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Applicability of Environmental Laws to the Remedial Investigation and Cleanup of a Site at Naval Air Station Fallon, Nevada

D. R. Smuin
J. W. Crutcher

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D. R. Smuin
J. W. Crutcher

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ABSTRACT

A hazardous waste remedial investigation is currently being performed at 21 sites at the Naval Air Station Fallon in Fallon, Nevada. The investigation is driven by various regulations and under the purview of two regulatory agencies. This paper examines the application of environmental regulations to one site at Fallon. The complex history of events at the site and the involvement of the Department of Defense combine to complicate the issues at hand. These issues include (1) resolving which agency is the lead agency in the investigation; (2) deciding whether the site falls under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or under the Resource Conservation and Recovery Act (RCRA); (3) rescoring the site under the new hazard ranking system as more information is gathered; and (4) applying changing regulations and standards to the site investigation and cleanup.

INTRODUCTION

A hazardous waste remedial investigation is currently being performed at 21 sites at the Naval Air Station (NAS) Fallon in Fallon, Nevada. One of these sites, a fuel tank farm, is the subject of a lead agency controversy. The discovery, in August 1986, of JP-5 jet fuel floating on the water table at the base's fuel tank farm prompted the Nevada Department of Environmental Protection (NDEP) to issue a finding of alleged violation of a state statute prohibiting discharge of pollutants without a permit and an order for remediation. Application of confusing and sometimes ambiguous state and federal regulatory standards to the jet fuel contamination leads to problems with interpretation. Does jurisdiction belong to the state, to the Department of Defense (DOD), or to the U.S. Environmental Protection Agency (EPA)? If EPA has jurisdiction, does the site fall under the program to manage past waste disposal sites, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or does it fall under the Resource Conservation and Recovery Act (RCRA), which was promulgated to control current activities? Furthermore, is JP-5 jet fuel a hazardous waste, or is it exempt because it is classified as a petroleum hydrocarbon?

This report attempts to answer these questions by presenting the chronology of events that created a lead agency controversy at this site and by examining both the basis and application of environmental regulations. Also addressed are the elements of human risk and threat to the environment pertaining to remediation at this site.

ENVIRONMENTAL REGULATIONS

DEPARTMENT OF DEFENSE ENVIRONMENTAL PROGRAM

Past waste disposal methods, although acceptable at the time, have frequently caused unexpected long-term problems through release of hazardous pollutants into the soil and groundwater. In response to a growing recognition of these problems, Congress directed the EPA to develop a comprehensive national program to manage past waste disposal sites. The program is outlined in the Comprehensive Environmental Response, Compensation, and Liability Act of December 1980 and the Superfund Amendments and Reauthorization Act (SARA) (NEESA 1984).

Department of Defense efforts in this area preceded the nationwide CERCLA program. In 1975 DOD developed a pilot program to investigate past disposal sites at military installations. DOD defined the program as the Installation Restoration Program (IRP) in

1980 and instructed the services to comply with program guidelines (NEESA 1984). Funding was provided under the Defense Environmental Restoration Account (DERA).

The Navy manages the IRP in three phases. Phase I, the Preliminary Assessment/Site Inspection (PA/SI), identifies potential threats to human health or to the environment caused by past hazardous substance storage, handling, or disposal practices at naval facilities. Phase II, the Remedial Investigation/ Feasibility Study (RI/FS), verifies and, if necessary, characterizes the extent of contamination present through sampling. The RI/FS provides additional information regarding migration pathways, characterizes the extent of contamination present, and evaluates the most feasible remedial action. Phase III, the Remedial Action (RA), provides the required corrective measures to mitigate or eliminate confirmed problems.

The Chief of Naval Operations initiated the Navy IRP in September 1980, and superseded this order by another in May 1983. The Naval Facilities Engineering Command (NAVFACENGCOM) manages the program within the existing structure of the Naval Energy Protection Support Service (NEPSS) (Dames and Moore 1988). The program is administered by the Naval Energy and Environmental Support Activity (NEESA). NEESA conducts Phase I PA/SIs in coordination with NAVFACENGCOM.

The Navy was directed by the Congress to comply with the provisions of CERCLA in Executive Order 12316, August 1981, and the policy was adopted in the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated December 1981. The Navy has since adopted the EPA methods presented in OSWER Directive 9335.3-01, *Guidance for Conduction of Remedial Investigation and Feasibility Studies Under CERCLA,* March 1988, for the IRP. The investigation portion of the RI/FS is generally conducted in two phases—verification and characterization. In the verification phase, short-term analytical testing and monitoring determine whether specific toxic or hazardous materials, identified in the PA/SI, are present in concentrations considered to be hazardous. Various standards are compared to the analytical data in determining the degree of each potential hazard. The risks involved are determined by considering specific contaminant characteristics, such as mobility in various media, toxicity, proximity to receptors, and pathways to receptors. In the characterization phase, the extent of contamination in various environmental media is defined (e.g., soil and groundwater). During the phased investigation, a technical review committee (TRC), composed of state and federal regulatory personnel, state and local government representatives, local technical professionals and members of the IRP field investigation team, exchange information about the progress and findings of the investigation. During this exchange, questions of the applicability of various regulations and enforcement authority are often broached.

IRP, NCP, AND CERCLA

The legislative mandate for both federal and nonfederal programs to remedy uncontrolled hazardous waste disposal at sites created before 1980 is CERCLA, which is administered by the EPA. However, Executive Order 12316 delegates the responsibility for response actions at DOD facilities to the Secretary of Defense. These actions are required to be consistent with the National Contingency Plan (NCP). Amendment of the NCP is the responsibility of EPA.

Overall, the Navy IRP is consistent with the NCP and CERCLA as illustrated in Fig. 1. IRP steps are positioned parallel to the equivalent steps specified in the NCP. The differences in terminology are inconsequential. Other differences between the two programs are due to the following factors:

- Phase I of the IRP includes a site ranking step based on available data obtained during the records search. The NCP does not call for ranking sites until initial field sampling efforts have been conducted. The reason for the early ranking in the IRP is that the Phase I evaluates all sites on the installation, whereas the NCP is concerned with individual sites. The Navy relies on its own score as a resource management tool to screen out lower priority waste disposal sites and to prioritize site investigations.* In contrast, individual sites brought into the NCP evaluation already show some evidence of high-hazard potential.

- The NCP provides for implementing "operable units" prior to the feasibility study. Operable units are control methods that will be consistent with the finally selected remedial actions and can be put in place without detailed planning. The Navy IRP has an equivalent option that involves implementation of emergency responses or simple removal actions, where judged necessary by NAVFACENGCOM.

- The Navy IRP contains an alternate phase between the RI and FS, involving the development of new cleanup technologies. The NCP has no equivalent provision; however, this is inconsequential because, in practice, the Navy IRP generally utilizes known and accepted cleanup technologies.

- The NCP does not spell out the procedural steps for design, construction, and compliance review as does the IRP. There is, however, no conflict in the program on this issue.

LEAD AGENCY

A question raised by the preceding comparison is: If the IRP is so similar to CERCLA, why did the Navy formulate its own guidance and program directives? The answer is: to maintain territorial control. Even though Congress has mandated that all Federal Agencies must comply with CERCLA, the Navy is determined to maintain control of activities related to Navy property or wastes.

In practice, as long as the Navy demonstrates a "good faith" effort and makes progress with the administration of its program, the EPA and the Nevada Department of Environmental Protection will probably not challenge the Navy's position as lead agency. However, if the Navy fails to act on sites with demonstrated impacts, sites with potentially damaging impacts, or sites in the public eye, the agencies may start flexing their regulatory muscles to force the Navy to action. This is the case at the new fuel farm at NAS Fallon

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*This practice may someday be challenged by EPA because exempting a potentially contaminated site on the basis of records and interviews, without a formal Record of Decision (ROD), is questionable. Field sampling and testing are generally required.

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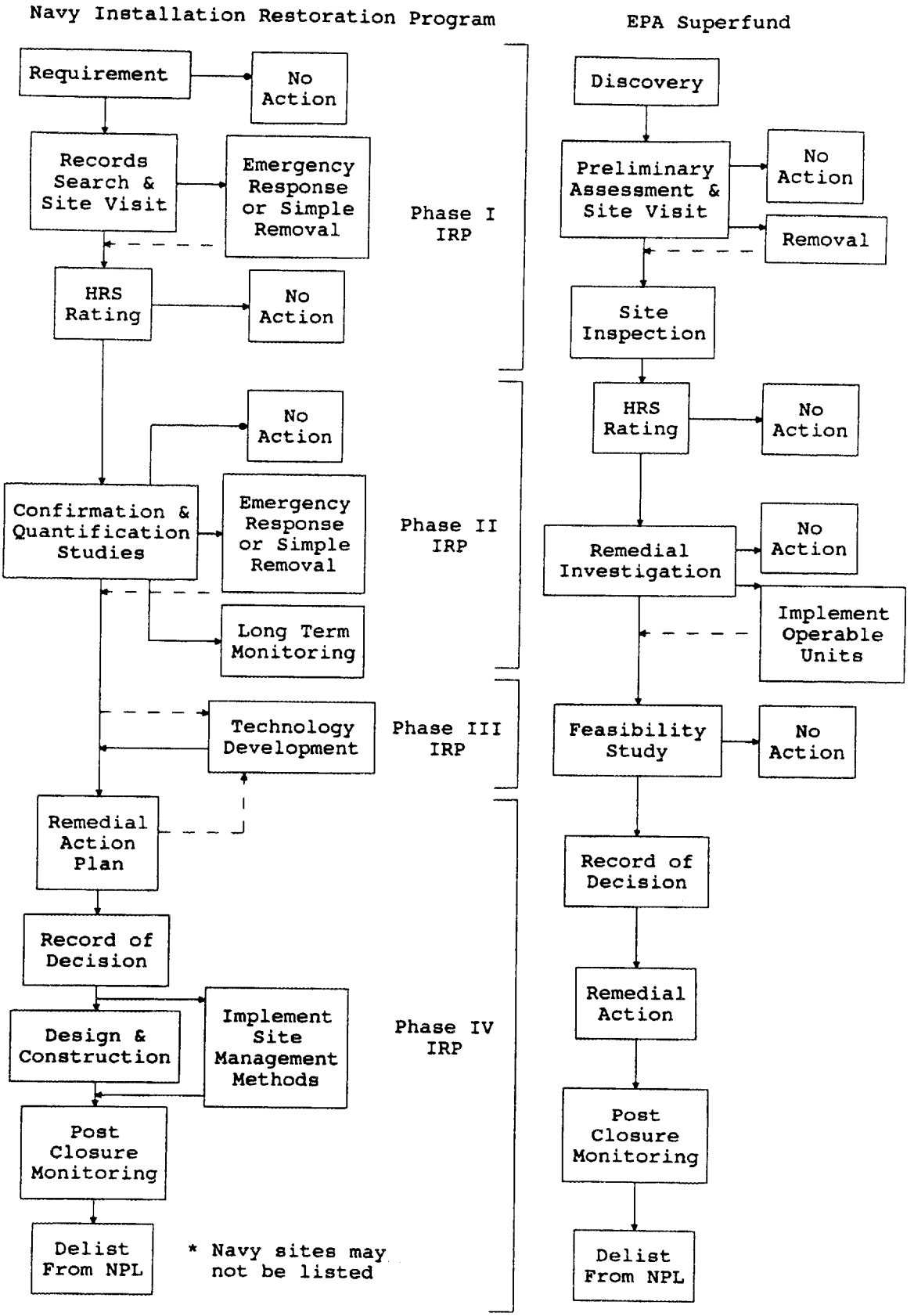

Fig. 1. Comparison between EPA's Superfund and U.S. Navy's IRP.

where the NDEP has issued orders to clean up the site and has performed a limited investigation to assess the extent of soil contamination.

The CERCLA guidance and the Navy's IRP guidance both address the issue of lead agency and support agency. The terms "lead agency" and "support agency" are used to reflect the fact that either EPA or a state or a federal facility may have the lead responsibility for conducting an RI/FS. The supporting agency plays a review and concurrence role and provides information, such as applicable or relevant and appropriate requirements (ARARS). ARARS contain the specific contaminant concentration standards that trigger remedial actions and define their success (EPA, CERCLA Compliance 1988). The roles of the lead and support agencies in each phase of the RI/FS process are described in the CERCLA guidance. Conflict arises when there is a question as to which agency should occupy the lead position. For instance, the Navy considers itself the lead agency in all investigations of sites on or related to Navy property or wastes; the NDEP considers itself the lead agency in all matters related to the issuance of orders to clean up a site and all nonlisted CERCLA sites in the state; and the EPA considers itself the lead agency at all sites listed on the National Priorities List (NPL) under the NCP. When a site satisfies all three agencies' criteria for lead agency status, there is no clear provision for settling the conflict. However, the NCP would undoubtedly have jurisdiction, and the EPA would eventually assume the role of lead agency.

NAVY IR PROGRAM APPLICATIONS AT NAS FALLON

The Phase I PA/SI was completed by NEESA on the Naval Air Station (NAS) at Fallon, Nevada, in April 1988 (Dames and Moore 1988). The PA/SI contains the results of a thorough records search, employee interviews, and an on-site survey with some limited soil sampling. Sufficient information was collected during the PA/SI to evaluate each site on the base using the Hazard Ranking System (HRS). The HRS, developed by the EPA, systematically evaluates (scores) the relative severity of potential problems related to each site. An RI/FS was recommended for 21 sites where the PA/SI indicated the presence of contamination.

At NAS Fallon there is one site that is the subject of a lead agency controversy. The discovery of fuel floating on the water table at the fuel tank farm on the base prompted the issuance by NDEP of a finding of alleged violation and an order in August 1986. These were issued in accordance with the Nevada Revised Statutes (NRS) 445.317 and 445.324. The NDEP found that NAS Fallon was in violation of NRS 445.221, which prohibits the unlawful discharge of pollutants without a permit. The order required that NAS Fallon submit data on the extent of contamination and implement an approved plan to clean up the site to the satisfaction of the NDEP.

As a result the base embarked on a program to install wells and assess the extent of contamination at the site. Base personnel, who lacked the required experience and technical expertise, were in charge of the initial investigation. Little useful information was obtained. The base then contracted a private engineering consulting firm, ERM West, to perform an investigation. ERM West completed a soil-gas survey, drilled several soil

borings, and installed eight wells. All of the wells, with the exception of the upgradient background well, indicated groundwater contaminated by petroleum hydrocarbons (JP-5 jet fuel), which in turn demonstrated that the limits of the contaminant plume were still unknown.

One of ERM West's recommendations was to design an interim extraction system to start removing free product found floating on the shallow groundwater (ERM West 1988). As an interim cleanup measure, the base initiated a program to pump product from two previously installed wells. The program was unsuccessful because of improper well design (ERM West 1988) and was discontinued when Phase II of the IRP began in September 1988. The rationale was that the Phase II RI/FS would take care of the site along with the other 20 sites recommended for RI/FS on the base.

After two years and several delays caused by lack of funding, the site investigation is essentially complete and a remedial action plan (RAP) is being prepared. The RAP is subject to NDEP and EPA approval prior to implementation. Thus, actual cleanup activities may still be several months, or even years, away, depending on the extent of comments and revisions requested by the regulators and the availability of DERA funding for the cleanup.

In March 1989 the NDEP issued a notice of violation on the oil/water separator at the fuel farm, considered to be the main source of contamination at the site. The order required the base to take immediate action. The base closed the oil/water separator, but the unit will probably remain in place until a permanent remedial action is undertaken for the site.

In February 1990 another state action was started at the site. It resulted when disgruntled subcontractor employees at the fuel farm reported to the media that a 20,000 to 30,000 gallon fuel spill had occurred at the site in January 1988 (NDEP April 1990). The spill had allegedly occurred during transfer of fuel from one tank to another and was partially cleaned up and then covered up by site subcontractor personnel (NDEP April 1990). State underground storage tank regulations require that all spills over 25 gallons be immediately reported to the NDEP. The subcontractor did not report the spill to the Navy or to NDEP. The Navy was unaware that the spill had occurred and denied claims of an unreported spill by the NDEP and the news media. The state, assuming the role of lead agency, with grudging Navy approval, proceeded to mount their own investigation on the base. Using a backhoe to trench and collect soil samples, they found fuel-contaminated soil in the vicinity of the alleged spill and confirmed that a significant spill had occurred in the area (NDEP April 1990). Further investigation by the Navy and NDEP revealed the details of the occurrence. The state fined the subcontractor $118,000, and the case was settled out of court (Asher 1990). The Navy is still considering criminal action against subcontractor personnel.

Prior to the controversy caused by the fuel spill cover up, the EPA had assumed a passive role relating to the NAS Fallon site investigation. The site is not on the NPL, and the EPA was content to let NDEP assume the support agency role. EPA representatives were invited to comment on various planning documents and to join in planning and information meetings, but declined to participate. With the increased level of awareness of

problems at the site, the EPA became interested. They have forgone all opportunities for project planning input, but they are considering rescoring the site under the new HRS method, using the new data collected by the recent investigation. This would be consistent with CERCLA because, unlike the Navy's IRP, some sampling is usually performed at a site before it is given an HRS, and the HRS is often revised to reflect new information developed by field activities. Because of the potential for migration of contaminated groundwater to the surface water at the Stillwater National Wildlife Refuge, rescoring will probably result in listing the site on the NPL and allow the EPA to assume lead agency status. Stillwater National Wildlife Refuge is considered a vital wetland for migratory birds along the Pacific flyway and has received national media attention in recent years (Moser 1988). If the site is rescored and listed on the NPL, there may be conflict between the Navy and the EPA because the Navy will want to retain control of the project. The Navy still uses the fuel farm to supply fuel to flight training operations. Therefore, having an outside agency in control of activities at the fuel farm could impact the operations at the base. Of course, this problem may never arise. Unless public outcry forces the issue, the site may already be undergoing remedial action by the time the EPA completes their rescoring and listing procedure.

The fact that the fuel farm is an operable unit brings up another controversy concerning the site. Does the site come under CERCLA or RCRA regulations?

CERCLA VERSUS RCRA CLASSIFICATION

SITE CLASSIFICATION

CERCLA legislation was promulgated primarily to deal with past waste disposal activities and spill sites. RCRA was promulgated to control current activities. The DERA funding used by the Navy for the IRP is specifically tagged for CERCLA compliance. Any actions related to RCRA at NAS Fallon must be paid for from the base's operating funds. Evidence at the fuel farm site suggests that some of the contamination is the result of current leaks and practices that would technically fall under RCRA. The spill of 1988 certainly relates to the RCRA underground storage tank regulations. However, much of the contamination is the result of past waste disposal practices and spills that relate to CERCLA. It is virtually impossible to determine which components of the contaminant plume, or even what percentage of the plume, are the result of activities falling under CERCLA as opposed to RCRA. When the time comes to start the major cleanup, a formula for funding the program may have to be derived. Obviously, to maintain funding and control, the base would prefer to have the site cleaned up with DERA funds; however, there is a question of legality involved because DERA funding is used only for CERCLA compliance.

The EPA guidance for dealing with CERCLA issues as opposed to RCRA issues differs significantly. One of the main differences is the project timetable. Work on CERCLA sites not listed on the NPL is allowed to progress as time, money, and other resources are available. On a RCRA site or a Superfund site, however, there are more rigid timetables for the completion of each step in the investigation and clean up of the site. The requirements for groundwater monitoring at a RCRA site are very specific and more

expensive to implement than the traditional hazardous waste industry's approach to site characterization. Even though the procedures in the guidance are not considered regulations, the regulators treat the procedures as such. For example, if a site work plan does not recommend the same number and type of monitoring wells for a site as the guidance recommends, then the regulators will not approve the work plan. It is acceptable to implement the plan without approval; however, later, when regulatory sign-off is required for a Record of Decision (ROD), approval may be withheld pending compliance with the guidance.

An action being taken to standardize procedures is the establishment by the American National Standards Institute (ANSI) of standard operating practices (SOPs) for hazardous waste site investigations. ANSI gathers input from professionals in the field and writes procedures that follow accepted practices. The establishment of accepted practices may not always be adaptable to changing field conditions. However, it is certainly better to implement SOPs than to risk having inexperienced regulatory personnel direct site investigation and cleanup activities. Problems arise when regulators come onto a site and require compliance with the general EPA guidance, while the professional managing the field operation is applying a specific technique mandated by field conditions at the site. In recognition of this problem, the EPA has already agreed to adopt the ANSI SOPs as soon as they are finalized.

WASTE CLASSIFICATION AND APPLICABILITY OF STANDARDS

Most of the contaminants of concern at NAS Fallon are classified as petroleum hydrocarbons. The various environmental laws treat oil related hydrocarbons as a separate category from hazardous wastes. Section 311 of the Clean Water Act (CWA) regulates accidental or intentional discharges of oil and hazardous substances (Arbuckle 1989). This elaborate provision was first enacted as part of the Water Quality Improvement Act of 1970, which was revised and incorporated into the Federal Water Pollution Control Act of 1972 as Section 311. The 1977 amendments modified Section 311 in several ways, principally with respect to limits on the liability of a discharger of oil or of hazardous substances. Congress further amended Section 311 in 1978, primarily in order to make the section's provisions for hazardous substances more workable. In 1980 with the enactment of CERCLA, the EPA's authority and resources to clean up spills and releases of hazardous substances were dramatically expanded. Spills of petroleum products continue to be regulated primarily under Section 311 of the Clean Water Act. Spills at deepwater ports, or from the outer continental shelf oil and gas operations, are also governed in part under the Deepwater Ports Act of 1974 and Outer Continental Shelf Lands Act Amendments of 1978.

Although oil and hazardous substances are covered by the same Clean Water Act provisions, they have traditionally been treated separately by the EPA. The Clean Water Act prohibits the discharge of harmful quantities of oil into navigable waters. EPA regulations have defined the term "harmful quantities" to cover all discharges that "violated applicable water quality standards or cause a film or sheen upon the surface of the water...." Thus, virtually all discharges of oil are prohibited. Oil is defined as "any kind or in any form," including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. Further refinement of the definition for oil includes

petroleum products, crude oil, or any of its fractions. The definition of navigable waters varies but, for the purposes of the Federal Water Pollution Control Act, is defined in Section 507(7) as "waters of the United States, including the territorial seas," and includes, but is not limited to (1) all waters that are presently used or were used in the past, or may be susceptible to use as a means to transport interstate or foreign commerce; (2) tributaries of navigable waters of the United States, including adjacent wetlands; (3) interstate waters, including wetlands; and (4) all other waters of the United States such as intrastate lakes, rivers, streams, mudflats, sandflats, and wetlands, the use, degradation or destruction of which affect interstate commerce (40 CFR Part 112). To more simply state this complex definition, we quote Trelease (1986):

> Thus a legal definition of "navigable waters" or "waters of the United States" within the scope of the CWA includes any waterway within the United States also including normally dry arroyos through which water may flow, where such water will ultimately end up in public waters such as a river or stream, tributary to a river or stream, lake, reservoir, bay, gulf, sea, or ocean either within or adjacent to the United States.

This definition has also been interpreted to include groundwater (Blake 1987).

CERCLA SUBSTANCES AND RCRA WASTES

Under CERCLA Section 101(14) a hazardous substance is any substance EPA has designated for special consideration under the Clean Air Act, Clean Water Act, or Toxic Substances Control Act. This definition includes any hazardous waste under RCRA. Moreover, EPA has designated additional substances as hazardous if they have been determined to potentially endanger human health and the environment. A list of these substances is presented in 40 CFR part 302.

Only two types of substances are specifically excluded from the definition of hazardous substances: (1) petroleum and (2) natural gas. Interestingly, tank bottom sludge from petroleum storage tanks is a listed waste in part 302. Under CERCLA Section 101(33), a "pollutant or contaminant" can be any other substance, not on the list of hazardous substances, which may cause any adverse effects in organisms and/or their offspring. Again, petroleum and natural gas are excluded, even though they would clearly qualify under this definition. CERCLA specifies that the petroleum exclusion protects petroleum, "...including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance" through other CERCLA provisions.

Two major questions of interpretation have been created by this exclusion. First, all petroleum naturally contains some substances (e.g., benzene, toluene, xylenes, and ethylbenzene) which are "otherwise specifically listed" as hazardous substances through other CERCLA provisions (Bauman 1988). Secondly, oil found at wastes sites may for various reasons (e.g., mixing, use) sometimes be contaminated with other hazardous substances not indigenous to petroleum. Does all waste oil—no matter how contaminated with other substances—qualify for the exclusion so long as it may be basically characterized as petroleum, or does no petroleum qualify for the exclusion due to the indigenous hazardous substance content?

EPA answered both questions in a legal memorandum in 1987 (Blake 1987). EPA ruled that the presence of indigenous hazardous substances (benzene, toluene, etc.) would not defeat the protection of the petroleum exclusion. EPA also ruled, that even though the material may be basically characterized as petroleum, it will lose the protection of the petroleum exclusion if the material is also found to contain substances which are "not normally found in refined petroleum fractions or present at levels which exceed those normally found in such fractions" (Blake 1987).

Under EPA's interpretation, the issue of whether a waste oil is a hazardous substance will depend upon EPA's ability to prove at a specific site that a waste oil contains levels of hazardous substances beyond those normally found in petroleum. This may be difficult because the various fractions of petroleum distillates can often contain quite different concentrations of certain constituents due to the composition of the original crude oil. Also it does not seem logical to exclude gasoline [especially leaded gasoline, which contains high levels of benzene, toluene, xylenes, ethylbenzene (BTXE), and lead] as non-hazardous while JP-5 jet fuel (which resembles kerosene and contains low concentrations of BTXE and no lead, but may be contaminated with minor amounts of solvents) would be classified as hazardous. Of course, there is the element of practicality. If gasoline were classified as a hazardous substance, the American public would have to be trained in hazardous waste management in order to fill automobile gas tanks, and this is not practical.

To trigger jurisdiction under RCRA regulations, a substance must be both (1) a waste and (2) either listed or meet one of the hazardous characteristics. Hazardous characteristics include four tests: ignitability (closed-cup flash point of 140°F), corrosiveness, reactivity, and toxicity (Bauman 1988). JP-5 jet fuel has a closed-cup flash point of 140°F (NDEP April 1990) and would qualify as a hazardous waste under RCRA hazardous characteristics criteria if it were not specifically exempted. In all cases the RCRA determination is based on concentrations of toxic constituents in some numerical threshold amount. Under CERCLA, however, EPA states that a substance that contains any amount of a listed hazardous substance will trigger jurisdiction (CFR 40, Section 302).

Testing at the new fuel farm at NAS Fallon indicates that the jet fuel floating on the groundwater is essentially pure product and contains no hazardous substances other than those indigenous to the fuel. This exempts it from CERCLA. Furthermore, the fuel has degraded somewhat through the loss of volatile organic compounds (VOCs), and the flashpoint is now about 155°F. This exempts it from classification as a RCRA waste. However, the product plume is in very close proximity to a surface water drainage ditch that ultimately drains into Stillwater Wildlife Refuge. Although JP-5 jet fuel is not a listed hazardous waste, it is known to be toxic to fish and wildlife if present in sufficient concentrations (NDEP April 1990). Apparently, NDEP believes that sufficient concentrations of JP-5 jet fuel are present in the plume to pose an environmental threat to the refuge, or they would not have issued an order for cleanup.

Problems encountered when considering petroleum hydrocarbon contamination include determining (1) the waste classification, (2) the threshold limit to target for cleanup, and (3) which regulations to follow. Fortunately, in Nevada and most other states, the state DEP has promulgated regulations setting forth action levels and cleanup goals. In October 1987 the NDEP promulgated a hydrocarbon cleanup policy that permitted up to 100 ppm of total petroleum hydrocarbons in the soil. Values greater than 100 ppm in 10 yds^3 of soil were

considered action levels requiring cleanup. Similarly, more than 1 in. of floating product on the water table required groundwater cleanup. This policy was amended in September 1990. Currently, the action level for soil is 100 mg/kg, with no volume specification, and the action level for groundwater is 0.5 in. of floating product. Cleanup goals are "removal for soil contaminated with petroleum hydrocarbons" and "below the dissolved product action level for groundwater" (NDEP October 1990). A formula for calculation of the dissolved product action level is presented in the regulations.

The implementation of an action level of 0.5 in. of floating product may sound reasonable; however, the measurement of floating product levels is very imprecise. The new regulations do not stipulate a technique for measuring the thickness of the floating product. Because of errors introduced by the density and viscosity differences between water and product, there is no way to determine product thickness in a well to the nearest 0.5 in. and correlate it to the product thickness on the water table. Because of the difficulty in measuring the thickness of floating product, the detection of any free-floating product is generally interpreted as an action level requiring groundwater cleanup.

The method by which the NDEP action levels were derived is not known. Evidence suggests that the policies are an outgrowth of regulations promulgated to deal with leaking underground storage tanks, rather than the application of a scientific, health-risk based model. Most of the established numerical standards or guidelines are in part "educated guesses" (Bauman 1988). Such numerical standards are typically based on limited field data and may be generated by analytical techniques of questionable accuracy, or they are based on modifications of existing water quality standards that may have no relevance to soil contamination. Examples of some of the numerical standards that have been used (formally or informally), or that are under consideration in various regulatory jurisdictions, include either 10, 100, or 1000 ppm total petroleum hydrocarbons; 100 and 500 ppm, cumulative benzene, toluene, and xylene; and 60 ppb benzene (a very conservative standard which is below many analytical detection limits) (Bauman 1988). The EPA uses 100 ppm total petroleum hydrocarbons in the soil as evidence that a release has occurred, although no substantive documentation is offered for selection of that value (Leiter 1988).

IMPLICATIONS OF THE NEW STATE REGULATIONS

Environmental regulations and standards are constantly in a state of flux, which can have a significant impact on an investigation and any subsequent remedial action. A site that may be considered for a no-action alternative under one set of standards may suddenly become targeted for cleanup if new, stricter standards are adopted. Additionally, the cost for cleanup of soil and groundwater to meet more stringent standards sometimes increases almost exponentially beyond certain concentrations, while the incremental decrease in the health risk is very small. For example, removing floating product from the surface of groundwater is often relatively simple and inexpensive, but removing low concentrations of dissolved constituents in a groundwater plume may be very expensive and time consuming. In fact, merely monitoring the cleanup progress of a dissolved plume can cost hundreds of thousands of dollars because of the high cost of laboratory analyses.

In the case of the fuel farm at NAS Fallon, negotiation of cleanup goals may be possible. The new NDEP hydrocarbon policy lists several criteria for exemption to the

standards. For contaminated soil above the action level, corrective action may be exempted depending on the following considerations (NDEP October 1990):

- the depth to groundwater,
- the distance to irrigation or drinking water wells,
- the type of soil,
- the annual precipitation,
- the type of regulated substance released,
- the extent of contamination,
- the present and potential land use,
- the preferred routes of migration,
- the location of structures or impediments,
- the potential for a hazard related to fire, vapor, or explosion, and
- any other factor that is specific to a site as determined by the division.

For groundwater, the NDEP may exempt corrective action if any of the following conditions are true (NDEP October 1990):

- the groundwater affected by the release does not serve as a source of drinking water and is not likely to serve as a source of drinking water in the future because it is economically or technologically impractical to (1) recover the water for drinking because of the depth or location of the water or (2) render the water fit for human consumption;
- the total dissolved solids in the groundwater is more than 10,000 mg/L, and the groundwater is not reasonably expected to become a supply of drinking water; or
- the owner or operator demonstrates that the contamination does not and will not in the future exceed the dissolved product action level beyond the boundary of the site.

Several of the above criteria could be applied at the fuel farm at NAS Fallon, and at least part of the contaminated media may be exempted from corrective action. At least three soil criteria for exemption may be applicable. First, the annual precipitation is very low (less that 5 in. per year), which provides very little moisture to mobilize residual soil contamination. Further measures could be used to prevent infiltration of precipitation and prevent migration of residual fuel in the unsaturated zone. These measures could include covering the land surface with an impermeable barrier and maintaining a constant positive head in the nearby drainage ditch. Secondly, the land use is restricted to base personnel and will continue to be restricted as long as the Navy controls the property, thus preventing possible exposure to the public. Thirdly, unlike gasoline, JP-5 jet fuel is composed mostly of aliphatic hydrocarbons, not aromatic hydrocarbons. Therefore, very low concentrations of VOCs are associated with JP-5, and the potential for fire and vapor hazards is low. The residual aromatic hydrocarbons are generally very biodegradable once the floating product has been removed and would not represent a long term health hazard.

Several of the groundwater criteria for exemption may also apply to the site. The shallow groundwater is of very poor quality. It is naturally high in dissolved salts and has concentrations of arsenic, selenium, boron, and barium that exceed all federal water quality criteria. There are no downgradient drinking water wells. Once the floating product is removed from the water table, there will be little likelihood of the dissolved product ever reaching beyond the boundary of the site. And, even if it did, the distance to the base boundary would preclude the plume's extending across the base boundary because the dissolved product would naturally biodegrade long before moving that distance. Aliphatic hydrocarbons generally have very low solubility in water and are not extremely toxic; thus, the release of minor amounts of contaminated groundwater does not represent a significant hazard to human health or the environment. Based on these criteria, there does not seem to be sufficient justification for cleaning up the site, beyond removing the floating product plume.

FEDERAL PETROLEUM HYDROCARBON POLICY

The Federal Government has not completely ignored the problem of petroleum hydrocarbon contamination. There has been a proposal to enact an oil superfund since 1975 (Wallace and Ratcliffe 1983). The House of Representatives has twice passed bills on the subject by wide margins, but in both instances the bills died in the Senate. No oil superfund bills have been adopted because of the controversial nature of the problem and the far reaching effects of enacting comprehensive oil pollution legislation. Congress did finally act on the largest unregulated problem concerning petroleum hydrocarbons by enacting the Subtitle I of RCRA in 1984 (Hills 1988). Subtitle I of RCRA required EPA to develop a comprehensive regulatory program to prevent, detect, and correct releases from underground storage tanks storing regulated substances—petroleum and hazardous substances, including chemicals. The law also encouraged states to develop and substitute their own underground storage tank regulatory programs that are no less stringent than the federal rules. But again the federal mandate lists no action levels or cleanup standards for comparison of soil and groundwater test results. They do, however, provide for a comprehensive regulatory program for underground storage tanks and for identifying and remedying spills and overfills. A spill or overfill of petroleum must be reported if the release exceeds 25 gallons or causes a sheen on nearby surface water, and a spill or overfill of a hazardous substance must be reported if the release to the environment equals or exceeds the reportable quantity for that substance under CERCLA. If the spill or overfill is less than these quantities, the owner and operator still must contain and immediately clean up the release. If the cleanup cannot be accomplished within 24 hours, the owner or operator must immediately notify the implementing agency (Hills 1988).

Corrective action includes several required abatement measures [40 CFR Section 280.62(a)]. These consist of:

1. removing as much of the regulated substance from the system as is necessary to prevent further release to the environment;
2. performing a visual inspection of any above-ground release or exposed underground releases and preventing further migration into surrounding soils and groundwater;

3. continuing to monitor and mitigate any additional fire and safety hazards;
4. remediating hazards posed by contaminated soils that are excavated or exposed as a result of release confirmation or site investigation;
5. measuring for the presence of a release where contamination is most likely to be present at the site, unless the presence and source of the release have been confirmed; and
6. investigating to determine the possible presence of free product.

Where the owner/operator has identified free product, free product removal must be conducted immediately in a manner that "minimizes the spread of contamination into previously uncontaminated zones by using recovery and disposal techniques appropriate to the hydrogeologic conditions at the site," and a report must be submitted to the implementing agency within 45 days as to the type of free product recovery system being used (40 CFR Section 280.64). Additionally, where evidence shows that groundwater has been affected by a release, an investigation for soil and groundwater cleanup must be conducted, and the results must be submitted to the agency as soon as practicable (40 CFR Section 280.65) Finally, a corrective action plan may be required by the implementing agency. The regulations provide for public comment on the corrective action plan proposed by the site owner/operator (40 CFR Section 280.67). Again, no cleanup standards are listed, and it is assumed that they are negotiated in the corrective action plan.

The EPA has also enacted considerable legislation to prevent the occurrence of spills and leaking underground tanks in the future. The major thrust of the underground storage tank regulations is to mandate requirements for new and existing tanks as well as closure of tanks no longer in use. Spill prevention and control fall under the realm of RCRA, and all facilities that meet the provision of 40 CFR Section 112.1 are required to formulate a Spill Prevention Control and Countermeasures (SPCC) Plan and get it approved by the State or EPA. NAS Fallon has written and adopted an SPCC Plan which outlines a base-wide oil and hazardous substance SPCC procedure to comply with the NDEP regulations. Implementation of this plan, combined with an increased awareness by Navy personnel regarding proper waste disposal methods and recycling, would seem to constitute a positive approach to maintaining a clean environment at the base once the IR Program is completed.

SUGGESTIONS FOR FUTURE EFFORTS

The most positive aspect of the current dilemma surrounding petroleum hydrocarbon contaminated sites is the commitment by the EPA to adopt ANSI standards for field methods. Other avenues exist that could promote more definitive policy applications and a scientifically based approached to site investigation, risk assessment, and cleanup goals. These include development of an expert system for interpretation of regulations, based on site-specific conditions and historical data, and computer modeling of risk, based on chemical concentrations, extent of contamination, relative toxicity of compounds, potential receptors, and pathways to receptors.

The proposed expert system would consist of logic-based rules that could provide more objective interpretations of which regulations are applicable to a site and which ARARS to use. Past interpretations would be programmed into the system, and a committee of recognized experts would provide input to complete the knowledge base. Weighting of rules would allow a "best" interpretation of conflicting regulations. The system's ability to provide detailed documentation of why each rule was invoked would allow review of the system's "thinking" and, whether or not its interpretation was accepted. It would also serve to better pinpoint the specific areas of conflict.

Risk-based computer modeling is not a new concept. However, it is not widely used, and many professionals in the environmental remediation field view risk assessment as a "black art." Perhaps if the EPA developed and endorsed a standard model, the methodology of risk assessment would begin to be better understood and accepted. Certainly there is a need for a risk model that takes into account site usage, present and projected, human risk, and threat to the environment. This model should be programmed to output risk-based alternative levels. These would become proposed goals for cleanup, and could be used by regulators.

SUMMARY

The IR Program at NAS Fallon is intended to mitigate potential hazards from past spills and disposal of substances considered harmful to human health or the environment. The Navy administered IR program follows CERCLA guidelines as mandated by Congress and is funded by money specifically tagged by the Navy for CERCLA sites. The application of confusing and sometimes ambiguous state and federal regulatory standards to the jet fuel contamination at one Fallon site presents a challenge in legal interpretation. Because the fuel floating on the shallow groundwater appears to be pure product, it is exempt from listing as a CERCLA hazardous substance. Because the plume of contaminated groundwater at the site is the result of both recent and past activities, it could be considered both a CERCLA and a RCRA site. Only the state promulgated regulations deal definitively with the problem of petroleum hydrocarbons in soil and groundwater, and even these leave several options for interpretation of the applicability of action levels and cleanup standards. The best approach to the mitigating the contamination may be to remove the floating product from the water table, negotiate with the NDEP to leave the contaminated soil and dissolved product in place, and periodically monitor the site.

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GLOSSARY

ANSI	— American National Standards Institute
ARARS	— Applicable or Relevant and Appropriate Requirements
BTXE	— Benzene, Toluene, Xylenes, and Ethylbenzene
CERCLA	— Comprehensive Environmental Response and Liability Act
CFR	— Code of Federal Regulations
CWA	— Clean Water Act
DEQPPM	— Defense Environmental Quality Program Policy Memorandum
DERA	— Defense Environmental Restoration Account
DOD	— Department of Defense
EPA	— Environmental Protection Agency
HRS	— Hazard Ranking System
IRP	— Installation Restoration Program
NAS	— Naval Air Station
NASF	— Naval Air Station Fallon
NAVFACENGCOM	— Naval Facilities Engineering Command
Navy	— United States Navy
NCP	— National Contingency Plan
NDEP	— Nevada Department of Environmental Protection
NEESA	— Naval Energy and Environmental Support Activity
NEPSS	— Naval Energy Protection Support Service
NPL	— National Priorities List
NRS	— Nevada Revised Statutes
PA/SI	— Preliminary Assessment/Site Inspection
RI/FS	— Remedial Investigation/Feasibility Study
RA	— Remedial Action
RAP	— Remedial Action Plan
ROD	— Record of Decision
SARA	— Superfund Amendments and Reauthorization Act
SOPs	— Standard Operation Procedures
SPCC	— Spill Prevention Control and Countermeasures
TRC	— Technical Review Committee
UST	— Underground Storage Tank
VOC	— Volatile Organic Compound

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