Groundwater Monitoring Statistical Methods

Omaha Public Power District

North Omaha Station – NOS
Combustion Ash Landfill

Omaha, Nebraska

December 2016
Revision 1: July 24, 2019
Revision 2: December 13, 2021

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Certification

I hereby certify that the selected statistical method described herein is appropriate for evaluating the groundwater monitoring data for the Omaha Public Power District North Omaha (NOS) Ash Disposal Area and meets the requirements of 40 CFR 257.93(f) and (g).

Megan B. Seymour 12-13-21

Megan B. Seymour, P.E. Date
Nebraska License No. E-15931
My license renewal date is December 31, 2022.

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1 Introduction

On April 17, 2015 the U.S. Environmental Protection Agency (EPA) published the final rule for the regulation and management of coal combustion residuals (CCR) under the Resource Conservation and Recovery Act (RCRA). The CCR rule is formally promulgated in the U.S. Code of Federal Regulations (CFR), Title 40, Part 257 (EPA, 2015). The rule – effective on October 19, 2015 and subsequent amendments – applies to electric utilities and independent power producers that fall within NAICS code 221112, and the facility produces or stores CCR materials in surface impoundments or landfills. This regulation applies to the Omaha Public Power District's (OPPD) North Omaha Generation Station.

The Station is located east of Pershing Drive and Craig Street, approximately 3.5 miles northwest of Eppley Airfield, along the west bank of the Missouri River in Omaha, Nebraska. The Station has a five-unit fuel-fired generation station with one active CCR ash disposal landfill – NOS Ash Disposal Area. This statistical certification covers the NOS Ash Disposal Area, which consists of an unlined active CCR landfill of approximately 18 acres and undeveloped portion of approximately 1.4 acres that is permitted for ash disposal. The NOS Ash Disposal Area is permitted under the current Nebraska Department of Environment and Energy (NDEE) Title 132 Integrated Solid Waste Management Regulations.

Pursuant to the 40 CFR §257.93, the facility must develop a program to address the selection of statistical methods to be certified by a Qualified Professional Engineer. HDR Engineering, Inc. (HDR) has prepared this Statistical Methods Report to certify that the statistical methods selected for evaluating the groundwater monitoring data at the NOS Ash Disposal Area are appropriate under the requirements of 40 CFR §257.93(f) and (g).

2 Statistical Methodology Summary

This Statistical Selection Methods Report describes the method(s) that are implemented for evaluating the groundwater monitoring data at the NOS Ash Disposal Area. The method(s) described herein are implemented in accordance with the EPA's Unified Guidance Document (EPA, 2009). A list of statistical methods from which to choose for evaluating the groundwater monitoring data from CCR management areas is provided in 40CFR §257.93(f). The statistical options include:

- A parametric analysis of variance followed by multiple comparison.
- An analysis of variance based on ranks followed by multiple comparison procedures.
- A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
- A control chart approach that gives control limits for each constituent.
- Another statistical test method that meets the performance of 40 CFR §257.93(g).

These same statistical method options are listed in NDEE Title 132, Chapter 7, Section 003.07. The goal of the statistical analysis is to provide a quantified means to evaluate whether a CCR management unit has released contaminants into the groundwater. Following the collection of groundwater monitoring data, detected constituents are statistically evaluated to identify if a statistically significant increase (SSI) over background has occurred. The Sanitas™ Statistical Software is used to conduct statistical analysis of groundwater analytical data collected for the NOS Ash Disposal Area. However, if during the period of the groundwater monitoring program an updated or more comprehensive statistical software program is available or may become available, OPPD reserves the right to change software packages.

As groundwater monitoring progresses, the use of the selected statistical method is subject to ongoing review. OPPD reserves the right to use other statistical tests in place of, or in addition to, the methods specified in this Statistical Selection Method Report if such methods are better suited for analysis of future results. If test methods are changed, this Report will be revised, as appropriate, and its certification updated.

2.1 Data Review & Outliers

Data for each sampling and analysis event is reviewed for outliers and trends. The review will include evaluations using time series plots, box-whisker plots, Sen's Slope/Mann-Kendall trend test, and Outlier screening. If the data is determined to be an outlier, the data point may be replaced with a corrected value, discarded from statistical calculations, or left "as is" in the database. In accordance with 40 CFR §257.93(g)(6), data is evaluated, as necessary, for seasonal and spatial variability using the procedures previously mentioned.

Statistical analysis is completed in accordance with the data's distribution type, parametric or non-parametric. The Shapiro-Wilk/Francia test for normality is performed for each combination of well and constituent. During the normality test, non-detect values are identified as a function of percent non-detect. If 15 percent to 50 percent of the data are non-detects, the Kaplan-Meier method is used to determine the sample mean and variance. If fewer than 15% of the data are non-detect, the non-detect data is replaced with one-half of the laboratory reporting limit. If the percent of non-detects is 50 percent or higher, or when the data do not follow a normal or transformed-normal distribution, a non-parametric test is used in lieu of parametric testing. Analytical results between the method detection limit and reporting limit (i.e., "J-flagged" values) are entered into the database if provided by the laboratory. A J-flagged value is an estimated value and is not considered a statistically significant detection.

A duplicate sample is collected in the field as part of the facility's quality assurance/quality control (QA/QC) program. Results from these samples are used for QA/QC evaluation and will not be used for statistical analysis.

2.2 Determining Statistically Significant Increases

Appendix III and Appendix IV monitoring results are statistically compared to established background levels through interwell statistical methods to determine if there is an SSI above background. Interwell parametric or non-parametric upper prediction limits (UPLs) are used to

statistically evaluate SSIs over established background for the Appendix III and Appendix IV constituents. In detection monitoring, a "1-of-2" retesting plan is used on individual sample results. The 1-of-2 retesting plan as defined in the EPA Unified Guidance concludes that an SSI has occurred when 2 out of 2 consecutive sample results exceed the prediction limit, while no SSI is concluded if 1-of-2 is below the limit. Verification resampling will be collected within 90 days of the constituents being initially detected above its limit. The results of the verification resampling will be incorporated into the database for statistical analysis. In the event a confirmed "2-of-2" SSI over background is identified for any of the Appendix III parameters in detection monitoring, an SSI has been confirmed for the monitoring network. If it can be shown that the SSI resulted from a release from another source, from an error in sampling or analysis, or from natural variability, then an alternate source demonstration (ASD) of this finding must be made in writing and certified by a qualified professional engineer within 90 days of the statistical evaluation of the confirmed SSI. If a successful ASD is not made within 90 days of the statistical evaluation of the confirmed SSI, then the site must begin assessment monitoring.

According to 40 CFR §257.95(e), the CCR unit may return from assessment monitoring to detection monitoring when all Appendix III and Appendix IV constituents are "shown to be at or below background values, using the statistical procedures in §257.93(g) for two consecutive sampling events."

2.3 Updating Background Threshold Values

Interwell UPLs are used to compare assessment monitoring data to background to statistically evaluate SSIs over background for the Appendix III and IV constituents. Prediction limits represent a range where a future result is expected to lie. UPLs are calculated from the background dataset, and recent data are then compared to the UPL.

The UPLs (i.e., background threshold values) should be updated every four to eight measurements (i.e., every two to four years if samples are collected semiannually) in accordance with Chapter 21 of the EPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance (EPA, 2009) or during a monitoring program transition. New background data will be evaluated against the existing background dataset, as appropriate. If the new background data does not indicate a statistically significant difference, the new data should be combined with the existing background data to calculate an updated UPL. Increasing the background dataset will increase the power of subsequent statistical tests. If the new background data does indicate a significant difference between two populations, the data should be reviewed to evaluate the cause of the difference. In the absence of evidence of a release, the new dataset should be considered more representative of present-day groundwater conditions and used for background updates.

2.4 Determining Statistically Significant Levels

Appendix IV monitoring results are statistically compared to the Groundwater Protection Standards (GWPS) as defined in 40 CFR §257.95(h). Appendix IV constituents are statistically compared to the GWPS, using confidence intervals, to identify statistically significant levels (SSLs) above the GWPS. As required in 40 CFR §257.95(h), the CCR owner must establish

GWPS for each constituent in Appendix IV detected in the groundwater. The GWPS shall be defined as the following:

- The U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- the background concentration for constituents for which an MCL has not been established, or
- the background concentration for constituents for which the background level is higher than the U.S. EPA MCL established.

The GWPS shall be set as the greater of the USEPA MCL established for that constituent or computed from background data by calculating the upper tolerance limit (UTL) with 95% confidence and 95% coverage. In the case where a published MCL does not exist or where the background level is higher than the MCL, necessitating the use of background to determine regulatory compliance, a UTL is used as the GWPS. UTLs can be calculated parametrically or non-parametrically.

Once a GWPS has been established, confidence intervals constructed on the recent data against the GWPS is used to determine whether a move to corrective action is warranted. When the lower confidence limit (LCL) of this interval exceeds the GWPS at the 95 percent confidence level, corrective action may be justified. Evaluations should be done for each detected Appendix IV constituent at each well. Parametric or non-parametric confidence intervals can be utilized. In the case of normally distributed data, a normal-based parametric confidence interval is used. If the data are not normally distributed or the non-detects are greater than 50%, a non-parametric confidence interval on the median is used. GWPS are determined for detected Appendix IV constituents in accordance with 40 CFR §257.95(d)(2). If all the data for a constituent are non-detect, then a statistical evaluation for SSLs do not need to be performed.

3 Corrective Action Monitoring Program

Pursuant to 40 CFR §257.98(a)(1)(i), at a minimum, the corrective action monitoring program must meet the requirements of an assessment monitoring program. Thus, the reporting requirements for corrective action monitoring will be similar to those within the assessment monitoring program, as described above. Once remedial activities begin, semi-annual sampling will continue in accordance with 40 CFR §257.98(a)(1)(i) and confidence intervals will monitor the progress of the selected remedy. Confidence intervals are compared to GWPS, which are determined as described in the Section 2.4. Completion of remedial measures and corrective action monitoring is achieved when the upper confidence limit (UCL) of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years in accordance with 40 CFR §257.98(c). Upon completion of remedial measures, the facility must prepare a notification that the remedy has been completed. The notification must be certified by a qualified professional engineer or approved by the State Director or USEPA and placed in the operating record pursuant to 40 CFR §257.98(e).

4 References

EPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. Environmental Protection Agency Office of Resource Conservation and Recovery. EPA 530/R-09-007. March 2009.

EPA, 2015. 40 CFR parts 257 and 261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, Federal Register vol. 80, no. 74. Environmental Protection Agency. April 17, 2015.

NDEE, 2004. Title 132 Integrated Solid Waste Management Regulations; Chapter 7 – Ground Water Monitoring and Remedial Action. November 17, 2004.