40 CFR Part 257.93(f)(6) Statistical Method Certification
CCR Unit: Dynegy Midwest Generation, LLC; Wood River Power Station; Wood River West Ash Ponds 1, 2E, 2W

In accordance with Title 40 Code of Federal Regulations (40 CFR) Part 257, Subpart D, Section 257.93(f)(6), the owner or operator of a coal combustion residual (CCR) unit must obtain a certification from a qualified professional engineer that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area.

This certification is based on the description of the statistical methods selected to evaluate groundwater as presented in the *Statistical Analysis Plan*, prepared for Dynegy Midwest Generation, LLC, and dated October 17, 2017. The procedures described in the plan will be used to establish background conditions and implement detection, assessment, and corrective action monitoring as necessary and required by 40 CFR §257.93-257.95. The *Statistical Analysis Plan* was prepared in accordance with the requirements of 40 CFR §257.93, with reference to the acceptable statistical procedures provided in USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (March 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring. In accordance with 40 CFR §257.93(f), the statistical method chosen for analysis of groundwater monitoring data will initially be the prediction interval procedure or control chart approach for each Appendix III constituent, and either the tolerance interval or the prediction interval procedure for each Appendix IV constituent at this CCR unit per 40 CFR §257.93(f)(3), in which the interval is established from the background data and compared to the level of each Appendix III constituent in each compliance well, or a confidence interval for each Appendix IV constituent in each compliance well.

Narrative Description of Statistical Methods

A narrative description of the statistical methods chosen for analysis of groundwater monitoring data are provided below. Application of these methods for determining a statistically significant increase (SSI) for Appendix III constituents or statistically significant levels (SSLs) for Appendix IV constituents is provided in the *Statistical Analysis Plan*.

Parametric and Non-Parametric Prediction Limit

Parametric upper prediction limits (UPLs) for future values will be utilized when background data contains less than 50% non-detects, and can be normalized. Parametric UPL for individual future values will be calculated from normally-distributed background data as follows:

$$UPL_{1-\alpha} = \overline{x} + \kappa s$$

$\overline{x}$ = sample mean of background data
s = standard deviation of background data
κ = multiplier based on the number of downgradient compliance wells to be tested (w), the background sample size (n) the number (c) of constituents of concern (COCs), the "1-of-m" retesting scheme, and the evaluation schedule (annual, semi-annual, quarterly). Tabulated in Table 19-1 in Appendix D of the *Unified Guidance*.

Non-parametric UPLs for future values will be utilized when background data cannot be normalized, or contains a large percentage of non-detects. To calculate the non-parametric UPL on a future value, the target per-constituent false positive rate (α_{const}) will be determined as follows:

$$\alpha_{const} = 1 - (1 - \alpha)^{1/c}$$

α = the SWFPR of 0.10
c = the number of monitoring constituents

For a target SWFPR of 10%, and 7 monitoring constituents, the target per-constituent false positive rate (α_{const}) will be 0.015%.

UPLs will be compared to individual future downgradient values for detection monitoring and either future downgradient means when using the parametric UPLs method or future downgradient medians when using the non-parametric UPL method for Assessment Monitoring.

Parametric Shewhart-CUSUM Control Chart

Combined Shewhart-CUSUM control charts may also be used when pooled background data contains less than 50% non-detects, and can be normalized. This method can be used to determine whether downgradient data plotted on the control chart follow the same distribution as the background data used to compute the baseline control limit. Combined control charts use both the new individual measurement and the cumulative sum (CUSUM) of past and current measurements at every sampling event. This technique gives control charts increased sensitivity to detect trends and shifts in concentration levels. The Shewhart portion of the chart is ideal for detecting sudden concentration increases, and the CUSUM portion is preferred for detecting slower, steady increases.

Parametric Tolerance Limit

The upper tolerance limit (UTL) will be used to calculate the groundwater protection standard (GWPS) when pooled background data are normally distributed, with a non-detect frequency of 15% or less. When non-detect frequency is 15% or less, half the reporting limit (RL) will be substituted for non-detects. The *Unified Guidance* recommends 95% confidence level and 95% coverage (95/95 tolerance interval). The non-detect data will be replaced with half the RL (simple substitution), and the normal mean and standard deviation will be calculated.

$$UTL = \overline{x} + \kappa\,(n, \gamma, \alpha - 1) \cdot s$$

$\overline{x}$ = background sample mean

s = background sample standard deviation

$\kappa\,(n, \gamma, \alpha - 1)$ =one-sided normal tolerance factor based on the chosen coverage (γ) and confidence level (α -1) and the size of the background dataset (n). Values are tabulated in Table 17-3 in Appendix D of the *Unified Guidance*.

The Kaplan-Meier, or the ROS method, will be used when the detection frequency is between 15% and 50%. The Kaplan-Meier method assesses the linearity of a censored probability plot to determine whether the background sample can be approximately normalized. If so, then the Kaplan-Meier method will be used to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. The Kaplan-Meier or ROS estimate of the mean and standard deviation will be substituted for the sample mean and standard deviation. If background normality cannot be achieved, non-parametric UTLs will not be calculated until a minimum of 60 background samples have been collected (to achieve 95% coverage).

UTLs will be compared to the upper confidence interval around a mean for parametric downgradient constituents in each compliance well. When downgradient constituents are non-parametric, UTLs will be compared the upper confidence interval around a median.

A linear regression, coupled with a t-test for slope significance may be used on datasets for each constituent with few non-detects and a normally distributed variance of the mean to evaluate time trends. The Theil-Sen trend line, coupled with the Mann-Kendall test for slope significance, will be used for datasets with frequent non-detects or non-normal variance. If either the t-test for a parametric linear regression line or Mann-Kendall test for a Thiel-Sen line detect a significant trend, confidence bands will be constructed around the trend line. The upper confidence band will then be used as the GWPS.

Performance Standards
As specified by 40 CFR §257.93(g), the prediction limit, control chart, and tolerance limit statistical method chosen complies with the following performance standards:

(1) The statistical method to evaluate groundwater monitoring data will use parametric methods for normal distributions of data and non-parametric methods for non-normal distributions of data. If the distribution of constituents is inappropriate for a normal theory test, then the data must be transformed, or a distribution-free (non-parametric) theory test will be used. If the distributions for the constituents differ, more than one statistical test may be needed.
(2) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.
(3) The levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach listed in 40 CFR §257.93 for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentrations values for each constituent of concern.
(4) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall be at least as effective as any other approach in 40 CFR §257.93 for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.
(5) The statistical method must include, if necessary, procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

If the prediction limit, tolerance interval, or control chart statistical test chosen for analysis of groundwater monitoring data does not meet the above performance standards, one of the following alternative statistical methods may be substituted in order to meet the performance criteria of 40 CFR §257.93(g): parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination; analysis of variance based on ranks followed by multiple comparison procedures to identify evidence of contamination; control chart approach that gives control limits for each constituent; or, another statistical test method that meets the performance standards. In the event one of these alternative statistical methods is used, an updated certification will be provided.

Based on the analysis of the first eight rounds of background groundwater monitoring data at this CCR unit, the statistical approach and methods described in this certification, and as detailed in the *Statistical Analysis Plan*, are appropriate for evaluating the groundwater monitoring data.

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the statistical methods described in this document, as supported by the Statistical Analysis Plan in the facility's Operating Record, are appropriate for evaluating the groundwater monitoring data for the CCR management area.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: October 17, 2017

I, Stuart J. Cravens*, a qualified professional geologist in good standing in the State of Illinois, certify that the statistical methods described in this document, as supported by the Statistical Analysis Plan in the facility's Operating Record, are appropriate for evaluating the groundwater monitoring data for the CCR management area.*

Stuart J. Cravens
Licensed Professional Geologist
196-000108
Illinois
Date: October 17, 2017

I, Kendall L. Simon, a qualified professional, certify that the statistical methods described in this document, as supported by the Statistical Analysis Plan in the facility's Operating Record, are appropriate for evaluating the groundwater monitoring data for the CCR management area.

Kendall L. Simon, PhD
Project Statistician
Date: October 17, 2017