The revised Large Combustion Plant Directive

A major challenge

Following the completion of the formal 'conciliation procedure' of the EU Institutions, a joint text for the revision of the 1988 Directive (88/609/EEC) on 'the limitation of emissions of certain pollutants into the air from Large Combustion Plants' was approved by the Conciliation Committee on 2 August 2001.

While maintaining many of the structural elements of the original Directive, this revision includes an important and fundamental change, in that it prescribes the upgrading of existing plants (built before 1 July 1987) to meet the same requirements as new plants (as defined in Directive 88/609/EEC).

Such a requirement, while founded on the principles of Best Available Techniques (BAT) enshrined in the IPPC Directive[1], removes the inherent flexibility provided by that Directive through its site-specific and integrated provisions. As discussed in the previous article it also results, at least for SO_2, in emission reductions (and attendant costs) significantly beyond those required to achieve the associated environmental objective in most southern EU Member States.

Based on an assessment of developments in pollution abatement technologies since the adoption of Directive 88/609/EEC, the revised Directive also mandates more stringent emission limits for 'new new' plants[2].

In this article we briefly review some of the key implications for the EU refining rector of this revision to the original Directive.

SO_X EMISSIONS

The emission limits for SO_x in the revised Directive are shown in Figure 1 for 'old', 'new' and 'new new' combustion plants as a function of thermal capacity. As in the original Directive, two alternatives are possible for refineries, viz. emission limit values (ELV) for individual combustion plants or an overall average 'refinery bubble concentration'. In both cases, the requirements for 'new new' plants are much tougher than those for 'old' and 'new' plants. To enable the impact of these two alternatives on existing refineries to be more readily seen, Figure 2 expresses the limit values from Figure 1 in terms of the equivalent level of sulphur in the refinery fuel oil that can be used. This maximum sulphur level is plotted as a function of the percent fuel oil fired in a given unit or, in the case of the bubble, the refinery as a whole. Only the case of 'old' and 'new' units or existing refineries are covered in this figure.

[1] *Council Directive 96/61/EC on Integrated Pollution Prevention and Control*

[2] *Plants for which a full construction licence is issued 12 months or later after the entry into force of the Directive or that are brought into operation 24 months or later after entry into force*

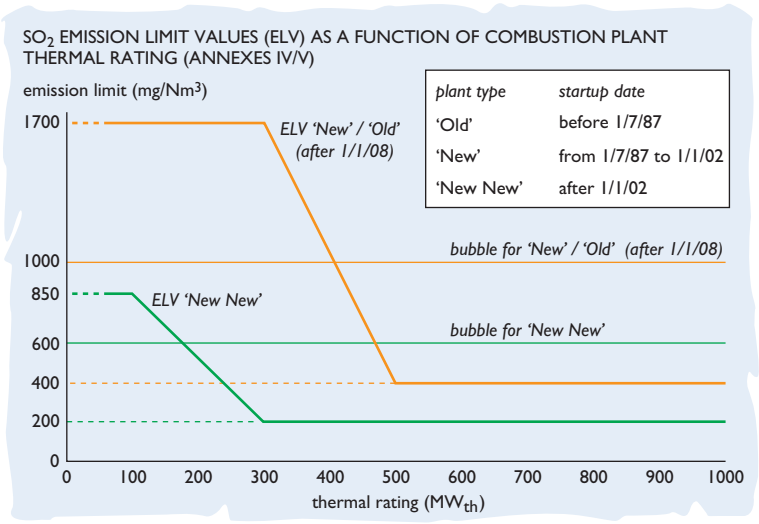


Figure 1
SO_x emission limits are much tougher for 'new new' plants than those for 'old' and 'new' plants.

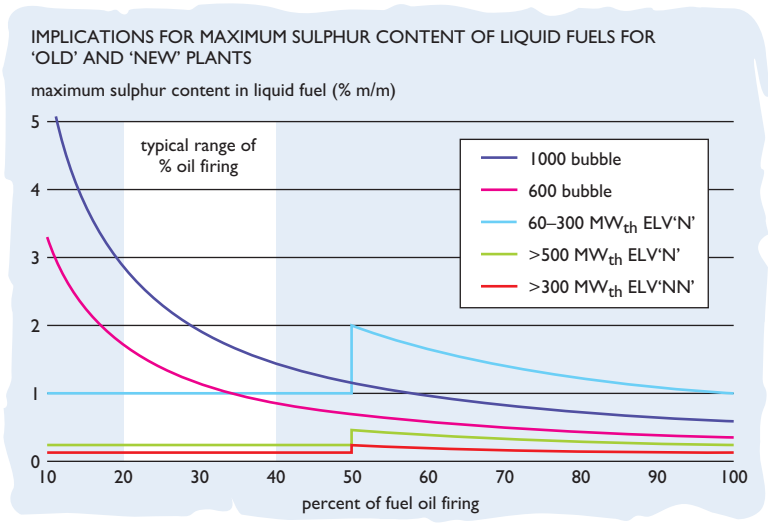


Figure 2
The limit values in Figure 1 are expressed here in terms of the equivalent level of sulphur in the refinery fuel oil that can be used.

For the alternative where emission limit values are set for individual plants, the 'majority fuel' concept—a specific provision for refineries—is preserved in the revised Directive. This important provision results in an emission limit for mixed oil and gas firing equivalent to the 'oil only' emission limit, provided the percentage of fuel oil firing is 50% or more on a thermal basis. The effect of this provision is clearly seen in Figure 2. For combustion units up to 300 MW_{th}, the emission limit is 1700 mg/Nm^3 and is equivalent to an average sulphur content in the liquid fuel of 1% m/m^3. This jumps to 2% m/m at 50% fuel oil firing as a consequence of the majority fuel concept.

Figure 2 also shows that the second alternative, which specifies a refinery bubble concentration, clearly provides for a greater flexibility in fuel usage in the refinery. For 'old' and 'new' refineries, at the typical overall range of oil to gas firing in EU refineries, the bubble limit of 1000 mg/Nm^3 would allow the firing of 1.5 to 3% m/m sulphur fuel oil regardless of thermal capacity. For a grass roots refinery ('new new'), the bubble limit of 600 mg/Nm^3 would make it very difficult to fire any high sulphur residual fuel oil, although the alternative individual plant emission limit value would be even more restrictive. In this case, with an emission limit of 200 mg/Nm^3, 'new new' plants over 300 MW_{th} would, even under the majority fuel concept, only be able to burn 0.25% m/m sulphur fuel oil.

Clearly, the revision to emission limits on SO_x outlined in the revised Directive will, in the medium/longer term, make it difficult for refineries to continue to burn residual fuel oil. With even higher downward pressure on the sulphur level of marketed heavy fuel (via the 'Sulphur in Liquid Fuel' Directive) this will make significant further investment demands upon the EU refining sector, particularly in southern Europe with its dependence on higher sulphur crude sources.

NO_X EMISSIONS

Figure 3 shows the emission limits for NO_x in the revised Directive. For NO_x the Directive makes no provision for an alternative average bubble concentration. This means that the special 'majority fuel' provision for refineries is particularly important. This is seen more clearly in Figure 4. This provision will have significant implications for the refinery's fuel management strategies on individual units. Maintaining the proportion of fuel oil firing above 50% on individual units has clear advantages in terms of the emission limit.

[3] *Assuming the sulphur content in the other fuels is negligible*

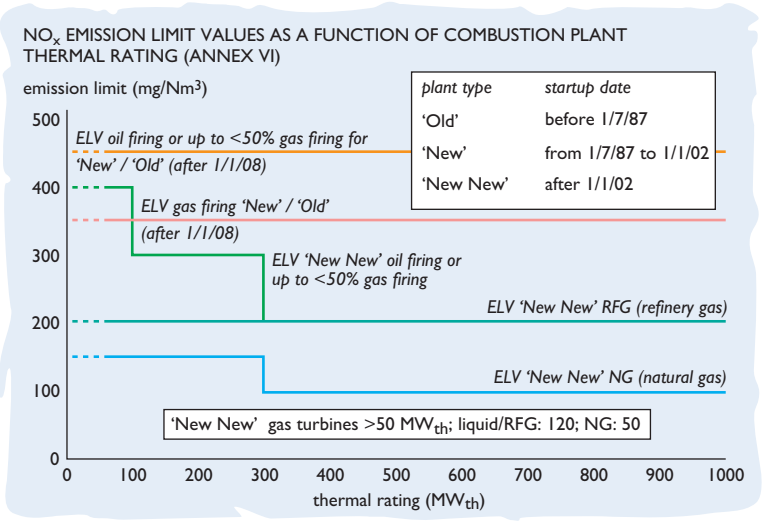


Figure 3
The Directive makes no provision for an alternative average bubble concentration for NO_x.

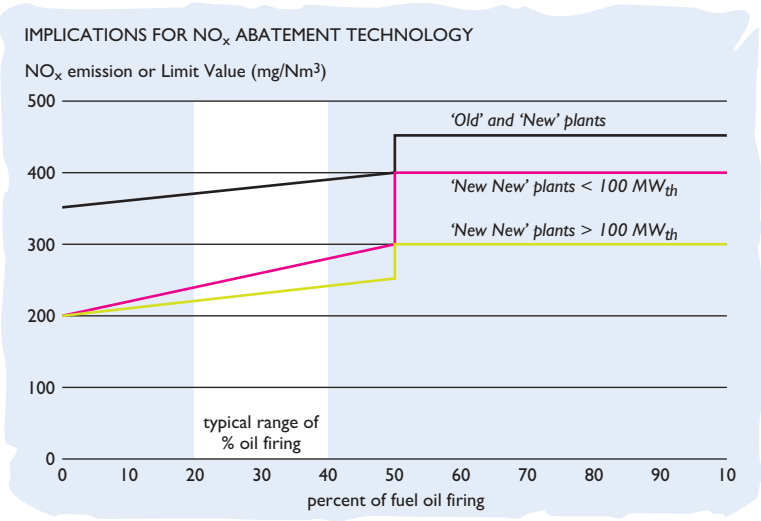


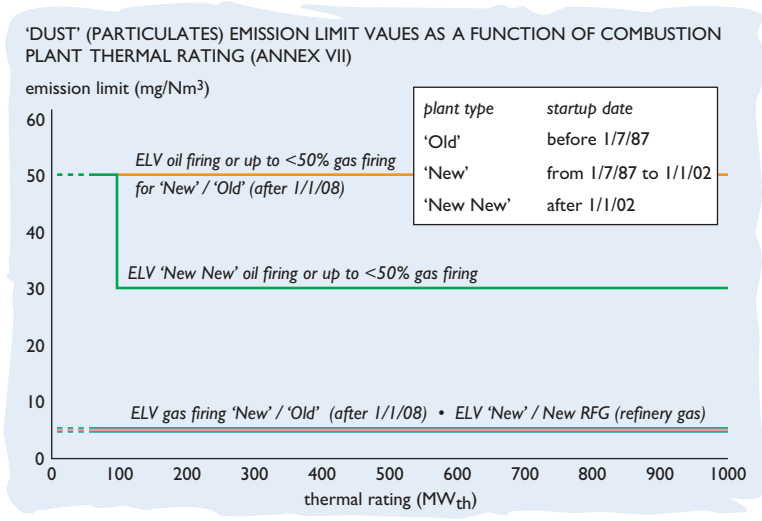
Figure 4
Maintaining the proportion of fuel oil firing above 50% has clear advantages in terms of the emission limit.

The NO_x emission limits are in themselves extremely challenging, especially for high nitrogen content residual fuels and/or units where investment in energy conservation has resulted in high levels of combustion air preheat. In some situations it may be impossible to maintain current levels of air-preheat and comply with the new emission limits. This illustrates the potential for 'environmental tensions' (energy efficiency v. NO_x emissions) when the 'integrated' aspects of the IPPC Directive are jeopardized by the application of fixed emission limits for a single *pollutant*. The requirement for compliance with the emission limit value over a 48/24 hour averaging period will effectively increase the stringency of the new limits since these limits will need to be met for the 'worst' set of operating conditions over the year.

PARTICULATE OR DUST EMISSIONS

Figure 5 shows the emission limits for particulates as a function of plant thermal rating. As for NO_x, there is no provision for an average bubble concentration for particulates. Hence the special 'majority fuel' provision for refineries again provides a much-needed flexibility. The advantage of maintaining fuel oil firing in a given unit just above 50% is clearly seen in Figure 6. Maximizing gas firing whilst staying within the requirements of oil being the 'majority fuel' will help to minimize the formation of carbonaceous particles. However, particularly for 'new new'

Figure 5
As with NO_x, there is no provision under the Directive for an alternative average bubble concentration for particulates.



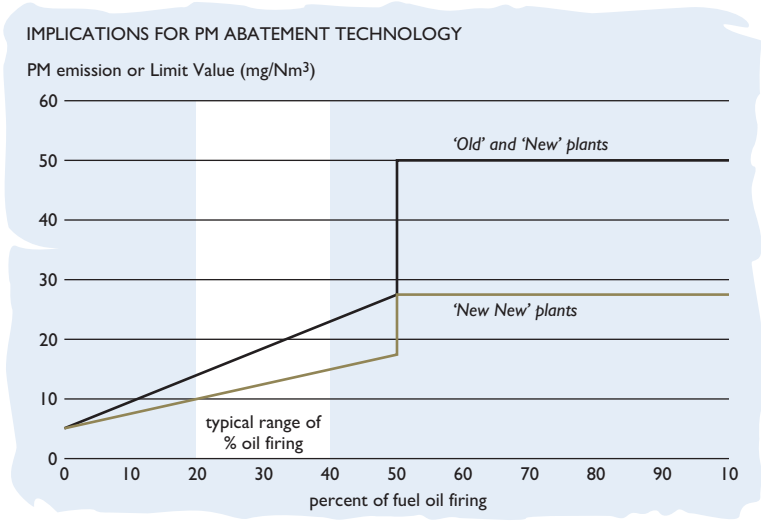


Figure 6
The advantages of maintaining fuel oil firing at just above 50% are clear; but for many plants this may be difficult to achieve given the stringent limit on PM emissions.

plants, the stringent limit on PM emissions is likely to seriously restrict the firing of heavy residual fuel oil in refineries, especially those with high Conradson Carbon Ratios/high ash contents. Complying with both the NO_x and PM emission limits, given the potential of primary control measures, will also be a significant challenge.

A SPECIAL PROVISION FOR ADDING NEW PLANT TO REFINERIES

An important provision of the Directive, is the determination of the emission limit value for 'extensions' to existing refineries. The limit value for a 'new new plant', added to an existing refinery, is based on the thermal rating of the additional plant alone and not on the whole site after the new plant has been added. The significance of this provision can be seen by reviewing Figure 3. If a 60 MW_{th} plant is added to a refinery which has an original thermal rating of 400 MW_{th} then the emission limit for the additional plant is 400 mg/Nm^3. Without the special refinery provision the limit would have been 200 mg/Nm^3.

AN IMPORTANT FLEXIBILITY FOR UPGRADING 'OLD' TO 'NEW'

One further important flexibility in the revised Directive is the provision of an alternative approach to the upgrading of 'old plants' to meet 'new plant' emission limits. This is based on the concept of a national 'old plant emissions bubble'. The provision is clearly aimed at providing a cost-effective route to delivering the overall emissions reduction achieved by upgrading 'old plants' to meet 'new plant' emission limits. The way it is designed to operate is best illustrated by a simple example of two 'old plants'.

Plant 1 emits 100 t during the 'accounting year[4]' while Plant 2 emits 150 t during the same period. When the upgrading requirements of the revised Directive are applied to these two plants, the allowable emissions are 60 t/a for Plant 1 and 100 t/a for Plant 2. Figure 7 illustrates how the flexible provision of the Directive would allow two basic means of achieving the overall goal of the 'national ceiling' of 160 t/a. One route would be to shut down Plant 1 and, without any upgrade, continue to operate Plant 2. This would result in emissions of 150 t/a, which is within the target of 160. However, a special restriction within the revised Directive does not permit the emission of Plant 2 to be increased above its original 'accounting year' level so that Plant 2 could not, with the same fuel, be operated at a higher capacity than in the accounting year.

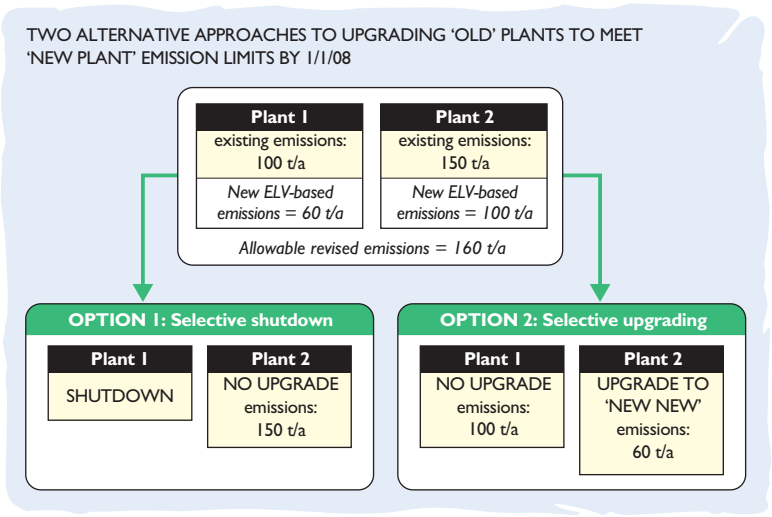


Figure 7
Upgrading 'old plants' to meet 'new plant' emission limits may provide a cost-effective route to achieving an overall reduction in emissions.

The other route to achieving the 'national ceiling' is 'selective upgrading'. This would be based on the notion that Plant 2 represents a more cost-efficient route for upgrading than Plant 1. In this case Plant 2 would be upgraded to meet more stringent emission limits than required for 'new plants' (perhaps close to 'new new' emission limits) so that its emissions were no more than 60 t/a. As a consequence, Plant 1 would be able to continue to emit its original base emissions of 100 t/a.

Such a provision at the national level will undoubtedly be difficult to implement, espe-

[4] *In the revised Directive this is set as year 2000*

cially if attempts are made to ensure a cost-effective flexibility across industrial sectors. However, within the context of an individual refinery or within a refining company with several refineries in a country, such a provision offers a significant potential for optimizing, from a cost point of view, the attainment of the overall environmental goal.

This brief review of the key implications of the revision to the Large Combustion Plant Directive demonstrates that it presents a major challenge to the EU oil refining industry. In particular it will significantly curtail the use of heavy residues from the refining process for which alternative disposal routes are already either closed or in the process of being closed. Such an outlook suggests further significant investment pressures on the downstream sector as well as additional CO_2 emissions associated with energy-intensive residue upgrading processes.

Furthermore, the new emission limits for both NO_x and particulates represent a significant challenge to combustion control technology. The prospect of these limits resulting in a need to retrofit high cost, end-of-pipe technologies, for an industry which is only a minor (<2%) contributor to both NO_x and particulate emissions in the EU is a major concern.