CCR Groundwater Statistical Method Certification

Omaha Public Power District

Nebraska City Station
NC1 Ash Disposal Area

Nebraska City, Nebraska

June 2016

OPPD Nebraska City Station
NC1 Ash Disposal Area
CCR Groundwater Statistical Method

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Professional Engineer Certification

"I hereby certify that the selected statistical method described herein is appropriate for evaluating the groundwater monitoring data for the NC1 Ash Disposal Area at the Omaha Public Power District Nebraska City Station and meets the requirements of the Coal Combustion Residual Rule 40 CFR 257.93(f). I am a duly licensed Professional Engineer under the laws of the State of Nebraska."

Print Name: Megan B. Seymour

Signature:

Date: 6/28/2016

License #: E-15931

My license renewal date is December 31, 2016.

1.0 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 rule – effective on October 19, 2015 – applies to Omaha Public Power District's (OPPD's) Nebraska City Generating Station. The Station, located southeast of Nebraska City, Nebraska has two coal-fired combustion units – Unit 1 and Unit 2. This Station has two existing CCR landfills that are permitted under the current Nebraska Department of Environmental Quality (NDEQ) Title 132 regulations for fossil fuel combustion ash disposal (the NC1 Ash Disposal Area and NC2 Ash Disposal Area).

The NC1 Ash Disposal Area is an unlined CCR landfill of approximately 52 acres that has historically received CCR for disposal and is permitted with the State of Nebraska. NC1 Ash Disposal Area is an active, existing CCR landfill as defined by the CCR rule.

Pursuant to the CCR rule, no later than October 17, 2017 the owner or operator of a CCR unit must develop the groundwater sampling and analysis program to include selection and certification of the statistical procedures to be used for evaluating groundwater monitoring data as required by §257.93. This certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data. The existing NDEQ Title 132 permit application for the NC1 Ash Disposal Area includes a Groundwater Sampling and Analysis Plan which describes the groundwater monitoring system, sampling and analysis procedures, detection and assessment monitoring requirements, and statistical methods to be used for evaluating the groundwater monitoring data. The description below is obtained from that plan.

2.0 Statistical Method

The fundamental goal of statistical analysis is to provide a means to formulate an opinion or judgment as to whether the CCR landfill has released contaminants into the adjoining groundwater. Therefore, upon completion of each sampling event, the data for detected constituents from groundwater samples collected from each monitoring well included in the monitoring network has been and will be statistically evaluated by a number of methods. These statistical methods will test whether there is a statistically significant difference (SSD) indicating that downgradient (compliance) data is from a different population than the upgradient (background) data and that this difference results in a Statistically Significant Increase (SSI). USEPA guidance document "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities," Unified Guidance, (March 2009) has been used as reference for the statistical methodologies. The computer software SANITAS™ For Groundwater or ChemStat by Starpoint Software, Inc. will be used to perform the analysis. OPPD may use other comparable software that is or may become available on the market.

An analysis of variance (ANOVA) has been chosen as the primary statistical method to evaluate compliance data relative to background data. Parametric or non-parametric ANOVA will be used to test whether there is an SSI indicating that the mean or median concentration of a given constituent is higher in one or more of the compliance wells than the baseline provided by the background well(s). Trend analysis is conducted using Sen's Slope/Mann-Kendall statistical analysis to determine if SSDs are increasing or decreasing over time. The following statistical procedures will be used to evaluate the data.

General

1. Input the sampling data for each background (upgradient) and compliance (downgradient) well, for each CCR rule Appendix III and IV constituents, into a database.

2. Perform basic statistics for all wells for all of the constituents. This includes constituent-specific values for all of the wells in the monitoring network (total observations, total non-detects, pooled mean, and background mean) and well-specific values for each constituent (number of samples, number of non-detects, percent non-detects, and the mean).

3. Prepare time series plots and box-plots for each constituent for each well to provide a general visual review of the data including indications of seasonal, spatial and/or temporal variability. If necessary, the data will be corrected for seasonal variability utilizing the statistical software package (SANITAS™, ChemStat or equivalent).

Analysis of Variance

4. If the percent of non-detects is greater than 15, proceed to Step 8 and use a non-parametric ANOVA to evaluate the data. If the percent of non-detects is 15 or less, proceed to Step 5 to determine if a parametric ANOVA can be used to evaluate the data. Use a value of one-half of the detection limit for the non-detects.

5. Determine the distribution of the data using the Shapiro-Wilk Test (up to 50 samples) or the Shapiro-Francia Test (51 samples or more). If the data distribution is normal or lognormal, proceed to Step 6. If the data distribution is not normal or lognormal, proceed to Step 8 and use a non-parametric ANOVA to evaluate the data.

6. Determine the equality of variances using Levene's Test. If the data distribution was lognormal, use the natural logarithms substituted for the original values to perform Levene's Test. If the data distribution was not lognormal but normal, use the original values to perform Levene's Test. If the variances are equal, proceed to Step 7. If the variances are not equal, proceed to Step 8 and use a non-parametric ANOVA to evaluate the data.

7. If the data has 15 percent or less non-detects, is both normally or lognormally distributed, and the variances are equal, parametric ANOVA is to be used to evaluate the data. Perform parametric ANOVA on the original data. If the calculated F-ratio is greater than the tabulated F, there is evidence of an SSD between the upgradient and downgradient well means. A Type I error level of no less than 0.05 will be used for the multiple comparison procedure. If an SSD is identified, the Bonferroni t-statistic test is performed to determine which compliance well's mean differs significantly from the mean of the pooled background observations. A Type I error of no less than 0.01 for individual well comparisons will be maintained.

8. If the percent of non-detects is greater than 15, the data is not normal and cannot be transformed to normal (lognormal), or the data is not of equal variance, non-parametric ANOVA is to be used to evaluate the data. Perform the Kruskal-Wallis Non-Parametric Rank test on the data. Use a value of one-half of the detection limit for non-detects and adjust for ties. If the adjusted H statistic (H') exceeds the chi-squared value, then there is evidence of an SSD between the upgradient and downgradient well medians. A Type I error level of no less than 0.05 will be used for the multiple comparison procedure. If an SSD is identified, then individual well tests are performed to determine which compliance well's median differs significantly from the median of the pooled background observations. A Type I error of no less than 0.01 for individual well comparisons will be maintained.

If the parametric or non-parametric ANOVA indicates evidence of an SSI between a compliance well and the background well(s), NDEQ will be notified of this finding that the SSI was placed into the facility operating record. OPPD will either begin an assessment monitoring program or demonstrate that the source is due to natural variation in groundwater quality or that the SSI was a result of error.

Trend Analysis

9. Perform trend testing using Sen's Slope/Mann-Kendall statistical analysis to determine if the identified SSDs are increasing or decreasing over time. In addition to running the tests on the well(s) and constituent(s) with the SSD(s), also test the background wells for trends in the SSD constituents.

10. Report these results along with the NDEQ notification of the SSIs.

OPPD reserves the right to use any other statistical test allowed by the CCR rule that meets the performance standard requirements of §257.93(g). If the statistical analysis method(s) are revised, OPPD will submit a request to NDEQ for approval as required with the existing NDEQ Title 132 permit. Pursuant to the CCR rule, this certification will also be revised with an updated statistical method description.