable Response
Detector Tubes	Draeger	1. Questionable sensitivity
		2. Subject to cross-interferences
		3. Semiquantitative
Air Sampling	Charcoal Silica Gel	1. Slow analytical turnaround
		2. Affected by high humidity
		3. Multiple media sampling may be necessary
		4. Can become expensive

compound or family of compounds. If it can't be identified and if the situation is critical, work at the site must be suspended until laboratory analysis of an air sample is performed.

Site characterization work differs from site clean-up significantly by having a relatively small point source, the well opening. Once drilling is completed, there is very little opportunity for the contaminant to become airborne, even though it may be present in environmental water samples. Permissible exposure levels are based only on airborne concentrations, so extrapolation from such environmental data is meaningless, although, as mentioned earlier, it may serve as a screening tool.

Operating Experiences

Much of the initial site characterization effort to date has involved the solid waste storage areas at ORNL. Odors have frequently been the trigger for employee concerns. Although in no instance has the measured level been significant from an exposure standpoint, one particular occasion strongly demonstrates the role of industrial hygiene in health protection. Predictably, it started with a call for Industrial Hygiene to investigate an unusual odor near one of the drilling sites.

The well in question had been partially drilled several days earlier. An interruption in the work schedule had necessitated that the driller move to another site. There was no indication of anything unusual during the initial drilling activities. When drilling resumed, it was discovered that water had seeped into the well, and needed to be removed. Due to regulatory concerns, all water, sludge, and cuttings coming from a well must be pumped into a containment tank for holding. Samples are taken of the contents, analysis is made for both radiological and chemical content, and the mode of disposal is determined.

The containment unit consists of a 200-gallon tank, and an exhaust stack with a set of demisters to remove large airborne particles and water droplets, a set of HEPA filters, and a rain cap (see Figure 3). A high-pressure rubber hose runs into the tank from a diverter assembly positioned around the drill shaft.

An initial survey of the area was made with a photoionization instrument. There was no significant difference from background readings. An odor was detected, but it was reportedly stronger when the drill had been operating. It was decided that a measurement of levels in the exhaust air would be useful for comparison, so the drill was again put in operation. As air began to be forced from the exhaust, measured levels began to increase, although not dramatically.

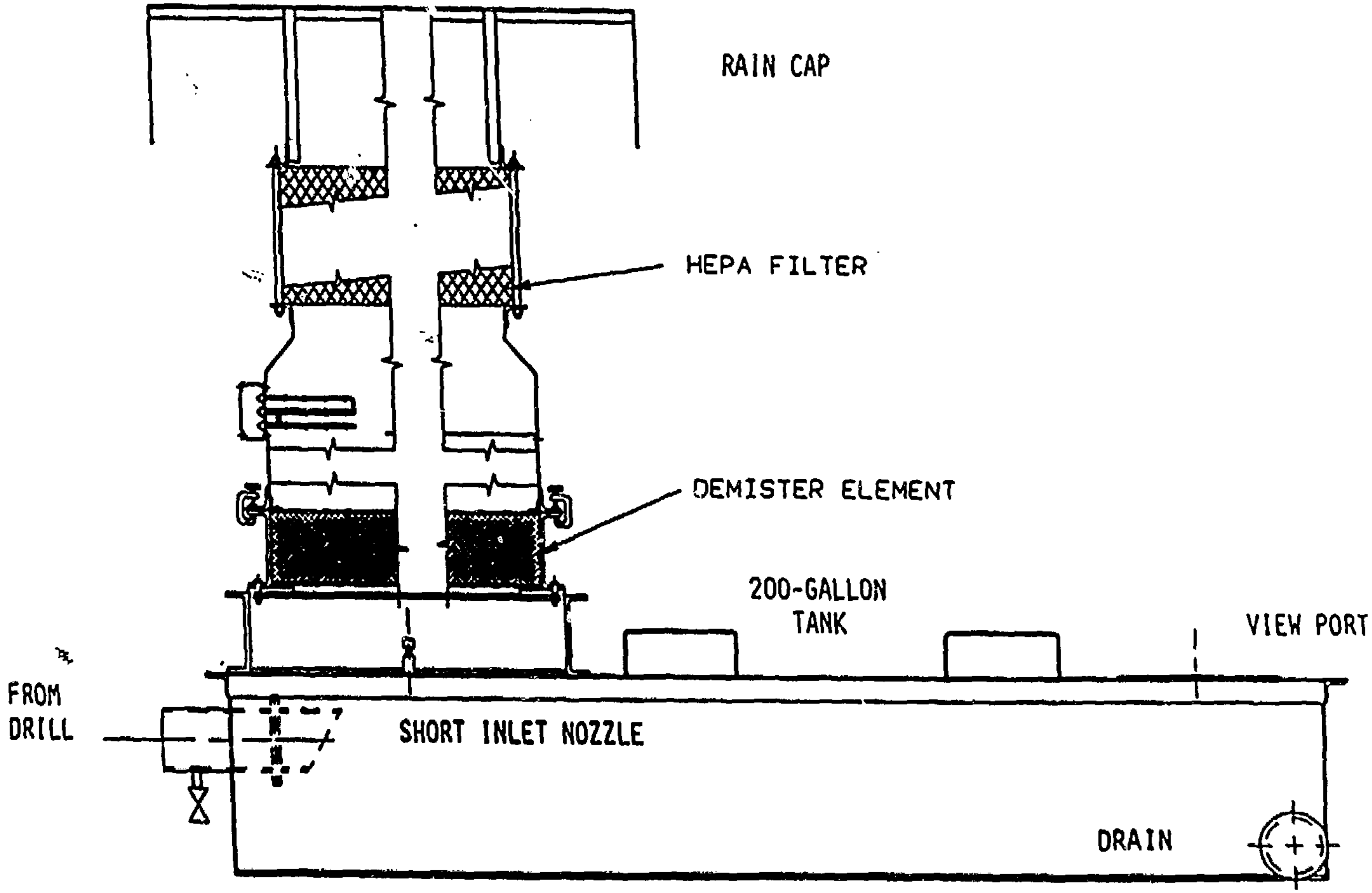

Figure 3
Well Drilling Containment Box

It was subsequently discovered that the well was located within a few feet of a group of solvent wells. It was also discovered that the removable top half of the containment tank had been reversed during a prior inspection, in effect positioning the drain valve directly beneath the exhaust. The early detection and communication of a suspicious odor brought about an examination of the tank configuration and an adjustment of that tank configuration to minimize any potential for exposure to the workforce. The situation provided an excellent learning experience on the benefits of proactive application of industrial hygiene procedures. An additional measure was taken to preclude possible skin exposure by replacing the rupture-prone high-pressure rubber hose with a flexible stainless steel hose.

Summary

It is essential that contractor health concerns be addressed in all stages of site characterization projects. Planning should address project team structures so as to establish channels of communication between various health and safety disciplines and workers. One effective means of doing this is by assigning a field engineer as a liaison. This person should be someone who is in constant contact with the site workers. Such an arrangement is advantageous in that it expedites information flow to project management.

Selection of field monitoring instruments should include state-of-the-art equipment as well as traditional methods. Work-site evaluation is complicated, and equipment selection may not be easy. Deciding on appropriate equipment may be facilitated by utilizing available environmental data to determine potential contaminants. It should be noted, however, that the existence of a chemical in soil or water samples does not mean it will be detectable in air samples, much less in similar quantities or proportions.

An Industrial Hygiene program should be developed as soon as the project scope is determined. Such a program should include a method of assessing and categorizing each specific site for the potential it has for exposing workers to hazardous substances. It should address the requirements necessary for workers to be considered qualified to work on the project. It should list the types and levels of personal protective equipment for each category. Finally, the program should outline the responsibilities of each group in the project team in relation to contractor health protection.