

## Agency Requirements for the application of WID & LCPD Confidence Intervals

### 1. Overview

Some confusion exists in relation to the application of 95% confidence intervals with regard to the interpretation of air emissions monitoring data from Continuous Emissions Monitoring (CEM) systems, as provided for in the interpretation sections of WID and LCPD licences. The aim of this short guidance is to set out the Agency's required approach.

### 2. What are the aims of the Waste Incineration Directive & Large Combustion plant Directives?

The aim of the WID is to prevent or limit, as far as practicable, negative effects on the environment, in particular pollution by emissions into air, soil, surface and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste.

The LCPD aims to reduce acidification, ground level ozone and particles throughout Europe by controlling emissions of sulphur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) and dust (particulate matter (PM)) from large combustion plants. The revised Large Combustion Plant Directive (LCPD, 2001/80/EC) applies to combustion plants with a thermal output of 50 MW or more.

### 3. What are 95% Confidence Intervals expressed in these Directives?

The WID and LCPD express uncertainty budgets and 95% confidence intervals at the ELV. The uncertainty budget can be viewed as an allowable margin of error in the measurement, as a combination of the systematic and random errors. The systematic error is a measure of the accuracy<sup>1</sup>, whilst the random error can be seen as a measure of the precision of the measurements. The 95% confidence interval encompasses approximately two standard deviations of the measurement either side of the mean average value. This is known as the expanded uncertainty, whereas the standard uncertainty is one standard deviation.

**Under the WID** the values of the 95 % confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:

*Carbon monoxide: 10 %*

*Sulphur dioxide: 20 %*

*Nitrogen dioxide: 20 %*

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<sup>1</sup>Accuracy refers to the closeness between measurements (observations) and their expectations ("true" values) while the Precision of a measurement system, also called reproducibility or repeatability, is the degree to which repeated measurements under unchanged conditions show the same results.

*Total dust: 30 %*

*Total organic carbon: 30 %*

*Hydrogen chloride: 40 %*

*Hydrogen fluoride: 40 %*

**Under the LCPD** the values of the 95 % confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:

*Sulphur dioxide 20 %*

*Nitrogen oxides 20 %*

*Dust 30 %*

***The validated hourly and daily average values are determined from the measured valid hourly average values after taking the calculated confidence interval into account. See Section 5 on how confidence intervals are calculated and applied.***

#### **4. How are Confidence Intervals applied in other jurisdictions?**

In the UK, The Environment Agency indicates that the full confidence interval value (applied as a percentage) can be taken away from the ten minute average or half hourly average figure in the case of WID plant, and from the hourly average values in the case of LCPD plant. This validated result can then be compared to the ELV figure for determination of compliance.

The approach taken in Germany (according to Umweltbundesamt, 2008, Leitfaden zur Emissionsüberwachung) is to subtract the fixed standard deviation from the QAL2 calculations from all measured results, i.e. for the example given in Section E.2.7 of EN14181, this would require 2.52 mg/m<sup>3</sup> to be subtracted from all results, with the proviso that any negative values should be set to zero (i.e. where the measured value is less than the standard deviation).

The EPA is aware that there are a number of different approaches taken to the application of confidence intervals on LCPD & WID sites in Ireland. In order to standardise the application of confidence intervals under WID and LCPD the Agency has outlined a required approach.

#### **5. The Agency's Required Approach to applying Confidence Intervals to WID & LCPD plant measurements.**

As part of the QAL2 element of EN14181, the operator is required to compare the 15 parallel measurements from the CEMS and the Standard Reference Method (SRM), by calculating the standard deviation of the measurements (i.e. the square root of the sum of the squared differences). This information will be available in the licensee's latest QAL2 report. **This standard deviation figure must be less than uncertainty requirements laid down in the relevant legislation (WID or LCPD)** as outlined in Section 3. The validated hourly and daily

average values are determined by subtracting the figure from the standard deviation of the methods from the measured valid daily/hourly average values. For an example of the various calculations see Section E.2.7 of the EN14181 standard which presents an example for particulates (SD calculated at  $2.52 \text{ mg/m}^3$ , allowed uncertainty from LCPD reported at  $9 \text{ mg/m}^3$ ).

This approach is less generous than the approach outlined in Section 4 which is applied in some other EU countries but is based on the calculated standard deviation of the equipment in normal operation.

**The Agency's required approach has been chosen because:**

- The calculated allowance is based on actual measured performance of the analyser during the QAL2 exercise;
- The allowance can be reviewed during repeat QAL2 exercises (every 3 years for WID and every 5 years for LCPD).

The licensee may choose to take more than 15 parallel measurements as part of the QAL2 test, and the full dataset can be used in these cases to determine the standard deviation.