UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - REGION II
290 BROADWAY
NEW YORK, NEW YORK 10007-1866

JUL 27 1995

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Sindulfo Castillo
Director, Environmental
Engineering Division
Public Works Department
U.S. Naval Station Roosevelt Roads
TSC 1008 Box 3001
Code NO
FPO AA 34051-3001

Re: Tow Way Fuel Farm (SWMUs/AOCs #7 & #8) - Free Product Recovery Project Monthly Reports
U.S. Naval Station Roosevelt Roads
E.P.A. ID. No. PR2170027203

Dear Mr. Castillo:

The United States Environmental Protection Agency (EPA) Region II has completed its review of the 4 monthly reports (January, February, April, and May 1995) on the free product Vacuum Assisted Recovery (VAR) System, transmitted by your letters of June 8, 1995 and May 1, 1995. No report was received for March 1995. Our review's objective was to assess significant operational/technical deficiencies, and determine if the system is being operated in a manner compatible with full site clean-up.

Our full technical comments and recommendations are given in the enclosed Technical Review, dated July 12, 1995, prepared by our contractor, the A.T. Kearney team. Major points include:

1. There is no discussion of whether an Operation and Maintenance (O&M) Plan governs the operation of the system, and how actual performance compares with designed and/or predicted performance contained in the O&M Plan.

2. The monthly reports should present data to evaluate if the VAR system continues to provide remediation benefit in excess of passive skimming. The field situation continually changes as remediation progresses, and it is therefore important to regularly re-evaluate the program. Attention should be paid to whether the system has reached diminishing returns with respect to the cost of operation versus the rate of recovery with unassisted passive skimming. Also, the report should provide data to assess if there is an optimal vacuum pressure, or range of pressures, at which to operate the system.

3. Only one pair of wells was utilized in measuring the radius of effective influence imparted by the VAR system. This is not considered adequate for characterizing either the lateral or vertical extent of the vacuum influence.

4. It is not clear from the monthly reports that the system is being operated in a manner to limit residual oil saturation. System induced changes in the water table and upper surface of the free product can immobilize product by smearing it into and across the geologic strata, resulting in residual saturation over a thicker interval than existed previously. Excessive vacuums can cause an upwelling of product near recovery wells, resulting in increased residual saturation. Accelerated recovery of free product at the expense of increased residual oil saturation will likely yield a reduction in the ultimate volume of product removed and complicate final clean-up.

Given these concerns, the monthly reports should present the vacuums, removal rates, water level and product level fluctuations, and precipitation data in a manner which demonstrates that the system minimizes the negative effects of residual saturation.

Within 50 days of your receipt of this letter, please submit a written response to all comments given above a nd in the enclosed Technical Review.

Also, only one copy of the monthly reports was submitted. As indicated in previous correspondence, please supply two (2) copies of all future reports submitted to my office.

Please contact Mr. Tim Gordon, of my staff, at (212) 637-4167 if there are any questions.

Sincerely yours,

Andrew Bellina, P.E.
Chief, Hazardous Waste Facilities Branch

Enclosure

cc: Mr. P.A. Rakowski, P.E., LANTDIV w/encl.
Mr. Carl A. Soderberg, 2EPA-CFO w/encl.
Mr. Israel Torres, PREQB w/encl.
Mr. Art Wells, LANTDIV w/encl.

TECHNICAL REVIEW

Vacuum Enhanced Product Recovery and Free Product Removal Reports for Tow Way Fuel Facility Naval Station Roosevelt Roads Cieba, Puerto Rico

Submitted to:

Ms. Elizabeth Van Rabenswaay
Regional Project Officer
U.S. Environmental Protection Agency
Region 2
290 Broadway, 22nd Floor
New York, New York 10007

Submitted by:

A.T. Kearney, Inc.
Kearney/Centaur Division
One Wall Street Court
New York, New York 10005

July 12, 1995

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) under Work Assignment R02020, has requested that A.T. Kearney provide support to the agency for technical review of documents associated with the RCRA Facility Investigation (RFI) of Naval Station Roosevelt Roads (NSRR) located in Ceiba, Puerto Rico.

NSRR is located on the east coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan. The primary mission of NSRR is to provide full support for the Atlantic Fleet weapons training and development activities. NSRR is currently operating under a Draft Corrective Action Permit that includes some degree of work at 28 Solid Waste Management Units (SWMUs) and 3 Areas of Concern (AOCs).

The overall objective of the current Kearney Team's task under Work Assignment R2020 is to assist EPA with the evaluation of four reports which discuss the effectiveness of free product removal utilizing the Vacuum Assisted Recovery (VAR) System at the Tow Way Fuel Facility. The four documents are monthly progress reports and are entitled:

- *Vacuum Enhanced Product Recovery, Pilot Test Report, January, 17, 1995* (TVR-1);
- *Vacuum Enhanced Product Recovery, Pilot Test Report, February 20, 1995* (TVR-2);
- *Free Product Removal Report 95-01, April 17, 1995* (TVR-3); and
- *Free Product Removal Report 95-01, May 25, 1995* (TVR-4).

Each of these monthly reports were prepared by Terra Vac of San Juan, Puerto Rico on behalf of the NSRR.

The Kearney Team's review is divided into four sections. Section 1 (Introduction) discusses the scope of the current review task. Section 2 (Methodology) discusses the Kearney Team's approach to performing the review of the monthly reports. Section 3.0 (General Overview) summarizes the major outstanding technical issues noted during the review effort. Section 4.0 (Detailed Technical Evaluation) provides page-specific technical comments on the monthly reports. Section 5.0 (Recommendations) presents suggestions for obtaining information necessary to adequately assess the VARS performance to date, and to develop a course of future action.

2.0 METHODOLOGY

The Kearney Team evaluated four monthly reports which document the operational performance of the VAR system. Product recovery volumes and removal rates are presented in each monthly report as well as a brief conclusions regarding system performance during each reporting period. As requested by the EPA Work Assignment Manager, the Kearney Team review focused on performance information that specifically related to product (petroleum fuel) recovery, corrective action, and on the site characterization performed previously at the Tow Way Fuel Facility.

The Kearney Team treated the four monthly reports as one document since similar information is presented in each report. This approach has two benefits. First, it allows a review of the comprehensive performance of the overall recovery program rather than focusing on short-term trends. Second, comments can be minimized to avoid redundancy. In this effort to minimize repetition, comments common to several of the monthly reports are presented once, the first time they appear.

3.0 GENERAL OVERVIEW

In general the four monthly reports present only a fraction of the data needed to evaluate the performance and efficiency of the VAR system. Assuming these monthly reports present all of the operational data that is collected each month, it is clear that insufficient data are being collected for evaluating both short- and long-term performance and efficiency of the VAR system. The NSRR needs to collect data which can be compared to specifications of the Operation and Maintenance (O&M) Plan for this system, assuming such a plan exists. If an O&M Plan does not exist, then it is not clear what governs the operation and maintenance of the system or how the system can be evaluated for performance within designed parameters. The Kearney Team assumes the existence of an O&M Plan. Therefore, the monthly reports need to relate the data which are collected during each reporting period to designed and/or predicted performance ranges contained in the O&M Plan. The monthly reports also need to present data which serve as criteria for identifying when the VAR system no longer provides remediation benefit in excess of unassisted passive skimming. In addition, the data need to be presented in typical time series charts/graphics which will allow rapid analysis of performance trends for the current month compared to previous months. The end goal of the progress reports should be to provide sufficient details for determining if the system is performing within designed parameters, if the system is effectively removing product at a rate which justifies the expenses, and if system modification/adjustment is necessary.

With regard to the information which is currently provided in the monthly reports, the Kearney Team is concerned with the limited

number of sampling points used to calculate the radius of effective influence imparted by the VAR system. Only one pair of wells was utilized, and this is not believed to be adequate for characterizing either the lateral or vertical extent of the vacuum influence. Use of a single well pair inherently limits the evaluation of preferential flow paths which may result from variations in geologic strata. As a result, the area which is currently being treated is suspect. More points need to be monitored to determine the radius of vacuum imparted by the VAR system.

In addition, it is not clear from the monthly reports that the system is being operated in a manner which limits the significant changes in the water table and upper surface of the product. Such changes immobilize product by smearing it into and across the geologic strata causing residual saturation. Excessive vacuums can similarly result in residual saturation by causing the upwelling of product near recovery wells. Given these concerns, the monthly reports should present the vacuums, removal rates, water level and product level fluctuations, and precipitation data in a manner which demonstrates that the system minimizes the negative effects of residual saturation.

4.0 DETAILED TECHNICAL EVALUATION

1. TVR-1, Page 3, §7, Phase One Operations: Steady State

   It is stated that product thickness has been dramatically reduced in well UGW-1. As is common when recovery systems are first activated, product thickness reductions were dramatic when VAR system was first implemented. Monthly reports (TVR-2, 3, and 4) for periods following initial system activation indicate that product levels have not steadily decreased. However, the volume of product recovery has been significant. There does not seem to be a correlation between the two variables. The effectiveness of product recovery is expected to eventually coincide with a reduction in product level. The monthly reports should present the product levels and recovered volume in graphical time series charts to illustrate this relationship.

   In addition, the monthly reports need to present additional data to demonstrate the overall effectiveness of VAR system. Specifically, the design criteria and specifications (e.g., recovery rates, air and ground water flow rates, vacuum radii, and treatment zone radii) need to be compared to the measured values. This information needs to be compiled, presented in a manner (time series charts and graphs) which depicts the trends in system performance over time. These charts and graphs will allow continued evaluation of the effectiveness of VAR system, its expected future role, and benefit. This information can then be easily used to

determine if system modifications are needed to increase system performance.

2. TVR-1, Page 4, §2, Phase One Operations: Steady State

The monthly report states that "...nearly all the free floating product has been removed with little recharge ..." of product in some recovery wells . Such a conclusion is premature given the short period over which the observation was made (i.e., less than 30 days). The conclusion that nearly all the product has been removed is only one possible explanation for reduced product recovery. Many variable can lead to limited recharge of product such as those discussed in Comment #1. The actual effects of the VAR system needs to be evaluated over a longer time than the pilot test period before conclusions about its effectiveness can be drawn. Product recharge relates to system performance which should be addressed as noted in Comment #1.

3. TVR-1, Page 4, Phase Two Operations: Radius of Influence

The report notes that the radius of vacuum influence is about 15 feet. However, the Kearney Team has a number of concerns regarding the pilot test which generated this value. First, the test was conducted for one and one-half hours and it is not clear whether sufficient time has elapsed to measure the radius of influence. Second, the test was performed on only one pair of wells, and so there is no way to gauge variation in the system among other wells, for instance there is no accounting for directionality resulting from variations in stratigraphy, or varying permeability. Third, pneumatic radius (pressure function) is noted as 15 feet, but the extent of the zone of treatment (flow based) is not discussed. The report indicates that the data for the test are presented in the appendix, but this was not attached so they could not be evaluated.

In order to correct these deficiencies, the following approach needs to be implemented: establish additional vacuum monitoring points from which data documenting the radii of vacuum and zone of treatment can be obtained. The test results should be presented in graphical and/or tabular form comparing actual flow rates (air, ground water), drawdown, vacuum, and recovery rates to the corresponding predicted design parameters. This information needs to be included in the monthly reports so that it can be evaluated.

4. TVR-1, Page 4, Phase Two Operations: Radius of Influence

Product and water levels in one of the wells were significantly raised above the static level by the applied

vacuum. The implication of raising product levels significantly is that free product may be smeared onto the soil, resulting in an increase in residual oil saturation. Similarly, the graphs of water and product levels depict large fluctuations. This implies significant oil smearing and resultant residual oil saturation.

The effect of residual oil saturation resulting from product upwelling and drawdown needs to be addressed. An estimate of the volume of product rendered immobile from these causes should be developed. This is important because it will affect the volume of product recovered as well as the operational life of the recovery system.

5. TVR-1, Page 6, §2, Evaluation

The monthly report concludes that the VAR system is 42 percent more effective than the skimmer pumps for product recovery. Subsequent reports indicate that appreciable maintenance was required to repair the VAR system and/or to keep it running smoothly. Therefore, a cost comparison analysis between the two systems should incorporate operational and maintenance costs (O&M) and water disposal costs in order to make a meaningful cost comparison.

Additionally, it is not clear if there is an Operations and Maintenance plan governing operation of the system. If one exists then it should be included as an attachment to the first monthly report and frequently cited as a benchmark in all monthly reports. If an O&M plan does not exist, then this document needs to be developed. Currently it is not clear what factors or conditions dictate operation of the VAR system. These factors need to be clearly documented.

6. TVR-1, Page 6, §3, Evaluation

It is not clear what data were used to determine that the removal area for the VAR system is 50 times larger than that for an unassisted passive skimmer system. Documentation is needed to support this contention. In addition, it is stated that remediation of contaminated soils above the water table can be effected via volatilization and biodegradation. Is this a general claim or are there any data to support this claim for the current site? This should be supported by data or the statement qualified so as to make it clear that it is general in nature.

7. TVR-1, Page 6, Summary of Conclusions

It is noted that the VAR system is significantly more efficient and cost effective in recovering hydrocarbons than a passive skimmer system. Having the benefit of later

reports, it is noted that the effectiveness and efficiency of the VAR system seemed to drop substantially (TVR-3, p.2, 1,200% reduction). Therefore, it is evident that one month is too short a time in which to make conclusions about the effectiveness of VAR system. At this juncture it is not clear whether the VAR system is an effective system.

It is strongly recommended that a time series chart be maintained that tracks the total amount of free product recovered; the rate of recovery; gallons per hour, day, etc.; and any other parameters required to evaluate system performance trends in the data. This is necessary in order to gauge system efficiency and make changes, modifications, or decisions about the future of the VAR system.

8. TVR-3, Page 2, Summary of Conclusions

With regard to a large drop in the VAR system's recovery rate, it is stated that ". . . the well recharge rate is now only being affected by the force of gravity, with no additional forces acting on the free product mass." This implies that the VAR system is no longer active or that they no longer have a positive effect on product recovery. Consequently, this statement needs to be expanded and the implications for continued utilization of the VAR system addressed.

9. TVR-4, Page 1, §7 Field Activities

The report notes that a sample was collected for RCRA analysis. It is not clear why RCRA samples are still required at this point in the recovery process. This point should be explained.

5.0 RECOMMENDATIONS

Based on the review of the four documents, the following are recommended:

- In order to gauge the performance of the recovery system it is recommended that all the data collected from the system to date be tabulated in a time series chart with accompanying graphs so that the performance trends can be identified. An overall assessment of the system is the desired goal.

- A comprehensive system performance evaluation should be performed on a quarterly basis to see whether there is any benefit of continuing the VAR system. The field situation continually changes as remediation progresses, and it is therefore important to regularly re-evaluate the program. Attention should be paid to whether the system has reached diminishing returns with respect to the cost of operation versus rate of product recovery. One aim of the performance evaluation should be to see if there is an optimal vacuum pressure, (or range of pressures) at which to operate the system.

  Existing data should be evaluated through the application of computer models. The aim of computer modeling should be severalfold: to develop a model utilizing site-specific information that can be used as a tool to compare actual recovery and flow rates and effectiveness with predicted system performance; to project system performance utilizing a continuously refined database; to forecast changes in efficiency; to monitor and forecast changes in the matrix being remediated; and to assist in making decisions about modifications in the remedial program.

  Specifically, the model(s) should simulate the effective radii of influence, directionality, and removal quantities and rates (ground water and product) over time; estimate time to reach specified goals and drawdown; compute total and component recovery versus time; and provide estimates of the contaminant mass remaining and the time remaining to reach the desired cleanup goals.

- Close attention should be paid to the issue of residual oil saturation and whether vacuum induced upwelling of product levels are resulting in unacceptable levels of residual saturation. Likewise, drawdown of the ground water table from pumping should be examined to see whether excessive smearing and residual oil saturation is occurring. Enhanced recovery of free product at the expense of increased residual oil saturation will likely yield a reduction in the volume of product removed.

- The issue of whether the radii of influence (vacuum and treatment zone) are accurately determined given one pair of wells should be re-examined. Additional data need to be collected from other well pairs to assess the effective pneumatic radii and treatment zone radii. Likewise, there should be a statement as to whether these radii are the same, or if there is a gap in which no remediation is occurring.

- Criteria need to be established for determining when the VAR system is no longer providing any additional remediation benefit, so that a decision can be made to modify the system or switch to some other approach.