Professional Engineer Certification, Statistical Analysis Evaluation

Introduction

On July 26, 2016, the United States Environmental Protection Agency (USEPA) Administrator signed a direct final rule, 40 CFR 257 ("the Rule") for the disposal of coal combustion residuals (CCR) under subtitle D of the Resource Conservation and Recovery Act (RCRA). Parts 257.90 to 257.98 of the Rule outline the required elements of ground water monitoring at CCR-regulated units such as landfills and surface impoundments. Additionally, the Rule sets out recordkeeping and reporting requirements as well as the requirement for each facility to establish and post specific information to a publicly-accessible website.

As part of the Rule, CCR unit operators are required to install a ground water monitoring network to assess potential impacts to ground water quality downgradient of CCR units. Ground water quality data collected from the network are to be assessed statistically to: 1) Determine background concentrations, 2) Detection Monitoring - identify statistically significant increases (SSIs) over background for Appendix III analytes and, if any exceedance, then 3) Assessment Monitoring – sample Appendix IV analytes and identify if any SSIs, as well as establish ground water protection standards (GWPS).

The intent of this document is to provide additional detail and justification of the selected statistical method as required under Part 257.93(g) that will be utilized during detection monitoring (Part 257.94) and/or assessment monitoring (Part 257.95) at the Intermountain Generating Facility (IGF) in Delta, Utah.

Statistical Method Alternatives

The rule describes four specific statistical methods [Part 257.93(g)] that could potentially be used to identify SSIs, they include:

- Parametric Analysis of Variance (ANOVA);
- Non-Parametric ANOVA;
- Tolerance or Prediction Interval Procedures; and
- Control Charts.

In addition, the rule allows for the use of alternative statistical methods, given that the methods meet the performance standard defined under 40 CFR 257.93(g).

Of the four methods, the Unified Guidance (USEPA, 2009) recommends prediction intervals combined with retesting to maintain a low site-wide false positive rate (SWFPR) while providing high statistical power. A brief narrative of prediction intervals is provided below.

Prediction Intervals

Prediction intervals represent concentration or measurement ranges computed from a sample that are designed to estimate (contain) one or more characteristics of the parent population (e.g., the mean or median).

A prediction interval is a type of statistical interval that can be used with predictions from linear and nonlinear models. A prediction interval is a range that is likely to contain the response value of a single new observation given specified settings of the predictors in your model.

A prediction interval constructed from an existing data sample consists of a lower and upper bound of a range of data values expected to contain the next one or more future data values from the underlying population, with a specified level of confidence. In the context of ground water monitoring where ground water is periodically sampled, the upper prediction limit (UPL) can be constructed using the background data set. One or more future samples can be compared to the UPL, if any of the future samples exceed the UPL, it can be concluded that there is statistically significant evidence of contamination.

The Unified Guidance (USEPA, 2009) encourages the use of prediction limits in ground water monitoring, as they are very flexible and can be used with a wide variety of monitoring networks. Prediction limits may be constructed to compare individual compliance points, means and medians. Prediction limits can be designed to accommodate a wide range of multiple statistical comparisons or tests, which occur with sampling protocols involving multiple compliance wells and multiple constituents. This greatly limits the site-wide false positive error rate.

Upper prediction limits are a viable statistical method to employ *after* the initial phase of Detection Monitoring (e.g. the initial eight rounds of sampling at existing CCR landfills or CCR surface impoundments), when sufficient background samples have been collected and Detection Monitoring is being conducted semi-annually. If Assessment Monitoring is required, UPLs derived from background samples may be calculated and will represent ground water protection standards (GWPS) when a Maximum Contaminant Level (MCL) is not available.

Conclusions

Based on the recommendations provided in the Unified Guidance (USEPA, 2009), the use of prediction interval statistical analysis combined with retesting is appropriate for evaluating ground water quality data for the CCR management at IGF in Delta, Utah.

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References:

Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, USEPA, 2009.

Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR §257. (2016)

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

By means of this certification, I certify that I am a qualified professional engineer as defined in 40 CFR 257.53, that I have reviewed this document, and that the statistical methods described therein are appropriate and meet the requirements of 40 CFR 257.93.

Chad Tomlinson

Printed Name of Qualified Professional Engineer

Signature

4777863-2202	Utah	Jan. 10, 2018
Registration No.	Registration State	Date