Nevada
Environmental
Restoration
Project

DOE/NV--641-ADD.

National Nuclear Security Administration

# Addendum to the Closure Report for Corrective Action Unit 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada

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March 2005



Environmental Restoration
Division

U.S. Department of Energy
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# ADDENDUM TO THE CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 329: AREA 22 DESERT ROCK AIRSTRIP FUEL SPILL, NEVADA TEST SITE, NEVADA

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

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**ADDENDUM TO THE CLOSURE REPORT
FOR CORRECTIVE ACTION UNIT 329: AREA 22
DESERT ROCK AIRSTRIP FUEL SPILL,
NEVADA TEST SITE, NEVADA**

Approved by: APPROVED SIGNATURE Date: 3/29/05

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Environmental Restoration Division

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# *List of Acronyms and Abbreviations*

| | |
|---|---|
| $CO_2$ | Carbon Dioxide |
| DRO | Diesel-Range Organics |
| GRO | Gasoline-Range Organics |
| ID | Inside diameter |
| $O_2$ | Oxygen |
| OD | Outside diameter |
| MRL | Method reporting limits |

# *Preface*

The following is an addendum to the *Closure Report for Corrective Action Unit 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada,* DOE/NV-641. This new information is based on the results of post-closure monitoring data that was not available at the time DOE/NV--641 was issued. This addendum replaces: Section 4.0, "Closure Verification Results," in its entirety; renumbers Section 5.0, "References" to Section 6.0, "References"; and introduces a new Section 5.0, "Conclusions and Recommendations." The list of acronyms and references only contains additions to the original document.

# 4.0 Closure Verification Results

This section describes closure and post closure activities conducted between 2000 through 2003 and details the actions to be taken in support of NDEP post-closure monitoring.

## 4.1 Data Quality Assessment

Post-closure monitoring was proposed to be conducted annually for five years and was intended to demonstrate that natural attenuation through biodegradation was occurring at a rate that would reduce the TPH concentrations to levels that would not adversely affect the underlying groundwater. The annual monitoring program was initiated in August 2000 using soil-gas samples collected from three specific intervals within the monitoring wells. Results of four sampling events from 2000 through 2003 have indicated there is uncertainty in the approach currently being employed to establish a rate of natural attenuation as specified in *Streamlined Approach for Environmental Restoration Work Plan for Corrective Action Unit 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada* (DOE/NV, 1999).

### 4.1.1 Closure Activities

Closure activities initially conducted included the installation of Borehole DRA-0 with the associated soil and soil-gas sampling as specified in the SAFER Work Plan (DOE/NV, 1999). The well installation was initiated in May and completed in June 2000. After the well was installed an initial soil-gas sampling event was conducted. The activities and results are detailed in Appendix A of the *Closure Report for CAU 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada* (DOE/NV, 2000).

A second soil-gas sampling event, considered part of the post-closure monitoring, occurred in August 2000. This sampling served two purposes: (1) to verify that the formation had recovered from the drilling activity and reached a state of equilibrium, (2) establish a baseline for post-closure monitoring data. The August 2000 levels showed less than a 50 percent change in TPH levels from the June 2000 levels so it was determined that the site was at equilibrium and the data was used to establish the baseline for future post-closure monitoring.

### *4.1.2 Initial Post-Closure Monitoring*

Uncertainty associated with post-closure monitoring from 2000 through 2003, arises from the lack of detailed construction diagrams for the existing monitoring points and the inability to ensure that specific intervals are isolated allowing the collection of samples from discrete intervals. Additionally, the frequency of monitoring has been determined to be insufficient to accurately evaluate or predict the rate of biodegradation. The document states that final closure will be accomplished by verifying that residual soil contamination is undergoing natural attenuation and is not migrating. Although the source of the TPH contamination has been removed, current cumulative data are inconclusive in determining the rate of natural attenuation. Therefore, the time required for TPH concentrations to decrease to below the l00 mg/kg PAL stipulated in NAC 459.9973 cannot be accurately predicted. To meet the NDEP closure requirements the following adjusted post-closure monitoring program will be implemented.

### *4.1.3 Post-Closure Monitoring System*

#### *4.1.3.1 Objective*

Because the current monitoring system and sampling frequencies are not providing adequate data to meet the original post-closure monitoring objective, a new soil-gas monitoring system will be installed. The primary objective of the post-closure monitoring is to meet the original closure objective by providing adequate data to demonstrate that natural attenuation is occurring. In addition, soil samples will be collected to confirm that the migration of the contamination has ceased and the wetting front is consistent with what was presented in the closure report, and to predict the time required for the TPH concentrations to biodegrade to concentrations below the 100 mg/kg PAL.

#### *4.1.3.2 Monitoring System Alteration*

This plan is intended to provide a procedure for identifying and monitoring specific intervals throughout the contaminated zone, present detailed borehole construction specifications with fixed depth soil-gas monitoring points, and increase the frequency of post-closure monitoring. The increased monitoring will allow for a more accurate evaluation of the biodegradation process and allow for a more precise estimate of the time required to meet the post-closure monitoring objectives. During the installation of the monitoring wells, soil samples will be collected at least at equivalent depths as the initial samples collected in 2000 and analyzed for TPH to determine if there has been a measurable change in the TPH concentration with time and depth.

The primary analytical techniques for the post-closure monitoring will be oxygen ($O_2$) consumption, carbon dioxide ($CO_2$) production, and hydrocarbon (TPH) consumption. As biodegradation occurs there is an associated decrease in $O_2$ with a corresponding increase in $CO_2$ due to microbial respiration. This will provide a cost-effective approach to the determination of the biodegradation rates.

This plan includes the installation of two new monitoring wells with multiple vertical sampling points selected based on the previous soil data and additional soil data collected during the drilling of the new boreholes. A new monitoring well will replace the existing borehole DRA-0 in the former fuel tank pit, and the second will replace the background borehole DRA-3. Post-closure monitoring of these wells will be conducted on a quarterly basis for a minimum of three years (e.g., 12 events).

### *4.1.4 Post-Closure Monitoring Borehole Configuration*

#### *4.1.4.1 Borehole Specifications*

This section describes the general borehole construction specifications to include approximate location and construction parameters. These specifications may be modified based on field conditions.

##### *4.1.4.1.1 Borehole Location*

Based on the requirements identified in Section 3.2 of the SAFER Work Plan (DOE/NV, 1999), the first of the two new monitoring wells (designated DRA-10) will be located within the footprint of the former tank pit. DRA-10 will be located in an area between 10 and 20 ft north-northeast of the DRA-0 location.

The second monitoring well (designated as DRA-11) is to be located between 10 and 20 ft to the southwest of the existing DRA-3 borehole. Based on previous sampling data, this location between boreholes DRA-3 and DRA-5, places the monitoring point far enough away to avoid interferences associated with the fuel spills yet close enough to provide adequate corresponding background conditions. Figure 4-1 shows the existing and proposed soil-gas mounting well locations.

#### *4.1.4.1.2 Soil-Gas Monitoring Well Construction*

To allow accurate comparison, both the DRA-10 and DRA-11 boreholes are to be of identical construction with DRA-10 to be constructed first. While the following total depth dimension may be adjusted based on field screening, previous soil sampling results from borehole DRA-0 indicate that the lower boundary for soil-gas sampling should be approximately 120 ft bgs. Figure 4-2 presents the construction diagram for the monitoring wells. the monitoring wells are to be constructed according to the following:

- Eight inch outer diameter (OD) boreholes using dual-tube rotosonic drilling.
- Total depth ranging between 140 – 200 ft.
- Sampling ports at 40, 80, and 120 ft based on previous borehole construction results. The depths may be adjusted based on the field-screening data.
- Sample zones will be approximately 10 ft long with the point being set in 10 ft of one-eighth in. minus sand extending 5 ft above and 5 ft below the center point of the sample interval.
- The upper and lower boundaries of the sampling intervals will be sealed with bentonite pellets and the sampling intervals will be separated with a minimum of 25 ft of 5 percent bentonite grout. Care will be taken to ensure that the seals are contiguous and free of voids. Care will be taken to ensure that the formation does not collapse allowing the sandy formation to prevent the establishing of an acceptable seal.
- One-eighth inch inside diameter (ID) stainless steel tubing with acceptable sampling ports will be installed to the mid point of each selected interval and set in one-eighth in. minus sand.
- Each sample interval will have at least 3 ft of bentonite hole plug placed over the sand pack.
- Each internal sample interval will be sealed from the upper and lower intervals using a 5 percent bentonite grout to further ensure accurate and representative sample collection.
- Dual dead-stop valves with sampling port at the surface.

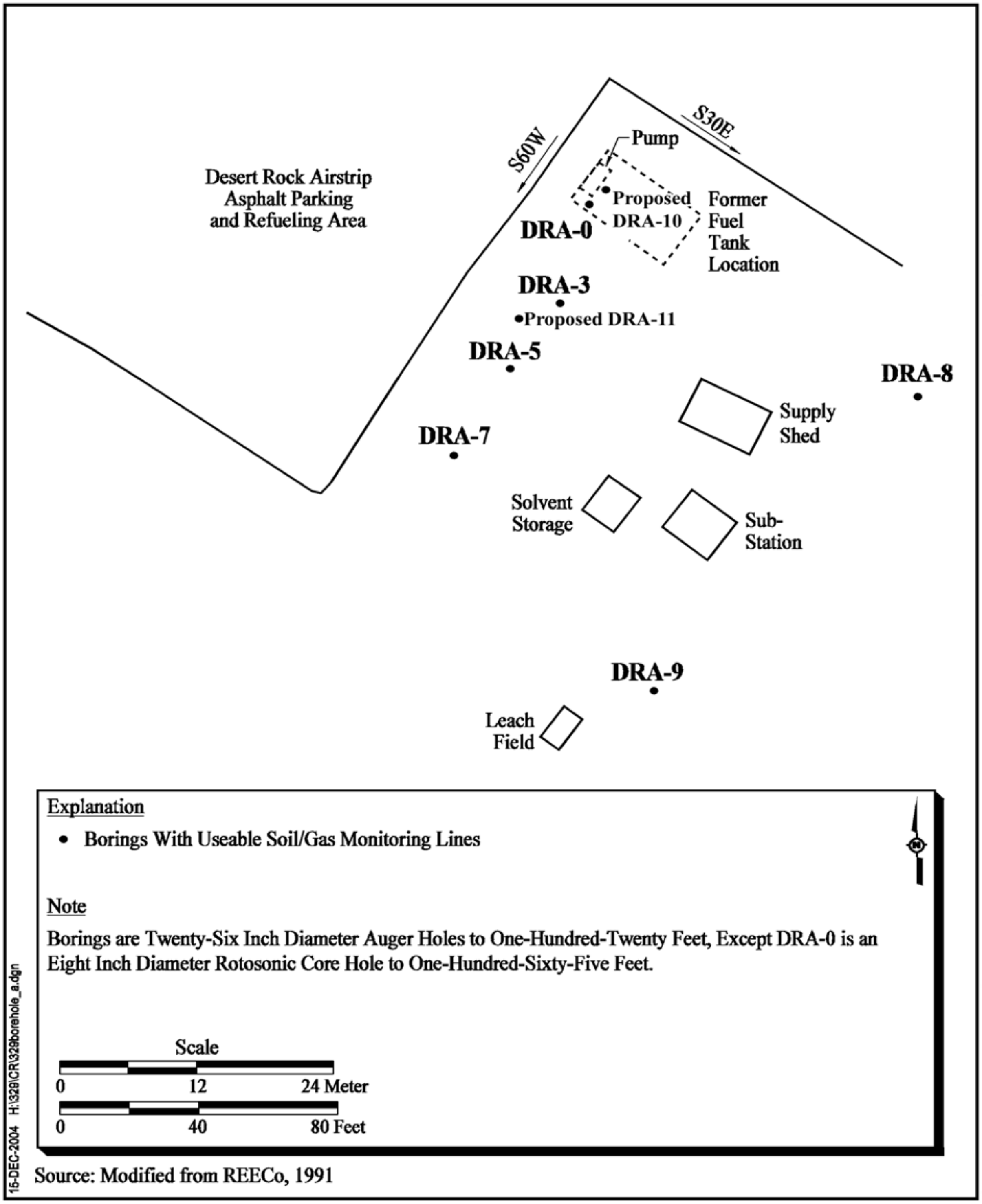


**Figure 4-1**
**CAU 329 Site Map Showing Location of Instrumented Boreholes**

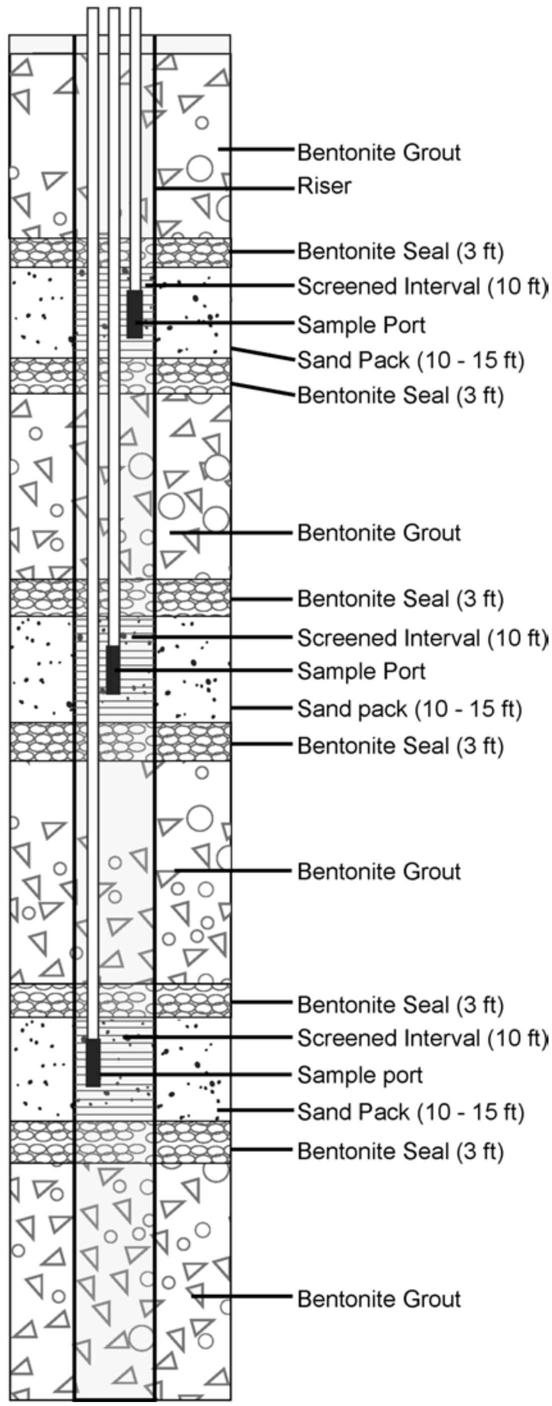


**Figure 4-2**
**Borehole Construction Diagram**

Once the installation and construction of the monitoring points are complete, final borehole dimensions and accurate post construction and lithologic soil diagrams are to be completed. The borehole diagrams will be presented in the Fiscal Year 2005 monitoring report.

#### *4.1.4.2 Borehole Soil Sampling Parameters*

This section details the soil sampling parameters to be followed during construction of boreholes, DRA-10 and DRA-11.

##### *4.1.4.2.1 Borehole Advancement*

Soil samples will be collected and field screened from 5 ft to a maximum of every 20 ft for TPH gasoline-range organics (GRO) and TPH diesel-range organics (DRO). Advancement of the borehole and field screening will continue until two consecutive samples, as measured by field-screening methods, are below the FSL or until a maximum depth of 200 ft bgs is achieved. Field-screening results along with previous monitoring well information will be used to guide sample collection and analyses, and determine proper placement of the monitoring points. The FSL for TPH is 75 mg/kg.

##### *4.1.4.2.2 Soil Sample Collection*

During drilling, the soil samples will be transferred from the plastic core barrel liner to the sampling table, opened, and screened for VOCs and TPH prior to collecting samples. Samples will be collected in appropriate containers, temporarily marked with sample label information, sealed with custody tape, and placed in an iced cooler. Soil descriptions will be recorded on a Sample Collection Log and retained in the project files.

Soil samples will be scheduled for off-site laboratory analysis from the intervals identified for the soil-gas monitoring based on field screening, including one of the two final samples that field screening show to be below the FSL. Upon completion of drilling borehole DRA-10, select samples will be shipped to the laboratory and analyzed for TPH- GRO, TPH-DRO, and semivolatile organic compounds (SVOCs) in accordance with the procedure specified in the SAFER Work Plan (DOE/NV, 1999). In addition, samples will be collected and analyzed for geotechnical and bioassessment parameters.

#### *4.1.4.2.3 Borehole Equilibrium Soil-Gas Sampling*

Soil-gas sampling will be conducted from both Boreholes DRA-10 and DRA-11. Samples will be analyzed for of $O_2$, $CO_2$, and TPH. Initial soil gas samples will be collected after the completion of the monitoring wells. Another soil-gas sampling event will occur from 45 to 60 days after borehole completion to verify that the site has reached equilibrium. If analytical results for this second sampling event indicate that the site has reached equilibrium, the results will be used as baseline monitoring data. The equilibrium determination will be based on the analytical results for $O_2$, $CO_2$, and TPH. The results from the first monitoring event will be compared to the results of the second monitoring event. The primary indicator for equilibrium will be the TPH results. If there is a less than a 50 percent change from the first monitoring event, it will be assumed that the site has reached equilibrium. The site will then begin the scheduled post-closure monitoring described in Section 4.1.5, Post-Closure Monitoring.

#### *4.1.4.3 Waste Management*

Investigation-derived waste will be segregated into the following waste streams:

- Personal protective equipment and sampling equipment that contacts potentially contaminated media
- Decontamination rinsate that contacts potentially contaminated media
- Plastic and minor amounts of soil from the decontamination pad
- Soil and absorbent material contaminated with hydrocarbons
- Absorbent material from any drill rig oil spill

Soil and debris incidental to sample collection (e.g., soil cuttings, discarded sample media) will be drummed for disposal. Hazardous waste generated during site operations will be drummed and labeled as such. All hazardous waste will be transferred to the hazardous waste accumulation area daily. The IDW will be documented in the waste management logbook.

#### *4.1.4.4 Quality Assurance*

The QA/QC activities for the CAU 329 post-closure monitoring system installation sampling are outlined in the following text. Detailed information regarding the QA program is contained in the Industrial Sites QAPP (NNSA/NV, 2002). Quality control results are typically judged in terms of precision, accuracy, representativeness, completeness, comparability, and sensitivity and are described in the following sections.

##### *4.1.4.4.1 Precision*

Precision is a quantitative measure of the variability of a group of measurements from their average value. Precision is assessed for inorganic analysis by collecting, preparing and analyzing duplicate field samples, and comparing the results with the original sample. Precision is also assessed by creating, preparing, analyzing, and comparing laboratory duplicates from one or more field samples in inorganic analyses and MS/MSD samples for organic analyses. Precision is reported as RPD, which is calculated as the difference between the measured concentrations of duplicate samples, divided by the average of the two concentrations, and multiplied by 100. Any deviation from these requirements will be documented and explained and the related data qualified accordingly.

##### *4.1.4.4.2 Accuracy*

Analytical accuracy is defined as the nearness of a measurement to the true or accepted difference value. It is the composite of the random and systematic components of the measurement system and measures bias in the measurement system. The random component of accuracy is measured and documented through the analyses of spiked samples. Sampling accuracy is assessed by evaluating the results of spiked samples and laboratory control samples. Accuracy measurements are calculated as percent recovery by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100. Field accuracy is assessed by confirming that the documents of record track the sample from origin, through transfer of custody, to disposal. The goal of field accuracy is for all samples to be collected from the correct locations at the correct time, placed in a correctly labeled container with the correct preservative, and sealed with custody tape to prevent tampering.

#### *4.1.4.4.3 Representativeness*

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Sample representativeness will be achieved through the implementation of a sampling program designed to ensure proper sampling locations, number of samples, and the use of validated analytical methods. Representativeness will be assessed through analysis of duplicate samples. Representativeness of the samples taken in this sampling event will be assured by collecting the specified number of samples (DOE/NV, 1999) and analyzing them by the approved analytical methods shown in Table 4-1.

**Table 4-1**
**Laboratory Analytical Methods for Soil Samples Collected at CAU 329 Area 22 Desert Rock Airstrip fuel Spill, Nevada Test Site**

| Analytical Parameters | Analytical Method |
|---|---|
| Total petroleum hydrocarbons - diesel range | EPA 8015B (modified) |
| Total petroleum hydrocarbons - gasoline range | EPA 8015B (modified) |
| Semivolatile organic compounds | EPA 8270 |

#### *4.1.4.4.4 Completeness*

Completeness is defined as a percentage of measurements made that are judged to be valid. A sampling and analytical requirement of 80 percent completeness is established for this project (NNSA/NV, 2002).

#### *4.1.4.4.5 Comparability*

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another (EPA, 1987). To ensure comparability, the CAU 329 field and sampling activities will be performed and documented in accordance with approved procedures, and all samples will be collected in accordance with the SAFER Work Plan (DOE/NV, 1999). Approved standardized methods and procedures will also be used to analyze and report the data (e.g., CLP and/or CLP-like data packages). This approach ensures that the data from this project can be compared to other datasets. Field (i.e., sample-handling) documentation, laboratory nonconformance reports, and the precision and accuracy of quality-control sample results will be evaluated for their effect on the results of the associated environmental soil samples. The environmental sample results will be qualified according to processes outlined in the following sections. Documentation of the data qualifications resulting from these reviews will be retained in the project files.

#### *4.1.4.4.6 Sensitivity*

The laboratory methods selected for analyzing the samples have been reviewed and the method reporting limits (MRL) for the TPH is below the action levels on which decisions will be made. The procedures to be used for measuring $O_2$ and $CO_2$ concentrations are sensitive enough to provide reliable percentages to support decisions.

#### *4.1.4.4.7 Tier I, Tier II, and Tier III Data Evaluations*

All laboratory data from samples collected at CAU 329 must be evaluated for data quality according to the EPA Functional Guidelines (EPA, 1999 and 2002). These guidelines are implemented in a tiered process and are presented in the following text. Only valid data, whether estimated (i.e., J-qualified) or not, will be used. Changes resulting from the data evaluation process will be documented in project files and summarized in memoranda for each SDG.

***Tier I Evaluation***

Tier I evaluation for both chemical and radiological analyses examines (but is not limited to):

- Sample count/type consistent with chain of custody
- Analysis count/type consistent with chain of custody
- Correct sample matrix
- Significant problems stated in cover letter or case narrative
- Completeness of certificates of analysis
- Completeness of CLP or CLP-like packages
- Completeness of signatures, dates, and times on chain of custody
- Condition-upon-receipt variance form included
- Requested analyses performed on all samples
- Date received/analyzed given for each sample
- Correct concentration units indicated
- Electronic data transfer supplied
- Results reported for field and laboratory QC samples
- Whether or not the deliverable met the overall objectives of the project

***Tier II Evaluation***

Tier II evaluation for both chemical and radiological analyses examines (but is not limited to):

***Chemical:***

- Correct detection limits achieved
- Sample date, preparation date, and analysis date for each sample
- Holding time criteria met
- QC batch association for each sample
- Cooler temperature upon receipt
- Sample pH for aqueous samples, as required
- Detection limits properly adjusted for dilution, as required
- Blank contamination evaluated and applied to sample results/qualifiers
- MS/MSD %R and RPDs evaluated and applied to laboratory results/qualifiers
- Field duplicate RPDs evaluated using professional judgement and applied to laboratory results/qualifiers
- Laboratory duplicate RPDs evaluated and applied to laboratory results/qualifiers
- Surrogate %Rs evaluated and applied to laboratory results/qualifiers
- Laboratory control sample %R evaluated and applied to laboratory results/qualifiers
- Initial and continuing calibration evaluated and applied to laboratory results/qualifiers
- Internal standard evaluated and applied to laboratory results/qualifiers
- Recalculation of 10 percent of laboratory results from raw data
- Mass spectrometer tuning criteria
- Initial and continuing calibration verification
- Internal standard evaluation
- Organic compound quantitation

***Radioanalytical:***

- Correct detection limits achieved
- Blank contamination evaluated and applied to sample results/qualifiers
- Certificate of Analysis consistent with data package documentation
- Quality control sample results (duplicates, laboratory control samples, laboratory blanks) evaluated and applied to laboratory result qualifiers
- Sample results, error, and minimum detectable activity evaluated and applied to laboratory result qualifiers
- Detector system calibrated to NIST traceable sources
- Calibration source preparation will be documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations
- Detector system response to daily, weekly, and monthly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency
- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements
- Documentation of all QC sample preparation complete and properly performed

- Spectra lines, emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration

***Tier III***

Data quality considerations that are included in EPA data review functional guidelines (EPA, 1999 and 2002) as a Tier III review include the additional evaluations:

***Chemical:***

- Recalculation of all laboratory results from raw data

***Radioanalytical:***

- QC sample results (e.g., calibration source concentration, percent recovery, and RPD) verified
- Each identified line in spectra verified against emission libraries and calibration results
- Independent identification of spectra lines, area under the peaks, and quantification of radionuclide concentration in a random number of sample results

A Tier III review of at least five percent of the sample analytical data will be performed.

#### *4.1.4.4.8 Quality Control Samples*

Quality control samples will consist of trip blanks, one field blank, one equipment rinsate blank (as appropriate), one MS/MSD, and one field duplicate collected and submitted for laboratory analysis. The blanks and duplicates will be assigned individual sample numbers and sent to the laboratory "blind." Additional samples may be selected by the laboratory to be analyzed as laboratory duplicates. Documentation related to the collection and analyses of these samples will be retained in project files.

***Field Quality Control Samples***

Field and equipment rinsate blanks will be analyzed for the same parameters as the environmental samples and trip blanks, if required. One field duplicate soil sample will be sent as a blind sample to the laboratory to be analyzed for the parameters listed in Table 4-1. For this sample, the duplicate results precision (i.e., RPDs between the environmental sample results and their corresponding field duplicate sample results) will be evaluated to the guidelines set forth in EPA Functional Guidelines (EPA, 1999 and 2002). The EPA Functional Guidelines state that there are no required review criteria for field duplicate analyses comparability; however, the guidelines allow the data reviewer to exercise professional judgment. One field sample will be selected for use as an MS/MSD sample. The percent recoveries of this sample (a measure of accuracy) and the relative percent differences in these sample results (a measure of precision) will be compared to EPA Functional Guideline criteria (EPA, 1999 and 2002). The results will be used to qualify associated environmental sample results accordingly. The EPA Functional Guidelines for review of organic data state that no data qualification action is taken on the basis of MS/MSD results alone. The data reviewer exercises professional judgement in considering these results in conjunction with the results of LCSs and other QC criteria in applying qualifications to the data.

***Laboratory Quality Control Samples***

Analysis of method QC blanks and surrogate spikes for organic analyses, method blanks, preparation blanks, initial and continuing calibration blanks for LCS will be performed. The results of these analyses will be used to qualify associated environmental sample results according to EPA Functional Guidelines (EPA, 1999 and 2002). The EPA Functional Guidelines (EPA, 1999 and 2002) state that no qualification action is taken if a compound is found in an associated blank, but not in the sample or if a compound is found in the sample, but not in an associated blank. The action taken when a compound is detected in both the sample and the associated blank varies depending upon the analyte involved and is described in the "The 5X/10X Rule." For most SVOCs, TPH diesel, and TPH gasoline, if an analyte is detected in the sample and was also detected in an associated blank, the result is qualified as undetected (U) if the sample concentration is less than five times (5X) the blank concentration.

For the common laboratory contaminants (e.g., methylene chloride, acetone, 2-butanone [methylethyl ketone or MEK and cyclohexane], and phthalate esters [especially bis(2-ethylhexyl)phthalate]), the factor is raised to ten times (10X) the blank concentration. The sample result is elevated to the quantitation limit if it is less than the quantitation limit or remains unaltered if the sample result is greater than or equal to the quantitation limit.

Surrogate spikes, or system monitoring compounds, are added to the environmental samples analyzed by chromatographic techniques for SVOCs and TPH-DRO and -GRO. Surrogate compounds are analytes that are not expected to be present in associated environmental samples, but behave the same as similar target compounds chromatographically. Known amounts of each surrogate are added prior to sample preparation and are carried throughout the preparation/analysis procedure. The percent recoveries of these surrogate compounds give some measure of the anticipated recoveries of the target compounds whose chromatographic behavior they mimic. If any surrogate percent recoveries are out of the acceptable range (which differs for each surrogate in each method), laboratory protocol calls for the sample to be reprepared and/or reanalyzed. When the surrogate recoveries are acceptable on the second run, only the second analysis results are reported. When both analyses yield the same unacceptable range, the results of both analyses are reported. The evaluation of surrogate spike percent recovery results is not straightforward. The functional guidelines suggest several optional approaches, but require the data reviewer to exercise professional judgement in reviewing surrogate data and qualifying associated data as estimated (J or UJ, for detections or nondetections, respectively) or unusable (R). Documentation of data qualifications resulting from the application of these guidelines is retained in the project files as both hard copy and electronic media. Laboratory control samples, also known as blank spikes, consist of known quantities of target compounds added to purified sand or deionized, distilled water and analyzed along with the environmental samples in the sample delivery group. The percent recoveries of the compounds in the LCS give a measure of laboratory accuracy. The functional guidelines call for the data reviewer to use professional judgment to qualify associated data according to established criteria. Documentation of data qualifications resulting from the application of these guidelines will be retained in project files as both hard copy and electronic media.

#### 4.1.5 Post-Closure Monitoring Reporting

Post-closure monitoring will be conducted on a quarterly basis for a minimum of three years. Soil-gas samples will be analyzed for $O_2$, $CO_2$, and TPH. The $O_2$ and $CO_2$ percentages will be calculated and plotted. These relationships will be compared to the TPH concentrations to confirm that biodegradation is occurring. The $O_2$ and $CO_2$ concentrations collected from the background well (DRA-11) will serve to identify lithologic and climatic influences on the natural attenuation process. All sampling data will be consolidated and presented in an annual post-closure monitoring report.

### 4.2 Use Restrictions

Future use of any land related to this CAU is restricted from any activity that may alter or modify the contaminant controls as approved by the state, unless appropriate concurrence is obtained in advance.

Appendix D of the *Closure Report for CAU 329: Area 22 Desert Rock Airstrip fuel Spill, Nevada Test Site, Nevada* (DOE/NV, 2000) contains a copy of the use restriction form identifying the surveyed location.

# 5.0 Conclusions and Recommendation

The $O_2$, $CO_2$, and TPH soil-gas concentrations will be recorded quarterly for each sample interval. The $O_2$ and $CO_2$ percentages will be calculated and plotted. These data will be compared to previous quarterly sampling data, the baseline sampling data and to TPH concentrations. Changes in $O_2$ and $CO_2$ concentrations are an indicator of changes in the rate of biodegradation; therefore, as an indicator of changes in the TPH consumption. As these rates are measured over time for the various intervals and TPH concentrations initially measured, the rate and effectiveness of the natural attenuation can be assessed. Once adequate data are collected, a rate of biodegradation can be developed, and extrapolated to estimate the time necessary for reducing the concentration of TPH to an acceptable level. Based on the data, a rate constant will be calculated from the TPH concentrations based on the following equation:

$$C_t = C_o e^{-kt}$$

where

$C_t$ = Concentration of the parent compound at some time
$C_0$ = The initial concentration of the parent compound
$k$ = Rate constant
$t$ = Time

If a biodegradation estimate can be determined based on decreasing concentrations of TPH and the $CO_2$ and $O_2$ relationships after three consecutive years of monitoring, then post-closure monitoring will be suspended. The NNSA/NSO will notify NDEP via the post-closure monitoring report that final site closure has been achieved and no further monitoring is required. If data is not sufficient to determine an estimated rate of biodegradation after this time, bioassessment and geotechnical data may be used in a one-dimensional infiltration model to determine a migration rate of the TPH and the concentration expected at various depths over time. These data will be presented in the post-closure monitoring report and a request for final site closure based on the modeling results will be submitted. Once closure is accepted, all boreholes will be properly abandoned.

## *6.0 References*

Hemond, H.E., and E.J. Fechner. 1994. *Chemical Fate and Transport in the Environment.* San Diego, CA: Academic Press, Inc.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada,* Rev. 3, DOE/NV--372. Las Vegas, NV.

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U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87-003. Washington, DC.

# Appendix A

# NDEP Document Review Sheets

# NEVADA ENVIRONMENTAL RESTORATION PROJECT
# DOCUMENT REVIEW SHEET

1. Document Title/Number Draft Addendum to the Closure Report for Corrective Action Unit 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada
2. Document Date December 2004
3. Revision Number 0
4. Originator/Organization Stoller-Navarro
5. Responsible DOE/NV ERP Project Mgr. Janet Appenzeller-Wing
6. Date Comments Due January 19, 2005
7. Review Criteria Full
8. Reviewer/Organization/Phone No. John Wong, NDEP, 486-2866
9. Reviewer's Signature

| 10. Comment Number/ Location | 11. Type[a] | 12. Comment | 13. Comment Response | 14. Accept |
|---|---|---|---|---|
| Section 4.1.3.1, page 2 | | Though the post-closure monitoring objective is specifically defined, it is unclear how data will be used to show that "the wetting front is consistent with what was presented in the closure report..." Explain or modify the text in this section to describe what is intended by this statement. | The vertical extent of the wetting front from residual saturation was approximately 120 ft bgs in 1989 and was confirmed in the 2000 sampling by the collection of soil samples.<br><br>Soil samples will be collected at similar or appropriate intervals during the installation of the monitoring wells to confirm or disprove the wetting front has not migrated past 120 ft bgs.<br><br>The third sentence has been modified to read as follows: "In addition, soil samples will be collected to confirm..." | Yes |

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# NEVADA ENVIRONMENTAL RESTORATION PROJECT
# DOCUMENT REVIEW SHEET

Document Title/Number Draft Addendum to the Closure Report for Corrective Action Unit 329: Area 22 Desert Rock Airstrip Fuel Spill, Nevada Test Site, Nevada    Revision Number 0

Reviewer/Organization John Wong NDEP, 486-2866

| 10. Comment Number/ Location | 11. Type[a] | 12. Comment | 13. Comment Response | 14. Accept |
|---|---|---|---|---|
| Section 4.1.3.2, page 3 | | Is there agreement/consensus amongst the subject matter experts that the parameters carbon dioxide and oxygen (in addition to TPH) are sufficient for accomplishing the stated objective, or are there other parameters or indicators that need to be considered? Also, in the last sentence of the sections, specify the proposed duration of monitoring (i.e., quarterly for x events, or x years, or a minimum of...) | It is assumed that some degree of natural attenuation is occurring and we proposed to measure finite increases and decreases in this process. In addition, it has been stated previously that the physical properties of the soil and site conditions are not optimal for this process to reduce the total TPH concentration. Many approaches have been developed for monitoring the effectiveness of natural attenuation in soil by collecting information on various parameters to establish the effectiveness of the process. These approaches are generally tailored to site-specific conditions that are more conducive to the process than what exists at the NTS. Although, other typical methods measure additional parameters such as reduced iron content, nitrogen, ammonia, and carbon isotopes, all methods generally monitor the $O_2$ and $CO_2$ concentrations over time. Because of the arid environment, time since the release, and depth to groundwater, the measurement of these two parameters provides a cost effective method of evaluating the natural attenuation processes. In addition, under these arid conditions the $CO_2$ and $O_2$ concentrations would be the most prevalent parameters to measure.<br><br>The second paragraph text was modified to "The primary analytical techniques for the post-closure monitoring will be the measurement of oxygen ($O_2$) consumption, carbon dioxide ($CO_2$) production, and hydrocarbon (TPH) consumption. As biodegradation occurs there is an associated decrease in O2 with a corresponding increase in $CO_2$ due to microbial response. This will provide a cost-effective approach in the determination of the biodegradation rates." | Yes |

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| Section 4.1.4.1.1, page 3 | | Though background well DRA-11 has been proposed for location between former wells DRA-3 and DRA-5, is this the most appropriate location for collecting background data? Based on Figure 4-1, is proposed well DRA-11 down gradient up gradient of the Former Fuel Tank Location? | The location for DRA-11 to collect background data was selected to keep it as close as possible to the original background well without having the original well interfere with the completion of the new one. Data collected from the first well was acceptable and represented the background conditions beyond the plume. The up gradient or down gradient location has not been determined, nor is it necessary, because the monitoring is being conducted in an unsaturated alluvial zone above the groundwater table. In addition, the source of the plume has been removed and little migration either vertically or horizontally is expected. Having the background well close to the plume is more important than having it in an up gradient location, in that it reduces the potential variability in the physical properties of the alluvium that may impact the effectiveness of the evaluation process. | N/A |

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| Section 5.0, page 17 | | Define or propose a duration for monitoring, such as a minimum length of time or minimum number of sampling events over which data will be collected. Such proposal can be modified later, as appropriate, but to indicate that "monitoring will continue until data is available to demonstrate natural attenuation is occurring..." is vague, non-definitive, and may be excessive/too encompassing.<br><br>To make a determination based on TPH concentrations, carbon dioxide production, and oxygen consumption, the amount of monitoring data, and thus, a defined period of monitoring, may be appropriately estimated by the criteria you define for the data (i.e., if carbon dioxide results significantly increase (%), and oxygen results significantly decrease (%), while TPH concentrations decline (%)...)...this type of discussion, similar to that contained in Section 4.1.4.2.3. regarding equilibrium, may help define an appropriate period of monitoring and when it will be possible to calculate the rate of attenuation. | Section 5.0 has been changed to read as follows: "The $O_2$, $CO_2$, and TPH soil-gas concentrations will be recorded quarterly for each sample interval. The $O_2$ and $CO_2$ percentages will be calculated and plotted. These data will be compared to previous quarterly sampling data, the baseline sampling data and to TPH concentrations. Changes in $O_2$ and $CO_2$ concentrations are an indicator of changes in the rate of biodegradation; therefore, as an indicator of changes in the TPH consumption. As these rates are measured over time for the various intervals and TPH concentrations initially measured, the rate and effectiveness of the natural attenuation can be assessed. Once adequate data are collected, a rate of biodegradation can be developed, and extrapolated to estimate the time necessary for reducing the concentration of TPH to an acceptable level. Based on the data, a rate constant will be calculated from the TPH concentrations based on the following equation: $C_t=C_0e^{-kt}$ , where Ct=concentration of the parent compound at some time, | |

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| Section 5.0, page 17 (Continued) | | | $C_0$=the initial concentration of the parent compound, k=rate constant, and t=time.<br><br>If a biodegradation estimate can be determined based on decreasing concentrations of TPH and the $O_2$ and $CO_2$ relationships after three consecutive years of monitoring, then post-closure monitoring will be suspended. The NNSA/NSO will notify NDEP via the post-closure monitoring report that final site closure has been achieved and no further monitoring is required. If data is not sufficient to determine an estimated rate of biodegradation after this time, bioassessment and geotechnical data may be used in a one-dimensional infiltration model to determine a migration rate of the TPH and the concentration expected at various depths over time. These data will be presented in the post-closure monitoring report and a request for final site closure based on the modeling results will be submitted. Once closure is accepted, all boreholes will be properly abandoned."<br><br>The best indicators that natural attenuation is occurring is that $CO_2$ concentrations will increase and $O_2$ will decrease. It would be difficult to predict an acceptable percentage goal for these parameters, especially in an environment that is not well suited to the process. The residual TPH in soil has been in the ground for approximately 10 years and we are measuring the effectiveness of the natural attenuation process after 10 years of degradation. | Yes |

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| Section 4.1.4.2.2 | | NA | The analysis of SVOCs and geotechnical and bioassessment parameters were added to this section. | |
| Section 4.1.4.2.3 | | NA | Modified text to correctly state that soil-gas sampling will occur after the completion of the monitoring wells and again from 45 to 60 days after borehole completion to verify equilibrium. Results will be used as baseline monitoring data. | |
| Section 4.1.5 | | NA | Modified this section slightly to include what may be reported. The text will read as follows: "Post-closure monitoring will be conducted on a quarterly basis for a minimum of three years. Soil-gas samples will be analyzed for $O_2$, $CO_2$, and TPH. The $O_2$ and $CO_2$ percentages will be calculated and plotted. These relationships will be compared to the TPH concentrations to confirm that biodegradation is occurring. The $O_2$ and $CO_2$ concentrations collected from the background well (DRA-11) will serve to identify lithologic and climatic influences on the natural attenuation process. All sampling data will be consolidated and presented in an annual post-closure monitoring report." | |

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