AQF 11/06

UPDATE ON PROGRESS ON THE ASSESSMENT OF THE AIR QUALITY STRATEGY'S SULPHUR DIOXIDE 15 MINUTE OBJECTIVE FOR THE CURRENT REVIEW

1. Issue

The 1997 UK National Air Quality Strategy adopted an air quality objective based on a 15minute averaging period to guard against the short term effects of sulphur dioxide (SO_2). This objective is more stringent than European legislation.

In recent years, some UK industries have suggested the 15minute SO_2 objective is an example of 'gold plating'. This paper describes the work being undertaken by Defra, the devolved administrations and the Health Protection Agency (HPA) to consider whether the objective should be retained.

2. Background

Directive 1999/30/EC sets two air quality limit values for SO_2 for the protection of human health to be achieved from January 2005: the 1hour mean of 350ug/m^3, which is not to be exceeded more than 24 times per year; and the 24hour mean of 125 ug/m^3, not to be exceeded more than 3 times per year. The UK Air Quality Strategy has set an additional objective for SO_2 of a 15minute mean of 266ug/m^3 (100ppb), not to be exceeded more than 35 times per year.

The 15minute SO_2 objective was set following recommendations by the Expert Panel on Air Quality Standards (EPAQS) in 1995. EPAQS concluded that a short averaging time was desirable as the effects of SO_2 on the lung's airways could occur very rapidly. EPAQS also concluded that any averaging time may conceal short-term exposures to concentrations higher than the average. A 15 minute averaging time was decided upon as a sensible compromise between the desirability of a standard which reflected the rapidity of response to SO_2 in sensitive individuals and the practicality of gathering monitoring data to show compliance. A "safety" factor of 2 was applied to allow for the possibility of shorter peaks being concealed within the 15 minute period.

The World Health Organisation (WHO) have also produced a short-term guideline for SO_2 of 500 µg/m^3 over a 10 minute averaging time (with no exceedences). Their rationale based on a rapid response to short term exposures of around 200ppb was similar to EPAQS except they did not take into account the possibility of short lived peaks over the lowest observed effect level within the averaging period. WHO have recently recommended a new guideline for SO_2 of 20ug/m^3 averaged over 24 hours. Preliminary analysis suggests this is considerably more stringent than the 15minute objective. WHO also proposed two interim 24 hour guidelines of 50ug/m3 and 125ug/m3 – the latter being roughly equivalent to the 15 minute objective.

The EC legislation has been derived from the recommendations of the WHO using a 1hour limit value for SO_2 derived from the 10minute short term guideline. An averaging time of 1 hour will conceal exceedences and potential effects which may occur over shorter periods.

There are other legislative constraints on sulphur emissions within the UK, such as the National Emission Ceilings Directive, the Integrated Pollution Prevention and Control (IPPC)

Directive and the Large Combustion Plants Directive (LCPD). Sulphur emissions may also be relevant to the requirements of other directives.

It is important to recognise that there are very few remaining exceedances of the 15minute objective within the UK. By 2006, 15 Air Quality Management Areas (AQMAs) had been declared based on failure of the 15minute SO_2 objective. Of these, two are related to refineries, eight to other industrial installations, one to shipping, one to a steam railway and three to domestic coal burning.

3. Approach

In order to quantify the costs and benefits of the 15minute objective, an assessment will be carried out of the effects of **removing** this objective on health. This assumes that industry would only need to comply with the 1hour and 24hour objectives for SO_2 and those installations that currently meet the 15minute objective could therefore increase their emissions. The impact on health of this increase in emissions can be quantified, both in terms of the effects of SO_2 and secondary particulate matter (which is partially derived from atmospheric reactions involving SO_2). These health effects can be monetised and compared with the costs of the delivering the objective.

The following scenarios will be modelled using a base year of 2004 and projections to 2010:
(a) DTI Updated Energy Projections 21 (UEP21) energy baseline with the current 15min SO_2 objective in place;
(b) DTI UEP21 energy baseline without the current 15min SO_2 objective in place.

A further two scenarios will be analysed for the base year, 2010, 2015 and 2020:
(c) DTI UEP26 energy baseline with the current 15min SO_2 objective in place;
(d) DTI UEP26 energy baseline without the current 15min SO_2 objective in place.

4. Assumptions

A number of assumptions will be made in this modelling, which are detailed below. All other information including the same type of GIS-based air dispersion models is kept constant and is consistent with the baseline modelling for the April 2006 Air Quality Strategy consultation[1].

Scenario (a)

- The emissions were projected based on site specific information prepared by DTI for UEP 12 and adjusted by the projected emissions for the electricity supply industry for UEP 21.

Scenario (b)

- Site specific corrections were made for power stations based on the status of the power station with respect to flue gas desulphurisation (FGD) and the LCPD. The emissions from power stations with FGD and within the National Emission Reduction Plan (NERP) were kept constant. This is a conservative assumption based on two theories that the operation of a plant with abatement at less than optimum abatement conditions is not Best Available Techniques (BAT) and therefore unlikely to be allowed by the permit. Secondly that within the NERP the increase in emissions by one source would be cancelled by the decrease in emissions from another source. Hence annual total emissions will remain constant.

[1] Consultation on the review of the Air Quality Strategy – options for further improvements in air quality. Available at http://www.defra.gov.uk/corporate/consult/airqualstrat-review/index.htm

- 'Opted out' power stations will be able to manage their emissions by altering the proportion and times at which they use lower sulphur coal blends. The operating hours used are based on DTI estimates of behaviour and clearly are subject to the commercial decisions of individual operators. Annual emissions from these coal fired power stations were increased by 50%. This conservative factor of 1.5 arises from three concurrent studies and further detail of how this was derived can be found in Annex A.. No physical abatement equipment is assumed to be fitted in any of the scenarios. If necessary, the resulting emission was constrained to the station A limit. This leads to an overall 50% increase at power stations.

- Virtually all LCPD sources in the refinery sector have opted into the NERP and so, even if their emissions increase individually under trading, will not lead to an overall increase in emissions since the NERP in effect has a fixed maximum "bubble".

- The refinery emissions from non-LCPD sources were increased by a factor of 1.5 under the assumption that in the absence of the 15minute objective the regulator would no longer be able to take into account the short term health effects of sulphur dioxide in permit determinations, and therefore operators would apply for revised permits. It is assumed that operators will seek the most economic approach to emission management which would be to increase emissions from these sources, possibly through moving releases from LPCD sources on site and hence making available the possibility of a trading gain for the operator and hence an increase in the national total. This could lead to an overall 30% increase in emissions from refineries.

- While smaller operators may also be impacted by the removal of the objective possibly allowing the increase in emissions this was considered insignificant on a national scale compared to the uncertainties in the emission projections which are of the order of 20%.

- Emissions estimates for scenario were only calculated for 2010. Following advice from the Environment Agency it was assumed that the opted out power stations would be unlikely to emit in 2015 and this scenario would therefore be identical to scenario (a).

Scenario (c)

- The emissions were based on site specific information obtained from DTI for UEP26 for coal fired power stations.

Scenario (d)

- As the DTI UEP26 estimates show opted out power stations continuing to operate in 2015, the last year in which they are able to and non-LCPD sources at refineries were shown to be operating in 2015 in UEP26 through to 2020, emissions for scenario (d) were calculated for 2010, 2015 and 2020 using the assumptions described above. Emissions in UEP26 are considerably smaller for the sources considered and hence the power station A limits were not a constraint on emissions.

5. Next steps

The incremental cost savings and health disbenefits of removing the 15 minute objective will be calculated on a consistent basis.

The assessment of the health impact of predicted changes in SO_2 and particles PM_{10} (SO_2 as PM) concentrations is currently under way using the latest DTI energy projections (UEP26). This will be calculated using methods fully consistent with the Third Report of the

Interdepartmental Group on Costs and Benefits (IGCB)[2]. This assessment will also be based on expert advice from the Committee on the Medical Effects of Air Pollutants (COMEAP) who recommended a 6% reduction in hazard rate (per 10µg.m^{-3}) for $PM_{2.5}$ health effects. COMEAP also stated that the 6% coefficient should apply equally to all components of $PM_{2.5}$, including sulphate. This will be applied to the secondary particulate impacts of this objective following the completion of the concentrations modelling.

Further work is also being carried out in determining costs borne by both coal power stations and oil refineries (consistent with the modelling assumptions above) in meeting the 15 minute objective. This analysis will capture the incremental cost of meeting this objective as opposed to the next most stringent air quality SO_2 objective (1 hour limit value) and is being carried out based on information provided by industry and regulators.

Annex A

Study 1 (Environment Agency)

- This study involved analysis based on Gaussian plume dispersion theory, which suggested that a plant emitting sufficient to exactly meet the 15 minute objective could increase its emissions by between 100% and 300% if allowed to increase its emissions to meet the 1 hour objective.

Study 2 (Environment Agency)

- This study involved re-analysis of measurement data from sites impacted by plumes from major point sources, which suggested that an increase of between 30% and 450% in emissions would be allowed depending on the meteorological conditions and the relative location of other sources.

Study 3 (Envirobods)

- This study involved modelling carried out for a generic power station with and without flue gas desulphurisation, which showed that since ground level concentrations are linearly related to emissions, in the absence of the 15 minute objective, emissions could be increased by 80% before meeting the next regulatory constraint; the 1 hour EU standard. Further work on a range of generic sources gave increases of 52% for a refinery, 64% for a municipal waste incinerator, 50% for a hazardous waste incinerator and 57% for a cement works using the dry process and burning 25% tyres.

[2] 'An Economic Analysis to Inform the Air Quality Strategy Review Consultation'. Defra (2006). Available at http://www.defra.gov.uk/environment/airquality/publications/stratreview-analysis/index.htm