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SUBJECT: Guidance for the Determination of Toxicity Equivalents (TEQs) Associated with Dioxin and Furan
               Data

This memorandum outlines proposed guidance for the evaluation of laboratory data associated with samples analyzed for dioxins and furans. This document, developed by staff in the Chemistry Section, is intended to be a 'living' protocol for calculating toxicity equivalents (TEQs) in samples that have qualified results for one or more of the congeners of dioxins (polychlorinated dibenzodioxins) and furans (polychlorinated dibenzofurans). In particular, data interpretation is addressed for a variety of data qualifiers and guidance is proposed for interpreting the calculated TEQs.

It is common in the analysis of dioxin-containing samples to have some congeners detected, whereas other may be at or below detection limits. The issue of how to calculate TEQs in dioxin-containing samples and how to assess the non-detected congeners in the TEQ calculation has been addressed previously.[1,2] The determination of TEQs, however, becomes more complex when the data are qualified and questions arise in how best to make a quantitative interpretation of the results. It should be understood that the protocols given here will not cover every case and there will be situations that require further evaluation. The issue of how the qualified data are to be used (i.e., environmental monitoring, health risk assessment or legal enforcement) is also of paramount importance in assessing results.

Data Qualifiers and Interpretation:

 Each common qualifier is defined and discussed below. During data review, it is important to keep in mind that not all laboratories may use the same set of qualifiers or definitions. Each laboratory report should have a basic description of the data qualifiers used in the report. In some cases, laboratories have been known to use other character sets (brackets, italics, etc.) in lieu of standard qualifiers. The data consumer is encouraged to contact the laboratory whenever there is ambiguity regarding the qualifier definitions.

A – Value reported is the mean of two or more determinations. The qualifier "A" has no impact on the calculation of TEQs. The confidence in data with this qualifier is very high since the value reported is the mean of multiple measurements. Multiple determinations are particularly useful (and in some cases may be required).

EMPC – Estimated maximum possible concentration. All criteria for the qualitative detection of the congener were not satisfied and the reported concentration represents an upper bound on the congener concentration. For a conservative interpretation of the value, the congener should be assumed to be present at the reported concentration. The confidence in the compound identification and quantification is low since all the requirements for detection were not met.

I – Value reported is less than the practical quantitation limit (PQL), and greater than or equal to the method detection limit (MDL). The qualifier "I" has no impact on the calculation of TEQs. The confidence in the compound identification is high, but confidence in the quantification of data with this qualifier is low.

J – Estimated value. The qualifier "J" has no impact on the calculation of TEQs. The confidence in the compound identification is high, but confidence in the quantification of data with this qualifier is low since the value reported is an estimate. A review of the quality control data, such as surrogates and spikes, may indicate if the data have been biased high or low.

ND – Not detected. This qualifier has no numerical interpretation. The data consumer is advised to contact the laboratory and ask for the sample-specific detection limit for each reported analyte. It is important to recognize that detection limits for individual congeners will vary among samples due to differences in the volume of aqueous sample collected or differences in the moisture content of soils and sediments among samples.

Q – Sample held beyond normal holding time. The qualifier "Q" has no impact on the calculation of TEQs. The confidence in the compound identification is high, but confidence in the quantification of data with this qualifier is low since the value reported is beyond normal holding time. Under most circumstances the reported value should be interpreted as a lower limit.

U – Material was analyzed for but not detected. The value reported is the method detection limit for the sample. Refer to previously addressed guidelines[2] for calculating TEQs.

Other Factors Influencing Interpretation of TEQ Calculations:

There are several additional laboratory measurements that will influence the interpretation of TEQs, such as blanks and duplicates. Their impact on data interpretation is given below:

Blank Measurements (method, trip and field) – The analysis of blanks is an integral component of quality control procedures and is critical to the production of meaningful analytical results. Likewise, a thorough review of the blank data is an essential part of data interpretation. If contaminants are present in blanks above the MDL, then special care must be taken to determine the confidence and validity of reported detects. A general guideline for interpreting results is that the blank value should be less than 5% of the sample result or regulatory limit. However, this outcome is not always achievable when the regulatory limit is near or below the analytical capabilities of the method being employed. If the blank concentration is consistent, a positive result with a concentration 2 to 5 times the blank level can be used as presumptive evidence for the presence of the target compound, but caution must be exercised in the use of such data for enforcement purposes.

Duplicates – Field and lab duplicates are used to assess the precision of the sample collection and measurement techniques, respectively. A general guideline is that the duplicate results should agree within 20%. However, it is not unusual for duplicate samples to yield significantly different results, particularly when the results are near the MDL or when samples are heterogeneous or have multiple phases.

References:

[1] USEPA, "Interim Procedures for Estimating Risks Associated with Exposure to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and DCFs)", Risk Assessment Forum, EPA/625/3-89/016, 1998.

[2] Ochoa, H.G., Roberts, S.M., Letters to Ligia Mora-Applegate regarding the evaluation of analytical results for polychlorinated dibenzodioxins and dibenzofurans, May 17, 2002 and August 15, 2002.