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Addendum to the Compliance Monitoring Plan and Contingency Plan for Environmental Restoration at Lawrence Livermore National Laboratory Site 300

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May 2013

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Environmental Restoration Department

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In June 2012, the U.S. Department of Energy (DOE) proposed and the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the Regional Water Quality Control Board-Central Valley Region (RWQCB) agreed to changes to the Detection Monitoring and Reporting Program for the Pit 6 Landfill at Lawrence Livermore National Laboratory (LLNL) Site 300. The objectives of implementing these changes are to: (1) make the Detection Monitoring and Reporting Program for the Pit 6 Landfill consistent with the Site 300 Compliance Monitoring Plan requirements for detection monitoring of Site 300 landfills, and (2) eliminate reporting redundancies by consolidating reporting for the Pit 6 Landfill into the semi-annual and annual Site-wide Compliance Monitoring Reports. Documentation of the DOE proposal and regulatory concurrence with the changes to the Detection Monitoring and Reporting Program for the Pit 6 Landfill is maintained in the LLNL Administrative File for Site 300 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents and records.

This Addendum to the 2009 Compliance Monitoring Plan and Contingency Plan for Environmental Restoration at LLNL Site 300 (Dibley et al., 2009) incorporates the former detection monitoring program for the Pit 6 Landfill, and reflects the changes agreed to by DOE, EPA, DTSC, and the RWQCB. This Addendum supersedes the detection monitoring requirements presented in the Pit 6 Landfill Post-Closure Monitoring Plan (Ferry et al., 1998).

Only those sections of the 2009 Compliance Monitoring Plan that have been modified to incorporate the detection monitoring program for the Pit 6 Landfill are included in this Addendum. The changes to these sections are shown in tracked changes. A new table (4-2) has also been added that contains the detection monitoring sampling and analysis plan for the Pit 6 Landfill. Although referenced in the text of this Addendum, Table 4-1 (Detection monitoring sampling and analysis plan for the Pit 2, 3, 4, 5, 7, 8, and 9 Landfills) has not been modified and therefore is not included. The modified sections contained in this Addendum supersede the corresponding sections in the 2009 Compliance Monitoring Plan. Any portions of the Compliance Monitoring Plan not included in this Addendum remain as presented in the 2009 document. There are no changes to the Contingency Plan.

In addition, a new Appendix C has been incorporated to document the procedures for the statistical analysis of detection monitoring results for the Pit 6 Landfill. These procedures, which were contained in the Post-Closure Plan for the Pit 6 Landfill (Ferry et al., 1998), have been reviewed, and updated as necessary to ensure consistency with more recent versions of the California Code of Regulations and EPA guidance for the statistical analysis of ground water monitoring data (EPA, 2009).

The Pit 6 Landfill detection monitoring program results will be reported in the Compliance Monitoring Reports beginning with the 2012 Annual Site 300 Compliance Monitoring Report. The quarterly and annual Pit 6 Landfill Post-Closure Monitoring Reports were discontinued as of the third quarter of 2012, with regulatory concurrence.

1.3. Scope of the Compliance Monitoring Plan and Contingency Plan

This CMP/CP describes the monitoring activities and procedures to be followed during implementation of the selected remedies and includes the following programs:

- Ground and Surface Water Monitoring Program (Section 3).
- Detection Monitoring, Inspection, and Maintenance Program for the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills (Section 4).
- Extraction and Treatment System Monitoring Program (Section 5).
- Risk and Hazard Management (Section 6).
- Data Management Program (Section 7).
- Quality Assurance/Quality Control Program (Section 8).
- Reporting (Section 9).

A Contingency Plan is presented in Section 10 that describes how DOE and the regulatory agencies plan to address foreseeable problems that may arise during the remediation and monitoring of contaminants conducted under the ROD.

In the 2008 Site 300 Site-Wide ROD, DOE agreed to prepare an analysis after ground water contaminant concentrations have been reduced to MCL cleanup standards in OUs 2 through 8 to determine the technical and economic feasibility of continuing remediation to further reduce contaminant concentrations to Water Quality Numeric Limits (WQNLs) or background concentrations. The Site-Wide ROD specified that the details of the approach that will be used to perform technical and economic feasibility analysis would be provided in this Revised Site-Wide Compliance Monitoring Plan/Contingency Plan. Therefore, the technical and economic feasibility analysis process, the general schedule for conducting this analysis, and a discussion of how the results of this analysis will be used is included in Appendix A of this CMP/CP.

This CMP/CP applies to OUs 1 through 8. The following areas and programs are not included in this CMP/CP:

- Pit 1 Landfill – RCRA Closure and Post-Closure documents (Corey, 1988; Rogers/Pacific, 1990) have been approved and this facility is currently monitored under Waste Discharge Requirements issued by the RWQCB. This monitoring will not be affected by this CMP/CP.
- Building 865 – A report summarizing characterization activities at Building 865 is currently in review by the regulatory agencies and a CERCLA pathway for this area has not yet been determined. DOE will continue to monitor this area until the remediation pathway is determined and the Building 865 is incorporated into the CMP/CP.
- Building 812 – The RI/FS is in progress. DOE will continue to monitor this area until it is formally incorporated into the Site-Wide ROD and Building 812 is incorporated into the CMP/CP.
- Building 850 Soil Removal Action – Implementation of a soil excavation and solidification remedy is in progress. Inspection and maintenance requirements associated with the remedy will be incorporated into the operations and maintenance plan. However, contingencies that could impact the effectiveness of the remedial action are addressed in the CP.

- Pit 7 Hydraulic Drainage Diversion System – Inspection and maintenance requirements are incorporated into the Hydraulic Drainage Diversion System operations and maintenance plan. However, contingencies that could impact the effectiveness of the Hydraulic Drainage Diversion System are addressed in the CP.
- Surveillance Monitoring Program – The monitoring of water-supply wells, air, vegetation, and storm water runoff by the LLNL Environmental Protection Department will not be affected by this CMP/CP.
- ~~Pit 6 Landfill Detection Monitoring Program – The designated "detection monitor wells" for this landfill will continue to be sampled as specified in the Detection Monitoring Plan contained within the Post-Closure Plan for this landfill (Ferry et al., 1998). This monitoring will not be affected by this CMP/CP. Wells in the area that are not designated as detection monitor wells will be sampled as described in the Ground and Surface Water Monitoring Program presented in Section 3.~~
- High Explosives Open Burn Facility – A RCRA Closure Plan has been approved and this facility is monitored as specified in that document. This monitoring will not be affected by this CMP/CP.
- Standards for the discharge of treated ground water remain in the RWQCB Substantive Requirements and the Site-Wide ROD and are not affected by this CMP/CP.

2. Objectives

2.1. General Objectives

This CMP/CP describes the monitoring and compliance activities to be conducted in support of the remedies selected in the Site-Wide ROD, including:

- Performing regular ground and surface water sampling and analysis and ground water elevation measurement to monitor the effectiveness of the remedial actions.
- Conducting detection monitoring, inspection, and maintenance of the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills to identify and prevent future contaminant releases from these landfills.
- Monitoring soil vapor and ground water extraction and treatment facilities to ensure the regulatory compliance.
- Managing human and ecological receptors risks and hazards to prevent unacceptable exposure from occurring, including institutional and land use control implementation.
- Managing the collection, processing, and quality of monitoring data.
- Reporting monitoring results and interpretations to the regulatory agencies and other stakeholders.
- Establishing contingency measures and procedures to be implemented if cleanup does not proceed as planned.

4. Detection Monitoring, Inspection, and Maintenance Program for the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills

The remedies selected in the Site-Wide ROD for the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills included: (1) ground water monitoring to detect any future releases of contaminants from these landfills (Sections 4.1 and 4.2), and (2) landfill inspection and maintenance (Section 4.3). The Detection Monitoring, Inspection, and Maintenance Program for these landfills includes:

- Collecting and analyzing ground water samples as specified in Tables 4-1 and 4-2.
- Annually inspecting the landfills to identify any erosion, subsidence, or breaching of the landfill surface.
- Maintaining the landfill surfaces and drainage ways as needed.

There is no evidence of contaminant releases from the Pit 8 and 9 Landfills, and no unacceptable risk or hazard to human or ecological receptors has been identified. Therefore, detection monitoring and landfill inspection and maintenance only, as described in this section, will be conducted at these landfills. Section 10.1.4 describes procedures that would be implemented if contaminant releases from Pits 8 and 9 are detected.

Contaminant releases have already occurred from the Pit 2, 3, 4, 5, 6, and 7 Landfills. Therefore, the ground and surface water sampling and analysis program described in Section 3.1 will be implemented at these landfills, in addition to the detection monitoring, inspection, and maintenance program described in this section.

The detection monitoring, inspection, and maintenance program will be conducted as long as the waste buried in the Pits 2, 3, 4, 5, 6, 7, 8, and 9 landfills poses a potential threat to ground water.

Detection monitoring will be performed using the Standard Operating Procedures and quality assurance/quality control measures described in Section 8.

Reporting requirements are described in Section 9. Changes to the monitoring program will continue to be documented in the semiannual Compliance Monitoring Reports.

The detection monitoring, inspection, and maintenance program for the Pit 1 ~~and 6~~ Landfill~~s~~ is not included in this CMP/CP. ~~The Detection Monitoring, Inspection, and Maintenance Program for the Pit 6 Landfill is described in the Pit 6 Landfill Post-Closure Plan.~~ The Detection Monitoring, Inspection, and Maintenance Program for the Pit 1 Landfill is contained in Waste Discharge Requirements issued by the Regional Water Quality Control Board (RWQCB).

4.1. Ground Water Sampling and Analysis

Detection monitor wells, situated in close proximity to the landfills, will be used to identify any impact to ground water resulting from future releases from the landfills.

Ground water samples will be collected semi-annually from the Pit 6 detection monitor wells and annually from the detection monitor wells at the Pit 3, 4, 5, 7, 8, and 9 Landfills. Table 4-1 presents the list of analyses to be performed on the ground water samples collected from detection monitor wells at the Pit 2, 3, 4, 5, 7, 8, and 9 Landfills. Table 4-2 presents the list of analyses and frequency of analysis to be performed on the ground water samples collected from detection monitor wells at the Pit 6 Landfill. Samples from the Pit 6 detection monitor wells will

be analyzed semi-annually for halogenated VOCs and tritium, and annually for all other constituents of concern. Annual field measurement for water quality indicators (pH, total dissolved solids, specific conductance, and temperature) will be taken in all Pit 6 detection monitor wells. The constituents monitored at the Pit 6 Landfill (Table 4-2) differ from the constituents monitored at the Pit 2, 3, 4, 5, 7, 8, and 9 Landfills (Table 4-1) due to the difference in the source and nature of the waste. The waste in the Pit 6 Landfill consists of shop and research laboratory materials from the LLNL Livermore Site and Lawrence Berkeley National Laboratory, whereas the waste in the Pit 2, 3, 4, 5, 7, 8, and 9 Landfills consists of debris from explosives tests conducted at LLNL Site 300 firing tables. The lists of analytes includes all constituents that can~~could~~ reasonably be expected in the buried waste in these landfills based on an evaluation of disposal/operational records and procedures.

Detailed sampling and analysis plans will continue to be presented in the semi-annual Compliance Monitoring Reports that shows, the location, completion interval, sampling frequency, and analyte list for all detection monitor wells.

4.2. Ground Water Elevation Measurements

Ground water elevations will be measured quarterly in all detection monitor wells for the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills.

4.3. Pit 6 Landfill Statistical Analyses

Statistical analysis of ground water data from the Pit 6 Landfill detection monitoring wells will continue to be performed to detect future changes in constituent of concern concentrations that may indicate a new release. The statistical method used by DOE/LLNL is contained in the California Code of Regulations (CCR) Title 23. Statistical analysis of detection monitoring data will be performed semi-annually for halogenated VOCs and tritium, and annually for all other constituents of concern in Table 4-2 at each Pit 6 detection monitor well except for water quality indicators (pH, total dissolved solids, specific conductance, and temperature). A discussion of the statistical method to be used for detection monitoring at the Pit 6 Landfill is presented in Section C-8 of Appendix C.

4.4. Landfill Inspection and Maintenance

The Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills will be inspected annually to identify any degradation or damage to the landfill surfaces or damage or blockage of the drainage ways that could lead to: (1) increased infiltration of precipitation, (2) exposure of the landfill contents, and (3) flow of surface water on or adjacent to the landfill.

LLNL Maintenance and Utilities Services Department staff will perform the landfill inspections and the annual subsidence monitoring required by DOE. Any required maintenance will be performed promptly, and measures to prevent reoccurrence of the degradation or damage will be implemented.

9. Reporting

9.1. Compliance Monitoring Reports

Formal compliance monitoring reports will be submitted to the regulatory agencies semiannually no later than the last day of the third month following the reporting period. The following elements will be included in the compliance monitoring reports:

1. Ground and Surface Water Monitoring Program
   - Contaminant concentration and distribution summary.
   - Summary of remediation progress.
   - Remedy performance issues.
   - Sampling and analysis plans, including the identification of monitor well designations and any modifications from previous plans.
   - Evaluation of guard well selection, analytes, and sampling frequency (annual).
   - Analytical and ground water elevation data collected during the semester (annually).
   - Isoconcentration maps (annual, but maps for some areas may be generated semiannually upon the request of the regulatory agencies).
   - Potentiometric surface elevation contour maps (annual, but maps for some areas may be generated semiannually upon the request of the regulatory agencies).
2. Detection Monitoring, Inspection, and Maintenance Program for the Pit 2, 3, 4, 5, 6, 7, 8, and 9 Landfills
   - Contaminant concentration and distribution summary.
   - Sampling and analysis plans, including any modifications from previous plans.
   - Analytical and ground water elevation data collected during the semester (annually).
   - Isoconcentration maps (annual, but maps for some areas may be generated semiannually upon the request of the regulatory agencies).
   - Potentiometric surface elevation contour maps (annual, but maps for some areas may be generated semiannually upon the request of the regulatory agencies).
   - Results of landfill inspections (annual).
   - Results of subsidence monitoring (annual).
   - Description of any maintenance performed (annual).
   - Summary of the results of the statistical analysis of detection monitor well data for the Pit 6 Landfill (see Section 4.3 and Appendix C).
3. Extraction and Treatment Facility Monitoring Program
   - Facility performance assessment.
   - Operations and maintenance issues and corrective measures taken.
   - Compliance summary.
   - Facility sampling plan evaluation and modifications.

- Facility and extraction wellfield modifications.
- Capture zone analyses (annual).
- Treatment system influent/effluent analytical data collected during the semester.
- Contaminant mass removal data.
- Operational hours and flow volume measurements.

4. Risk and Hazard Management Program

Human Health:

- Results of vapor intrusion inhalation risk re-evaluation.
- Results of spring ambient air inhalation risk re-evaluation.
- Activities planned in response to the results of the human health risk estimation.
- Results of building access and use conditions review.
- Reporting of the institutional control monitoring results including the status of the institutional controls and how any deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls were communicated in the deed(s), whether the owners and state and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed with such restrictions and controls.

Data and information related to the human health risk and hazard management program will be reported annually in the Compliance Monitoring Reports.

Ecological:

- Results of hazard re-evaluation associated with cadmium in surface soil at Buildings 801 and 851, and in the HE Process Area, and any resulting revisions to the risk and hazard management activities.
- Results of the evaluation of future changes in contaminant and ecological conditions (every five years).
  - Results of identification of significant increases in concentrations for existing contaminants.
  - Results of identification of changes in the presence and abundance of species for which a hazard has been identified over time relevant.
  - Results of any calculations or recalculation of ecological hazard for existing contaminants exhibiting a significant increase in concentration.
  - Recommendations for modifications to ecological risk and hazard management.
- Annual reporting of ecological risk and hazard management activities conducted based on five-year review recommendations.

5. Data Management Program

- Modifications to procedures.
- New procedures.

6. Quality Assurance/Quality Control Program
   - Modifications to procedures.
   - New procedures.
   - Self-Assessments.
   - Quality issues and corrective actions.
   - Analytical Quality Control.
   - Field Quality Control.

Additional References

Dibley V., L. Ferry, S. Gregory, L. Hall, V. Madrid, L. Martello, E.N. Shiroma, M. Taffet, K.S. Wells (2009), *Compliance Monitoring Plan/Contingency Plan for Environmental Restoration at Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (LLNL-AR-411239).

L. Ferry, T. Berry, and D. MacQueen (1998), *Post-Closure Plan for the Pit 6 Landfill Operable Unit at Lawrence Livermore National Laboratory*, Lawrence Livermore National Laboratory, Livermore, Calif. (LLNL-AR-128638).

U.S. Environmental Protection Agency (EPA), (2009) *Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Unified Guidance*, USEPA Office of Resource Conservation and Recovery, EPA 530/R-09-007.

Appendix C

Statistical Analysis of Detection Monitoring Data for the Pit 6 Landfill

Statistical analysis of ground water data from the Pit 6 Landfill detection monitoring wells will continue to be performed to detect future changes in constituent of concern concentrations that may indicate a new release (Sections 4.1, 4.3). This Addendum supersedes the statistical analysis/detection monitoring requirements presented in the Pit 6 Landfill Post-Closure Monitoring Plan (Ferry et al., 1998) that was previously administered by the California Regional Water Quality Control Board-Central Valley Region (RWQCB) under 23 California Code of Regulations (CCR) Chapter 15. It is designed to meet the performance requirements of a "Detection Monitoring Program" as defined in 23 CCR Section (§) 2550.8.

Statistical methods for ground water detection monitoring are mentioned in several State and Federal regulations, including 23 CCR Chapter 15, 22 CCR Chapter 14, and 40 Code of Federal Regulations (CFR) Part 264. The State and Federal regulations contain similar, and sometimes identical, language with regard to statistical methods, and offer similar choices to the facility operator. In addition, the U.S. Environmental Protection Agency (EPA) has provided extensive guidance on the use of statistical methods for 40 CFR Part 264 in EPA 530/R-09-007, Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Unified Guidance (2009).

In accordance with 23 CCR Chapter 15, to establish a detection monitoring program using statistical analysis, the facility operator must first establish constituents of concern (23 CCR §2550.3), concentration limits (§2550.4) and monitoring points (§2550.5). The operator then proposes a statistical method (§2550.7) that will be used to determine whether there is statistical evidence that constituent concentrations at monitoring points (hereafter referred to as detection monitoring wells) might exceed their concentration limits. The constituents of concern, detection monitoring wells, and sampling schedule for the Pit 6 detection monitoring program are presented in Table 4-2.

C-1. Statistical Method

DOE has selected the intrawell prediction limit method with two discrete retests from 23 CCR Chapter 15. The prediction limit method is listed in 23 CCR 2550.7(e)(8)(C). Discrete retests are described in §2550.7(e)(8)(E)5b.

Use of the intrawell prediction limit method to determine concentration and statistical limits is appropriate when spatial variability is present, due either to natural causes or resulting from human activities such as pre-existing contamination, or when the absence of spatial variability cannot be demonstrated. In this case, the background, concentration limit, and statistical limit for each detection monitoring well and constituent of concern pair are based on its own concentration history.

The 2009 EPA guidance offers several variations of the prediction limit with retest methods. Two of them are almost identical to the method in 23 CCR: the "1-*of*-*m*" method (1 sample

followed by *m*–1 retests if needed) and the "modified California" approach. These methods differ from the original California method in 23 CCR only in terms of how the statistical significance level (false positive error rate, or α) is calculated, and how retests are used. Therefore, DOE plans to continue with the original California approach from 23 CCR.

C-2. Determination of Concentration and Statistical Limits

For the prediction limit method, the concentration limit is the average of background, and the statistical limit is calculated by multiplying the background standard deviation by a value determined by the regulations, and then adding the product to the average (this is the prediction limit formula).

However, the presence of results below their reporting limits (nondetections) complicates the calculation of the average and standard deviation. The proposed approach is as follows:

- When all results are detections, the background mean and standard deviation are calculated using their standard formulas.
- When some analytical results are below the reporting limit, but there are enough results above the reporting limit, the background mean and standard deviation are calculated using the method of maximum likelihood (Helsel, 2005) or methods in Chapter 15 of the 2009 EPA guidance.
- When all but a few analytical results are below the reporting limit and those few results are more than a few years old, the reporting limit will be used for both the concentration limit and the statistical limit.
- When all but a few analytical results are below the reporting limit and at least one of them is recent, but the number of detections is not enough to calculate mean and standard deviation values, the maximum recent detection will be used for the concentration limit and the statistical limit.
- When all analytical results are below the reporting limit, the reporting limit will be used for both the concentration limit and the statistical limit.
- For radiological constituents, the analytical laboratory generally provides estimated concentrations for results below the reporting limit, and such results will be used in calculating the background mean and standard deviation.

The statistical limits for the constituents of concern in the Pit 6 detection monitor wells will be presented in the annual Compliance Monitoring Reports, together with the semi-annual and annual analytical results for those wells. The statistical limits will be re-evaluated at least every five years as part of the Five-Year Review Process for Operable Unit 3, or more frequently if necessary to account for changes in data trends.

C-3. Anthropogenic Constituents

Some constituents of concern are not naturally occurring (for example VOCs and perchlorate), so reported concentrations are normally expected to be below the analytical laboratory reporting limit. Where such constituents of concern have not historically been detected in a detection monitor well, the statistical limit will be the reporting limit (see Section C-2). However, some anthropogenic compounds have been detected above reporting

limits in some detection monitor wells. Their presence has been documented as a result of a previous release. In order to detect a new release of these constituents of concern, the concentration and statistical limits for these constituents of concern must take into account previous releases detected in these wells. Therefore, for wells where anthropogenic compounds have been detected, the concentration limit and statistical limit are based on historical data, as described in Section C-2.

Some of the constituents of concern can have both natural and anthropogenic sources (for example, nitrates and some metals). The statistical methodology is based entirely on reported concentrations and cannot distinguish between natural and anthropogenic molecules. Therefore, concentration limits and statistical limits are based on historical data, as described in Section C-2.

C-4. Radiological Constituents of Concern

Radiological results with two-sigma uncertainty less than 100% are considered to be detections, even if below the reporting limit, and are used as such. Estimated concentrations with greater than 100% uncertainly will be used, even if they are less than zero.

When comparing radiological results with statistical limits, a result must be both above the statistical limit and also a detection in order to be considered to have exceeded the statistical limit.

C-5. Distributional Assumptions

The prediction limit method assumes that background concentrations follow a normal distribution, at least approximately, or can be transformed to do so. This assumption cannot be verified when there are too many values below their reporting limit, in which case the approaches described in Section C-2 will be used.

C-6. Appropriate Use of Available Data

When possible, all available data are used. However, some patterns of data indicate that only relatively recent data should be used.

For example, if there were a number of samples collected 10 to 12 years ago, followed by a gap and then two samples collected within the last year, this would be considered insufficient data. With a large gap in the sampling history it cannot be assumed that the older data is representative of current conditions.

Sometimes, older data appear to have a different distribution than more recent data. For example, data from 10 to 15 years ago may show a great deal more variability than data from the last four or five years (perhaps due to subsequent improvements in sampling and analytical procedures). In this case, the older data would not be considered representative of current conditions, so the concentration limit and statistical limit would be based on only the recent data. Inclusion of the older data in a case like this would weaken the ability of the statistical method to detect a new release.

The prediction limit method requires that the average constituent of concern concentration is not changing significantly over time. For example, if the constituent of concern concentration history indicates a trend that has leveled off in recent years, then only the recent data is used.

Single isolated outliers are excluded from the calculation of concentration and statistical limits. This causes the statistical method to be more sensitive to future increases.

C-7. Statistical Significance Levels

23 CCR 2550.7(e)(8)(E)5b states that for methods employing retests the Type I error rate (also known as the statistical significance levels or false positive rate) for each individual monitor well comparison, including retests, is greater than or equal to the larger of

$[1 - 0.95^{1/M*W*S}]^{0.5} \times [1/R]^{0.5}$ and

$1 - 0.99^{1/S}$,

where M = the number of constituents of concern using a prediction interval, W = the number of monitor wells, S = the number of times that suites of data are analyzed within a period of six months, and R = the number of discrete retests to be conducted in the event the initial sample result exceeds the statistical limit. These formulas assume at least semi-annual sampling. However, some constituents in Table 4-2 will be sampled annually, so the Type I error rate for future updates to statistical limits will be determined based on methods in the EPA 2009 guidance.

The false positive error rate associated with using the reporting limit (i.e., for rarely detected constituents) can be either much smaller than 0.01 or much greater than 0.01. It is not possible to design the monitoring program to control this error rate. For example, if naturally occurring constituent of concern concentrations are far below the reporting limit, then the statistical false positive error rate will be much smaller than 0.01. On the other hand, if naturally occurring constituent of concern concentrations are slightly below the reporting limit, and the background data consists of only a small number of samples (none of which has exceeded the reporting limit), then the statistical false positive rate will be greater than 0.01.

C-8. Implementation of the Method

If a regularly scheduled sample result exceeds its statistical limit as calculated by the prediction limit method for a constituent of concern at a detection monitoring well, then two additional samples (retests) are collected at that detection monitoring well. Retest samples are analyzed only for the constituent of concern that exceeded its statistical limit, and must use the same sampling and analytical methods and statistical limit as the initial sample.

The retest results are separately compared with the statistical limit. If either of them exceed the statistical limit, then the original exceedance is considered to be confirmed [2550.7(e)(8)(E)1] and the result is considered to be "statistically significant evidence of a release" (see Section C-9) and reported according to Section 9. Otherwise the original result is not confirmed.

23 CCR §2550.7(e)(8)(E)(3) requires the entire resampling effort to be completed, if possible, within 30 days after the initial result is found to exceed its statistical limit. However, retest samples should also be collected far enough apart in time to ensure statistical independence

between them [*consider citing the new EPA guidance document*]. Thus, because statistically analyses are performed at most semi-annually, the time interval between retests will be 30 days.

C-9. Evaluation of Statistically Significant Evidence for a Release

It is important to note that in an area where contaminants were previously released to ground water, as is the case at the Pit 6 Landfill, there are other factors that could cause a constituent's concentration to increase that are not indicative of a new release from the landfill. For example, if a high rainfall year occurs following several years of drought, it can cause water levels to rise and pick up residual VOCs or other contaminants in the vadose zone that were released prior to capping. Similarly, increases in concentrations of naturally-occurring metals can result if water levels rise into soils/rock containing residual metal salts that were previously deposited when water levels dropped during drought periods. Thus, a "statistically significant evidence of release" does not by itself show conclusively that a release has occurred. This should be determined by subsequent evaluation of all available information.

C-10. New Wells

If and when any new detection monitoring wells are installed, samples will initially be collected quarterly until at least six data points are obtained, after which concentration limits and statistical limits will be determined.

C-11. References

Helsel, D.R., (2005), *Nondetects and Data Analyis: Statistics for Censored Environmental Data*. Wiley-Interscience, Hoboken, New Jersey.

U.S. Environmental Protection Agency (EPA), (2009), *Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities, Unified Guidance*, USEPA Office of Resource Conservation and Recovery, EPA 530/R-09-007.

Table 4-2. Detection monitoring sampling and analysis plan for the Pit 6 Landfill.

Analyte	Frequency	Analytical method
Halogenated volatile organic compounds: 1,1,1-trichloroethane, 1,2-dichloroethane, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, chloroform, and methylene chloride,	Semi-annual	U.S. EPA Methods 601 or 624
Aromatic volatile organic compounds: benzene, ethylbenzene, toluene, and total xylenes	Annual	U.S. EPA Methods 602 or 624
Beryllium	Annual	U.S. EPA Method 210.2
Mercury	Annual	U.S. EPA Method 245.1
Tritium	Semi-annual	U.S. EPA Method 906
Uranium (isotopes or total)	Annual	Alpha or mass spectrometry
Radiological constituents: antimony-125, cesium-137, cobalt-60, sodium-22, strontium-90, thallium-204, and thorium-232	Annual	Gross alpha/gross beta by EPA 900 (isotopic analyses not routinely performed)
Perchlorate	Annual	U.S. EPA Method 300.0 or 314.0
Nitrate	Annual	U.S. EPA Method 300.0
pH[a]	Annual	Field measurement
Total dissolved solids[a]	Annual	U.S. EPA Method 160.1
Specific conductance[a]	Annual	Field measurement
Temperature[a]	Annual	Field measurement

Notes:

[a] Water quality indicators are not included in statistical analysis.

Quarterly samples will be collected from any new Pit 6 Landfill detection monitor wells for analysis of constituents of concern for six quarters to establish an appropriate statistical limit for the well.

Detection monitor wells = EP6-06, EP6-08, EP6-09, K6-01S, K6-19, and K6-36.

U.S. EPA = United States Environmental Protection Agency.

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