List of agreed corrections/additions to the IED compliance protocol

The current version of the IED compliance protocol is:

ELECTRICITY SUPPLY INDUSTRY – IED COMPLIANCE PROTOCOL FOR UTILITY BOILERS AND GAS TURBINES (UPDATE DECEMBER 2015), D P Graham & G Salway ETG/15/ERG/CT/1343/R

It is anticipated that the following agreed amendments will be made when the Protocol is revised in December 2016.

1. The supplementary firing emission limit formula in Section 3.2.2 Page 9 requires correction to read:

$$LCP\ NO_x\ ELV\ \left(\frac{mg}{MJ}\right) = \frac{[ELV_{GT} * \ MCR_{GT}] + [A * \ ELV_{SF} * \ MCR_{SF}]}{[MCR_{GT} + \ MCR_{SF}]}$$

2. Additional descriptive text is required in Section 3.6 Malfunction or Breakdown of Abatement Equipment. This is needed to clarify that the 120h malfunction and breakdown caps are applied individually to each pollutant.

3. Changes are required to sections 3.6.1 and 6.5 to incorporate provisions covering malfunction or breakdown of abatement equipment for low operating hours plant using the monthly average and ELV in place of the daily average and ELV.

    a. The third paragraph of section 3.6.1 (Malfunction or Breakdown of Abatement Equipment – Definitions) requires insertion of an additional provision as outlined below.

Current Text
The provisions laid down in this section apply when the LCP fails to comply with the daily Emission Limit Value across the stack due to the Malfunction or Breakdown of part or all of the abatement equipment. For multi-unit LCP and in keeping with the definition of an LCP, the provisions are determined on a stack basis rather than for individual units. It allows some inherent flexibility to offset a modest Malfunction in the abatement equipment for one unit by compensatory measures on other flue gas streams exiting the same stack.

Revised Text
The provisions laid down in this section apply when the LCP fails to comply with the daily Emission Limit Value across the stack due to the Malfunction or Breakdown of part or all of the abatement equipment.

For plant with very limited operation, it is possible that the daily ELV may not be exceeded but the monthly ELV specified in the permit could be exceeded. Where malfunction or breakdown of abatement equipment causes the LCP to fail to comply with monthly Emission Limit Values then these provisions may be applied with the agreement of the competent authority. In these cases, the LCP monthly ELV and associated monthly average shall be used, in place of the daily LCP ELV and daily average, within the provisions laid down in this section (including the calculation procedure set out in section 6.5). If an Operator considers that the malfunction or breakdown may cause an ELV to be breached but this will not be confirmed until a later date (e.g. after month end for a monthly average) then the Operator must report the malfunction or breakdown within 48 hours as per the conditions set out in Section 3.6.5.

For multi-unit LCP and in keeping with the definition of an LCP, the provisions are determined on a stack basis rather than for individual units. It allows some inherent flexibility to offset a

modest Malfunction in the abatement equipment for one unit by compensatory measures on other flue gas streams exiting the same stack.

b. Section 6.5 (Daily and Monthly Average Concentrations) requires a new paragraph to be inserted between paragraphs 6 (daily average ELV expressed as percentile) and 7 (monthly average) as outlined below.

New Text

For plant with very limited operation section 3.6.1 outlines a provision to identify periods of malfunction or breakdown of abatement equipment using the monthly Emission Limit Value and monthly average. To enact this provision, the LCP monthly ELV, the LCP validated monthly average and the unit validated monthly average shall be used, in place of the daily LCP ELV threshold, LCP validated daily average and unit validated daily average respectively, within the calculation procedure laid down in this section. When enacted on a plant where the daily LCP ELV is specified as an annual percentile, the LCP monthly ELV shall be used as the threshold without modification (i.e. not multiplied by 1.2).

c. The flowchart requires updating to reflect these new provisions - the revised flow chart is provided at the end of this document.

4. The Malfunction & Breakdown decision tree on page 55 needs to be amended to reflect the main text which highlights that Malfunction and Breakdown provisions only apply to abated units within a common windshield. The changes have been incorporated into the revised flow chart at the end of this document.

5. Reporting form IED CON1 (Concentration reporting at coal fired plant). Footnote (d) - FGD Efficiency is only required for indigenous fuels - this applies equally to the Fuel S% column. This footnote should be moved up a level in the table since it applies to both fuel sulphur and FGD efficiency.

   Footnote (b) should read 'Annual percentiles ~~of hourly average concentrations~~ are submitted with the final return (Quarter 4)' since this should be the same as that for gas turbines in the interim BAT period (a percentile may be applied to daily averages and/or hourly averages).

   Both corrections have been applied in Version 11 of the Excel template.
   http://www.energy-uk.org.uk/policy/environmental-regulation/industry-guidance.html

6. Reporting form IED CON2 (Concentration reporting at Gas Turbine plant). Footnote (g) and footnote (h) – relating to percentile reporting – need to swapped in order to read correctly.

   This correction has been applied in Version 11 of the Excel template.
   http://www.energy-uk.org.uk/policy/environmental-regulation/industry-guidance.html

7. In relation to reporting form IED BD1 (Cumulative Malfunction and Breakdown Hours). It needs to be noted in the main text that, for plant in England & Wales, the return for the first year is built up as the year progresses since compliance begins from 1 Jan 2016 (operation in 2015 is not relevant). Plant in Scotland that already report a rolling average should continue to report as before, i.e., 2015 data are included.

8. Note that TNP Registry reporting forms IED RTA1 (quarterly reporting of mass emissions) and IED AR1 (annual inventory reporting) are spreadsheet-based electronic forms. The latest versions can be obtained from the .GOV web site (TNP guidance):

https://www.gov.uk/government/publications/transitional-national-plan-tnp-guidance-on-the-trading-scheme

Note that IED AR1 has been removed from the .GOV web site and has therefore been added to the JEP template until the form is finalised by the regulators and is available on-line. Version 1.3 issued in Dec 2018 needs to be incorporated.

9. In Section 6.5 (Daily and Monthly Average Concentrations) it states that '…a daily average is reported if it contains more than the qualifying period of two validated hourly averages.' This should read 'at least' rather than 'more than' in order to be consistent with the rest of the document and the original intent.

10. Add 500h and 1500h protocols to the main document, noting differences between devolved administrations.

11. Add guidance on factors to be used for six-monthly concentration reporting (where applicable).

For natural gas and gas oil fired turbines and boilers.

Natural Gas firing

Dust = 0 mg/m^3 (CCGT and boilers [under review]) (Ref 1)

Un-odourised gas (Ref 2)

SO_2 = 0.088 mg/m^3 (15% O_2 dry, 0°C, 101.325 kPa) (CCGT)

= 0.265 mg/m^3 (3% O_2 dry) (Boilers)

Odourised gas (Ref 2)

SO_2 = 0.243 mg/m^3 (15% O_2 dry) (CCGT)

= 0.732 mg/m^3 (3% O_2 dry) (Boilers)

Gas oil firing

Dust = 2.4 mg/m^3 (15% O_2 dry) CCGT (Ref 1 US AP-42 factor)

= 23.8 mg/m^3 (3% O_2 dry) Boilers (Ref 3 US AP-42 factor)

SO_2 = 55 mg/m^3 (15% O_2 dry) CCGT

= 165 mg/m^3 (3% O_2 dry) Boilers

[0.1% fuel sulphur]

General cases

Emission factor in kg(pollutant)/tonne (as received solid fuel)

C (mg/m^3) = E (kg/t) * 10^6 (mg/kg) / F (m^3/t)

Coal, F = 9000 m^3/t (6% O_2 dry, 0°C, 101.325 kPa) Ref 3

Biomass, F = 6500 m^3/t (6% O_2 dry)

Oil, F = 12000 m^3/t (3% O_2 dry)

Nat Gas, F = 38500 m^3/t (15% O_2 dry)

Nat Gas, F = 13000 m^3/t (3% O_2 dry)

Emission factor in g/GJ (≡ mg/MJ) [Net CV]

C (mg/m^3) = E (mg/MJ) * / F (m^3/MJ)

Nat Gas, F = 0.845 m^3/MJ (15% O_2 dry) Ref 4

Nat Gas, F = 0.280 m^3/MJ (3% O_2 dry)

Gas Oil, F = 0.859 m^3/MJ (15% O_2 dry)

Gas Oil, F = 0.285 m^3/MJ (3% O_2 dry)

Coal, F = 0.359 m^3/MJ (6% O_2 dry)

HFO, F = 0.348 m^3/MJ (6% O_2 dry)

HFO, F = 0.289 m^3/MJ (3% O_2 dry)

[Note – if E is in g/GJ Gross then first divide E by (NCV/GCV)]

Note that, for NO_x and CO, where applicable, guarantee test data or manufacturers' data can be used.

References
1. GRAHAM DP, EMISSIONS OF PARTICULATE MATTER FROM GAS TURBINE INSTALLATIONS, ETG/14/TMR/CT/767/R, Sep 2014
2. GRAHAM DP, EMISSION FACTORS FOR SULPHUR IN NATURAL GAS, ENT/11/TPR/CT/1345/R, Feb 2012
3. WEATHERSTONE S, POLLUTION INVENTORY 2015 ELECTRICITY SUPPLY INDUSTRY METHODOLOGY, ETG/15/APA/FT/1309/R, Jan 2016
4. EN ISO 16911-1: 2013 Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts - Part 1: Manual reference method

12. Add a requirement for First Level Data (FLD) flue gas flow rate averages (typically one minute averages) to be recorded in the emissions reporting system. This is required for comparison with Test Laboratory flow data (verification check of the plant flue gas flow rate calculation).

13. Add a note that stack flow verification is best practice only for non-TNP plant.

14. Add a note that a CCGT operator can propose an SO_2 emission factor for natural gas firing that is different from the default factors based on national odorant levels, if the level of odorant addition at the site is different (based on either the specification for the odorant dosing or measured sulphur in natural gas).

15. Add REM definitions and reporting form.

16. Add approach for calculation of substitute oxygen (O_2) values from measured CO_2 values:

    If CO_2 is measured by the CEMs, a suitable substitute O_2 value can be calculated as follows:

    $$\%O_2 = 20.95 * (1 - [(\%CO_2 + \%CO) / \%CO_{2s}])$$

    Where
    $\%O_2$ = calculated flue gas oxygen concentration, % by volume dry
    $\%CO_2$ = measured flue gas carbon dioxide concentration, % by volume dry
    $\%CO$ = measured flue gas carbon monoxide concentration, % by volume dry
    $\%CO_{2s}$ = stoichiometric flue gas carbon dioxide concentration, % by volume dry

    Note that the CO concentration is very low during normal operation and can be neglected for compliance reporting.

    The stoichiometric CO_2 concentration (at 0% O_2) is fuel dependent and suitable values are given in Table X below for fuels that do not vary substantially in composition.

    Table X Stoichiometric CO_2 concentration

Fuel	**$\%CO_{2s}$**	**Source**
Natural Gas	12.0%	UK Natural Gas Regional Data
Gas Oil	15.5%	Technical Data on Fuel*
Heavy Fuel Oil	16.0%	Technical Data on Fuel*
Coal	18.6%	Uniper Fuels Database
Biomass	20.0%	Uniper Fuels Database

*Rose JW, Cooper JR, Technical Data on Fuel, 7th edition, Scottish Academic Press, 1977

Note that, for CEMs that measure CO_2, this method is best practice for all combustion processes that operate with an excess of air (all power generation processes). It is not suitable for sub-stoichiometric combustion processes that produce a reducing atmosphere.

17. Add an example and clarification on operating hours calculation. The operating 'hours' are first rounded to the nearest minute, e.g., 4,534 hours 33 minutes. The operating hours are then reported to two decimal places, e.g., 4,534.55 for the same example.

18. Reporting form PM1. Clarify that taking three measurements is good practice but only one measurement is required for compliance. Clarify that the compliance result reported on this form is for the LCP, i.e., this is the average of the unit results.

19. Clarify that the annual energy consumption return includes start-up and shut-down and is on a net basis.

20. Clarify that there are 120h caps for M&B – there is not an additional cap for 'unabated' operation since it is not an additional operational category (Malfunction and Breakdown cause partial or complete loss of abatement).

21. Reference constants for temperature, pressure and oxygen correction should be rounded to match the IED (273K, 101.3 kPa, 21% O_2). Existing DAHS systems can retain any value between 20.9 and 21.0 % O2 since 20.95% is the more exact value.

22. Concentration reporting form CON1. This is designed for utility boilers firing solid fuel. It needs to be edited for industrial gas fired boilers so that NO_x and CO are reported. Need a text addition or an additional footnote on the form.

23. Best practice for stack flow rate measurement is as follows.

Plants that calculate stack gas flow rate from energy consumption (using the mandatory calculation approach in EN ISO 16911-1 Annex E). Provided that previous QAL2/ASTs have verified the complete flow calculation and reporting chain as implemented in the DAHS, that is, the Test Laboratory verification is based on a direct comparison of SRM data with DAHS outputs[1,2], then the requirement to conduct an AST can optionally be replaced by simplified QA procedures, which are the responsibility of the Operator, as specified below.

Integrity of the calculation. In all cases, an annual manual calculation check of the DAHS reported stack flow rate based on the DAHS input data must be documented by the Operator to ensure that the calculation has not been modified.

Fuel flow rate. Flow meters that are used for EU ETS reporting require no further QA. Other meters must have a current calibration certificate, i.e., the meter is calibrated and maintained at the frequency specified by either the manufacturer or an appropriate flow standard or code of practice.

Fuel heating value. Natural Gas chromatographs that report the Net Calorific Value for EU ETS reporting require no further QA. An assumed Net Calorific Value must be checked and updated annually in line with EU ETS recommended values. For natural gas, this is the most recent value annually published by Defra for the applicable Local Distribution Zone. For liquid fuels, this is the value obtained from a fuel analysis, conducted by an accredited laboratory, or the commercially declared value from the supplier, or the default value published annually by Defra for the given fuel category, as applicable.

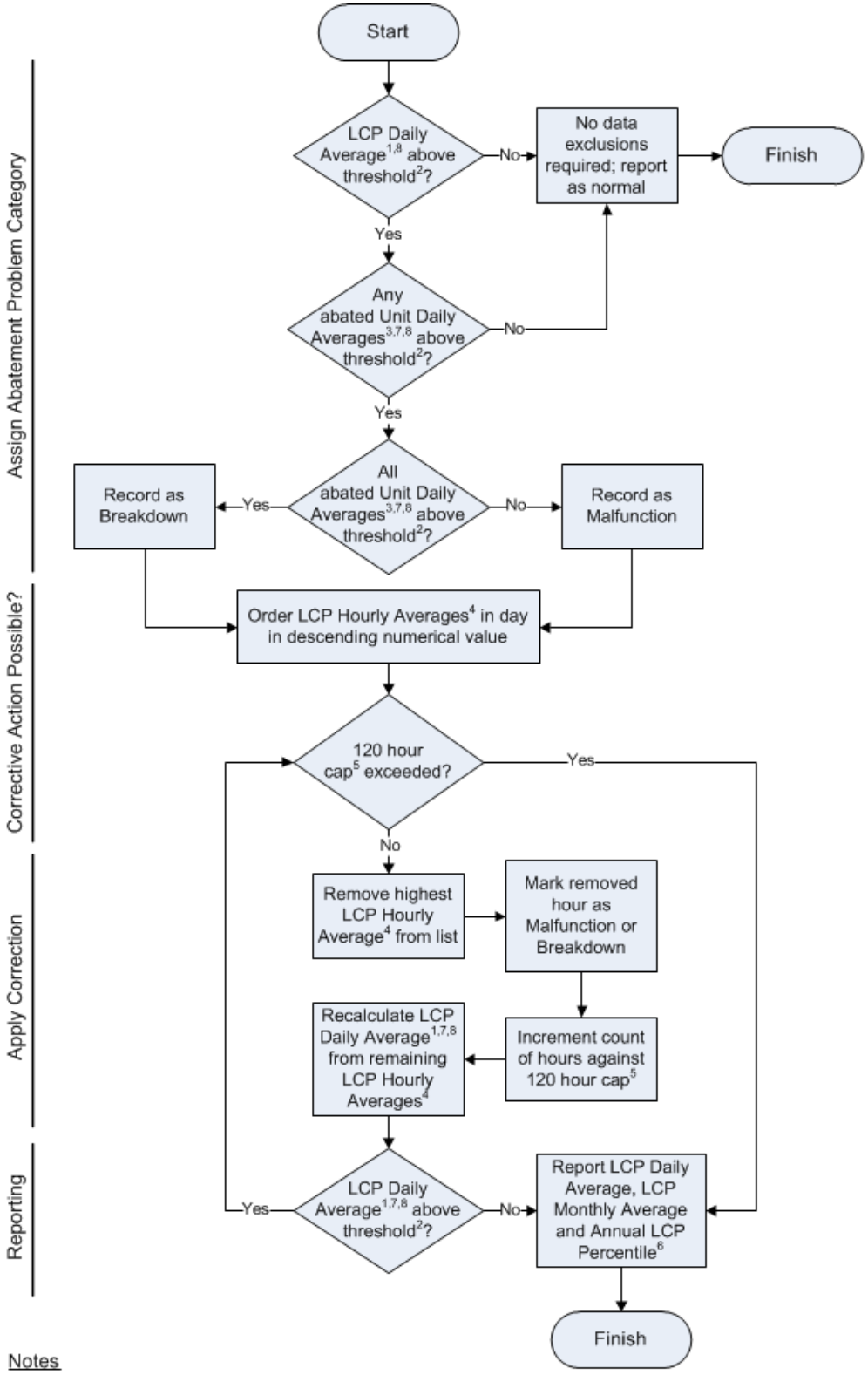
Electricity and steam flow meters must be of fiscal quality and calibrated and maintained at the frequency specified by either the manufacturer or an appropriate flow standard or code of practice.

Thermal efficiency. The thermal efficiency of the plant that is used for stack flow rate calculation must be checked and updated annually using EU ETS fuel input data and annual output data supplemented by plant performance data as required. The thermal efficiency may also be updated based on plant performance testing.

[1] When the averaging period of the DAHS output is not suitable for direct comparison with the SRM data, then the Test Laboratory may directly calculate the stack flow rate from the DAHS input parameters. In this case, the Test Laboratory must separately perform a manual check that the DAHS stack flow output is consistent with the DAHS inputs and document this check within the test report.
[2] AST testing must continue until the full measurement and reporting chain within the DAHS has been verified

(continued)

Revised Malfunction and Breakdown flow chart (see Points 3 and 4 above):



Notes

1: Validated daily average
2: Threshold is Daily ELV except for percentile approach where it is Daily ELV x 1.2
3: Validated daily averages from abated units only
4: Validated LCP hourly averages
5: 120 hour cap applied separately for Malfunction and Breakdown
6: Validated averages excluding validated LCP hourly averages marked as Malfunction or Breakdown
7: Qualifying period is not applied
8: If applying the calculation to monthly ELVs, use the monthly ELV as the threshold and replace Daily Average with the Monthly Average (see section 3.6.1)