

Environment Agency

Pollution Prevention and Control

**A Framework for the Regulation of Existing Large Coal- and Oil-Fired
Combustion Plant at Power Stations in England and Wales: 2008–15**

Note:

Version 12.2 (January 2006) has been updated by referring to a JEP Report *Implementing the Regulatory Framework 2008-2015 Compliance Regimes and Supporting Protocols* (December 2006 and subsequent agreed amendments). The JEP report incorporates several of the protocols included in version 12.2 as appendices.

There are some amendments to Section 1.2 and the redundant appendices have been removed.

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SUMMARY

This paper provides guidance on **Best Available Techniques (BAT) at sector level** as a regulatory Framework for the control of emissions of sulphur dioxide (SO₂), nitrogen oxides (NO_x) and particulates from large combustion plants (LCP) at 17 coal and oil-fired power stations in England and Wales. It covers the period 1 January 2008 to 31 December 2015. These LCP will be regulated under Pollution Prevention and Control (PPC), with some major constraints imposed by the revised Large Combustion Plants Directive (LCPD).

It is important to note:

1. That LCPD requirements constitute a minimum level of control and are without prejudice to determining ELVs and/or other controls under PPC.
2. This guidance is without prejudice to the determination of PPC applications for the installations concerned.

The period covered here is Phase 2 of a two-phase regulatory Framework. Phase 1 is a Transitional phase 1 October 2005 to 31 December 2007 and has been implemented.

The Framework has been developed over about two years, taking account of:

- new legislative requirements that will affect these LCP during the period 2005 to 2015;
- demand from these coal and oil-fired power stations which is above expectations of a few years ago; and
- the notice required to make changes involving major capital investment.

The new legislative requirements include the EU Emissions Trading Scheme (EU ETS) in 2005; PPC in 2006; LCPD provisions from 2008; and the National Emissions Ceiling Directive (NECD) targets for 2010.

The LCPD introduces some important definitions and limitations. This guidance is based on the following key LCPD considerations:

- The European Commission's interpretation supplied in September 2005 that LCP subject to the LCPD should be defined on the basis of flue gases being released through a common stack or windshield.
- The Government decision announced on 16 December 2005 to implement the LCPD for existing LCP through a combined approach of emission limit values (ELVs) and a National Emission Reduction Plan (NERP). Operators must state by 3 February 2006 whether each LCP under their control should be regulated under LCPD ELV or the NERP from 1 January 2008.
- Alternatively, operators may opt LCP out under the LCPD, taking a 20,000 operating hour limited life derogation across the period 2008-2015 and closing by 31 December 2015. The stack definition and definition of operating hours – taken in combination – have significant implications for the economics of opted out LCP by making it impractical to get 20,000 operating hours out of all boilers supplying flues in one common windshield, as would have been the case under a boiler definition of LCP.

The NERP is a plan to be implemented by Defra across the UK and will include many smaller LCP. Guidance will be developed on how the NERP will be implemented.

Operators have until 3 February 2006 to state which LCPD route they have chosen for each LCP¹.

Phase 2 of the Framework will provide the following controls:

- Site-specific controls: use of Best Available Techniques (BAT); emission limit values (ELV) for SO₂, NO_x and particulates; a Station A Limit on annual emissions of SO₂; a Site Annual Release Limit for NO_x and an Air Quality Management Plan.
- Cap and trade sector limits on total annual emissions of SO₂ and NO_x, in the form of transferable Operator B Limits for LCP under LCPD ELV; and a parallel but independent arrangement for SO₂, NO_x and particulates for those under a NERP.

We summarise in this document our view of sector-level BAT. Operators will provide BAT cases for each LCP installation in their PPC application. BAT will be finally determined on the basis of each application, having regard for all the relevant factors.

From 1 January 2008, we consider that sector-level BAT to reduce emissions of SO₂ from existing LCP at coal-fired power stations will be Flue Gas Desulphurisation (FGD) or an equivalent technique, unless it is limited in operating hours or life, e.g. by being opted out under the LCPD. BAT for opted out LCP will require use of low sulphur coal.

Sector-level BAT for coal-fired LCP will be use of low NO_x burners and Over Fire Air (or equivalent measures) to limit NO_x emissions.

Oil-fired LCP operate at low load factors. As such, we would anticipate that these LCPs are likely to be opted-out of the LCPD main provisions, taking the 20,000 operating hour derogation. SO₂ emissions will be effectively limited by the Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000 (SCLF). We will require opted-out oil-fired LCP to use burners capable of meeting BAT requirements for NO_x.

Sector level BAT for particulate control on existing coal and oil-fired LCP will generally continue to be based on use of electrostatic precipitators, whether opted-out or not.

¹ It is no longer possible to opt an LCP out, taking the limited life derogation. However, an opt-out declaration previously made can be withdrawn up to 3 February 2006.

1. BACKGROUND

1.1 This document provides guidance to a Framework for application of legislation to emissions of SO₂, NO_x and particulates from Large Combustion Plant (LCP) at coal and oil-fired power stations listed in Table 1. These plants are combustion activities as defined in the Pollution Prevention and Control (England and Wales) Regulations 2000, as amended (PPC). As such, they would form part of a PPC installation. They are also qualifying LCP under the Large Combustion Plants Directive (LCPD), as defined by the stack definition of LCP.

Table 1: Large Combustion Plant at Coal and Oil-Fired Power Stations in England and Wales

Power Station	Operator	Primary fuel	Capacity (GWe) ¹	FGD (as % of capacity)	Stack configuration (Qualifying LCP under LCPD based on a 'stack definition')	SO ₂ A-Limit From 2004/5 (ktpa)	Site NO _x Release Limit (ktpa)
Aberthaw	RWE npower	coal	1.5	Note 2	3 units, each with a flue in the common windshield (1 LCP)	39.0	36.0
Didcot		coal	2.0	-	4 units, each with a flue in the common windshield (1 LCP)	67.0	27.5
Fawley		oil	0.5	-	2 units, each with a flue in the common windshield (1 LCP)	9.0	5.4
Littlebrook		oil	1.4	-	3 units, each designed with a flue in the common windshield but 2 currently operated with a common ESP (1 LCP)	13.0	11.2
Tilbury		coal	1.1	-	4 units, feeding two chimneys (U7+U8, U9+U10) (2 LCP)	23.2	20.3
Grain	E.ON UK	oil	1.3	-	2 units each with a flue in a common windshield (1 LCP)	25.0	12.0
Kingsnorth		coal	2.0	-	4 units each with a flue in a common windshield (1 LCP)	68.5	32.0
Ratcliffe		coal	2.0	100%	4 units each with a flue in a common windshield (1 LCP)	50.0	40.0
Ironbridge		coal	1.0	-	2 flues exhausting into a common windshield (1 LCP)	34.3	26.3
Rugeley	International Power	coal	1.0	Note 7	2 units into 1 chimney flue (1 LCP)	34.3	19.8
Cottam	EDF Energy	coal	2.0	Note 3	4 units each with an independent flue within a common windshield (1 LCP)	61.0	26.0
West Burton		coal	2.0	100%	4 units to 2 stacks each with 2 independent flues (2 LCP)	30.0	26.0
Ferrybridge	Scottish & Southern Energy	coal	2.0	Note 5	4 units to 2 common stacks (2 LCP)	55.9	31.8
Fiddler's Ferry		coal	2.0	Note 6	4 units each with an independent flue within a common windshield (1 LCP)	44.6	22.8
Eggborough	British Energy	coal	2.0	50% ⁴	4 units each with an independent flue in a common windshield (1 LCP)	56.0	30.1
Drax	Drax Power	coal	3.9	100%	6 units, feeding 3 flues inside a single chimney (U1+U2, U3+U4, U5+U6) (1 LCP)	47.0	87.0
Uskmouth	Uskmouth Power Company	coal	0.4	100%	3 units feeding a common chimney (1 LCP)	3.5	3.5

Notes:

- Note that changes in capacity can occur. For example, as oil-fired boilers are made available.
- 1.5GW of FGD has been granted Section 36 consent.
- 2 GW FGD under construction. The schedule is 50% FGD by end of 2005 and 100% FGD by end of 2007.
- 1GW of capacity has FGD. This is commissioning 2005.
- FGD to be fitted to one LCP. Commissioning scheduled to start Feb/Apr 2008.
- FGD to be fitted to one LCP. Commissioning scheduled to start Feb/Apr 2008.
- FGD announced December 2005.

- 1.2 For definitions see the PPC Permits². A range of protocols referenced in the permits can be found in a supporting JEP Report³. The term *plant* is used generically when referring to a piece of process equipment. The term *power station* is used to describe a site. That site may include other power generating plant not addressed here, e.g. gas turbines.
- 1.3 The period 1 January 2008 to 31 December 2015 is the second phase of the Framework. The first phase is 1 October 2005 to 31 December 2007. This is described separately⁴, with more detail of the background leading to Phase 2.

Large Combustion Plants Directive

- 1.4 This guidance is based on the European Commission's interpretation supplied in September 2005 that *LCP qualifying under the LCPD should be defined on the basis of flue gases being released through a common stack or windshield*. Table 1 lists the LCP within this Framework arising from this definition.
- 1.5 The Government has decided to implement the LCPD through a combined approach, allowing those LCP that are not opted-out to meet either LCPD Emission Limit Values (ELV) or a NERP. These plant tend to be referred as opted-in⁵. Details of how the LCPD is to be implemented in the UK, including NERP allocations, are provided in documents at Defra's LCPD web site⁶.
- 1.6 Operators have had the opportunity to make a declaration to opt-out LCP, taking the 20,000h limited life derogation under Article 4.4 of the Directive. (Operators have the option to withdraw such declarations by 3 February 2006). These LCP can operate a maximum of 20,000 operating hours between 1 January 2008 and 31 December 2015, with a requirement to close by the latter date. The stack definition and the definition of operating hours – taken in combination – have significant implications for the economics of opted-out LCP by making it impractical to get 20,000 operating hours out of all boilers supplying flues in a common windshield. This is because at these power stations between two and four boiler/generating sets will discharge flue gases through flues in a common windshield or a single open chimney, making them a single qualifying LCP under the stack definition. See Table 1 for details. Apart from winter peaks, such boilers tend to work twice a day: 'two shifting'. They cannot be started up and shutdown simultaneously for safety reasons and it may not be possible to despatch the output from all these large boilers feeding a single stack at the same time without causing stability problems for the grid.

² Note that in preparing PPC permits the B Limits were calculated using *Connection Entry Capacity* data. A table is available showing how this was done.

³ Joint Environmental Programme (2006), Implementing the Regulatory Framework 2008-2015 Compliance Regimes and Supporting Protocols.

⁴ Environment Agency (2005), A Proposed Framework for the Regulation of Large Coal and Oil-Fired Electricity Generating Plants in England and Wales: Transitional Phase, 2005-2007

⁵ While known as 'opted-in', operators only need to make a declaration to Defra for LCP taking the NERP route. The ELV route requires no such declaration.

⁶ <http://www.defra.gov.uk/environment/airquality/lcpd>

- 1.7 Note that LCPD requirements constitute a minimum level of control and are without prejudice to determining ELVs and/or other controls under PPC.

Pollution Prevention and Control Regulations 2000

- 1.8 PPC^{7,8} is replacing Integrated Pollution Control (IPC), with the LCP of Table 1 falling within the combustion activities defined in Part A(1) of Section 1.1 of Chapter 1 of Part 1 of Schedule 1 of the PPC Regulations. Such activities are due to come under PPC in 2006/7⁹. We provide in this guidance a view on what constitutes sector-level BAT for controlling emissions of SO₂, NO_x and particulates from the LCP in Table 1. A European BAT Reference (BREF) document has been produced, which contains technical information on the performance of various abatement techniques.¹⁰ It was prepared by a Technical Working Group of European environmental regulators and industry, though it was not a united view^{11, 12} and the document itself contains several “split views”. We have taken account of the BREF and associated discussions in developing sector PPC Guidance¹³ and this Framework.
- 1.9 BAT assessment is installation specific in principle but the LCP covered here are of a sufficiently similar design (apart from certain controls at Aberthaw and Uskmouth) that we have been able to develop a view on BAT at sector level.
- 1.10 This Framework was prepared at the request of operators to give a basis for investment planning. BAT for existing installations takes account of the length of time required to make changes and consultation with operators in developing this guidance has provided them with notice. Hence, sector-level BAT until 31 December 2007 is considered to be continuation of use of the existing techniques but we expect Flue Gas Desulphurisation (FGD) and Over Fire Air (OFA) – where applicable – to be in place by 1 January 2008. BAT for each LCP will be determined in processing the PPC applications taking into account the operator’s own assessment and the views of consultees.
- 1.11 BAT will comprise a combination of controls, including:
- ELVs;
 - sector ‘cap and trade’ B-Limits or NERP which will limit emissions of acidifying and eutrophication gases; and
 - controls to protect local air quality.

⁷ PPC arises from the IPPC Directive: Council Directive 96/61/EC concerning integrated pollution prevention and control, *OJ L 254/26*.

⁸ Statutory Instrument 2000 No. 1973, The Pollution Prevention and Control (England and Wales) Regulations 2000.

⁹ IPPC Regulatory Guidance Series No 4 – Interpretation of Schedule 1 to the PPC Regulations.

¹⁰ European Commission (2005), ‘Reference Document on Best Available Techniques for Large Combustion Power stations’, May.

¹¹ Eurelectric (2004), Eurelectric’s Official Position on the BREF, December.

¹² Eurelectric (2005), Note on the BREF, January.

¹³ IPPC Sector Guidance Note Combustion Activities.

All these will be provided through installation-specific controls specified in each PPC permit. Appendix B summarises which particular controls will apply to opted-in and opted-out LCP.

2. LCP MEETING ARTICLE 4(3)(a) OF THE LCPD: THE ELV OPTION ('OPTED-IN')

We do not expect oil-fired LCP to fall into this category but any opting back in by 3 February 2006 will be addressed thereafter.

2.1 ELV from 1 January 2008

ELV for SO₂

2.1.1 We consider that by 1 Jan 2008 operators should have had sufficient time to upgrade these LCP to FGD (or an equivalent), i.e. as close as possible to BAT for new plant¹⁴. Sector-level BAT is based on use of FGD at 90% collection efficiency on a UK coal of 1.75% sulphur to give 400 mg SO₂/m³, giving an annual emission benchmark of 1.8 t SO₂/GWh generated.

2.1.2 LCP taking this route will need to meet at least the LCPD ELV, which is shorter term than the annual benchmark. Hence, BAT would be delivered using the compliance requirements of LCPD Article 14 regarding the **400 mg SO₂/m³ ELV** set out in Annex IIIA of the Directive¹⁵. Compliance will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs. See definitions of start-up and shutdown in Annex D.

ELV for NO_x

2.1.3 For coal-fired LCP, the BREF¹⁰ indicates that low NO_x burners plus Selective Catalytic Reduction (SCR) is BAT. We have considered NO_x abatement options and concluded that SCR and Reburn are not economic to retrofit on existing coal and oil-fired LCP at the present time¹⁴. We consider sector-level BAT for all opted-in and opted-out LCP firing high volatile coal to be low NO_x burners and OFA (or equivalent measures). Sector-level BAT on a high volatile coal is use of OFA to give 500 mg NO_x/m³, which corresponds to an annual emission benchmark of 1.8 t NO_x/GWh generated. It is not feasible to require OFA earlier than 2008.

2.1.4 LCP taking this route will need to meet at least the LCPD ELV, which is shorter term than the annual benchmark. Hence, sector-level BAT would be delivered using the compliance requirements of LCPD Article 14 regarding the **500 mg NO_x/m³ ELV** set out in Annex VIA of the Directive¹⁷. Compliance will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶.

¹⁴ OXERA (2003), 'Best Available Techniques for abating SO₂ and NO_x Emissions from Coal-fired Power Stations', February.

¹⁵ The NB to Annex IIIA of the LCPD sets minimum desulphurisation rates where ELV cannot be met due to the characteristics of the fuel.

¹⁶ Detailed arrangements will need to be developed for a range of flue configurations.

¹⁷ See Note 3 of Annex VIA of the LCPD giving derogation of 1200 mg/m³ for low volatile coals.

Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs and B-Limits.

- 2.1.5 BAT for NO_x control on opted-in LCP at Aberthaw designed to operate on low volatile coal will be determined on the basis of its PPC application. It may comprise some combination of the established technique of Thermal Input Biasing; the dynamic classifier technology currently being trialed; SCR; and/or other techniques. An ELV will be set based on BAT, at least matching the minimum requirements of Annex VIA Note 3.

ELV for Particulates

- 2.1.6 Electrostatic precipitators and FGD¹⁸ will continue to be regarded as sector-level BAT for particulate control on coal-fired LCP. This gives emission benchmarks of 25 mg/m³ for LCP with FGD and 50 mg/m³ for LCP without FGD (monthly averages). These benchmarks will be used as reference points in determining installation specific BAT and corresponding ELV.
- 2.1.7 From 1st January 2008, coal-fired LCP will be required to comply with LCPD Article 14 regarding the 50 mg/m³ ELV set out in Annex VIIA of the Directive. Hence, sector-level BAT for **LCP with FGD** will be a **25 mg/m³ monthly ELV plus the LCPD 50 mg/m³ ELV**. Sector-level BAT for **LCP without FGD** will be the **LCPD 50 mg/m³ ELV**. An interpretative protocol will be developed. Compliance with the LCPD ELV will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.
- 2.1.8 The LCP at Uskmouth has bag filters. A BAT-based ELV will be set in determining its PPC application.

2.2 B Limits from 1 January 2008

- 2.2.1 Under Article 3 of the IPPC Directive, *Member States shall take the necessary measures to provide that the competent authorities [Environment Agency] ensure that installations are operated in such a way that:*

- (a) *all the preventative measures are taken against pollution, in particular through application of the best available techniques;*
(b) *no significant pollution is caused*

For this reason, we shall continue to set a sector cap through transferable Operator B Limits for SO₂ and introduce similar B Limits for NO_x, as measures at sector level to minimise acidification and eutrophication. These will be based on BAT, transferable because it is a national and transboundary issue and cover both opted-in and out LCP. (These Operator B limits are

¹⁸ At an installation level, BAT for SO₂ control may involve a combination of FGD with other techniques. This has implications for particulate control.

broken down into Process B limits at station level for accountability under the permits). Note that B Limits will be unnecessary for LCP under a NERP.

SO₂ B-Limits

- 2.2.2 Transferable Operator SO₂ B-Limits would be allocated to operators at **9.0 kt/year per GWe** of net installed capacity, based on the total GWe of coal-fired LCP. This limit includes emissions during breakdowns of abatement equipment, but excludes emissions during start-up and shutdown. An allocation at 9 kt/GWe gives wide flexibility to operators while delivering a BAT level of performance. For example, LCP with wet limestone FGD at 90% removal efficiency could operate up to about 58% annual load factor on 1.75% sulphur coal as an average, increasing to 80% load factor at 93.5% efficiency on the same coal^{19, 20}. Higher load factors could also be achieved if these LCP used some coals with lower sulphur levels. Conversely, high frequency of FGD breakdowns would reduce this flexibility.
- 2.2.3 The LCP at Uskmouth has dry lime injection FGD that at about 80% collection efficiency is inherently less efficient than wet limestone FGD but it was designed and permitted on the basis that it will use lower sulphur coals than the UK average. At the design efficiency of 80% it could operate up to about 71% annual load factor on a 0.87% sulphur coal; and at higher load factors on lower sulphur coals¹⁹. Increasing the collection efficiency may also be possible. So it is considered capable of similar emissions performance as the rest of the sector and an allocation at 9 kt SO₂/year per GWe is appropriate.

NOx B-Limits

- 2.2.4 B Limits will be set to minimise NOx emissions across the sector, based on sector-level BAT, i.e. derived from an emissions rate and load factor. All LCP except the downfiring boilers at Aberthaw are expected to have OFA (or equivalent) in operation by 1 January 2008, fixing the emissions rate. (Unlike sulphur emissions, there is very limited scope for reducing NOx emissions through choice of coal type). It is important to recognise the interactions between the SO₂ and NOx caps, as well as adopting levels that will encourage operators to invest and optimise, and not take undue risk with security of supply.
- 2.2.5 From 1 January 2008, transferable Operator NOx B-Limits would be allocated to coal-fired LCP taking the LCPD ELV route (except at Aberthaw) at **12.7 kt/year per GWe**²¹. This is based on use of OFA (or equivalent) to give emissions at 500 mg/m³ and an annual load factor of 80%. 80% load factor is considered adequate to meet future needs.

¹⁹ Assumes FGD availability of 97.5%.

²⁰ Note that coal sulphur contents and corresponding generation levels are examples of what is feasible within the B Limit in a given year but the actual output and coal sulphur content will vary from year to year, in response to market conditions and other factors. The B Limits have been set to give sufficient flexibility for operators to respond whilst still achieving a level of performance consistent with the application of BAT.

²¹ Note the Site NOx Release Limits in Table 1.

2.2.6 Applying the same methodology, the down-firing LCP at Aberthaw burning low volatile coals would be allocated a transferable NO_x B Limit at **27.9 kt NO_x/year per GWe²¹**. This is calculated from an emission factor²² of 1100 mg/m³ and the 80% annual load factor used for other FGD plant. This allocation would be reviewed in 2012 under a PPC Improvement Condition, to reflect experience with dynamic classifiers and whether further controls were fitted as a result of the PPC determination and installation BAT assessment.

2.3 Detailed arrangements for all B Limits

Detailed arrangements will be developed for managing the B-Limits for all opted-in and opted-out LCP, based on the following:

- B Limits will be allocated based on generation capacity at the time of issue of the PPC permit and not changed (apart possibly NO_x at Aberthaw – see section 2.2.6) unless the LCP is closed.
- B Limits and the NERP are allocated on a different basis, so the two schemes must be separate. B Limits will only be transferable between LCP with B Limits and not with those within the NERP.
- B Limits allocated to opted-in (ELV) and opted-out LCP are transferable between these sub-sectors;
- Transfers between operators will be notified to us in a standard declaration made jointly, copied to the public registers.
- Changes in the division of B Limits amongst the operator's portfolio of LCP will be notified to us using a standard form.
- B Limit can only transferred within the calendar year concerned.
- Compliance with B Limits will be assessed at calendar year end; i.e. there is no reconciliation period after year-end.
- Compliance against the limits will be assessed using continuous emission monitors (CEMs).
- B Limits do not include emissions during start-up and shutdown.
- If an LCP is closed, the B Limits for its operator will be accordingly reduced.
- We will maintain an up-to-date register of B Limits that will be available to the public.

²² An emission factor of 1100 mg/m³ assumes some improvement on current performance of 1200 mg/m³, based on development of combustion optimisation and including a contribution made by introducing dynamic size classifiers.

3. LCP THAT MEET THE REQUIREMENTS OF LCPD ARTICLE 5(1) AND NOTE 2 TO ANNEX VI: THE 2,000 HOUR OPTION ('OPTED-IN')

These plants will not operate more than 2,000 h per year, as a rolling average over a period of five years. Operators will need to identify any such plant in their PPC application. Their PPC permits will limit them to this operating regime from 1 January 2008 and will set BAT-based ELVs accordingly. After that date it would be necessary to apply for a PPC Variation and to fit FGD (or equivalent measures) before being allowed to operate at higher load factors.

We consider that only LCP firing high volatile coal might fall into this category. If operators of other types of LCP approach us with plans to use this route, then we will address it after 3 February 2006.

3.1 ELV from 1 January 2008

ELV for SO₂

3.1.1 It is not considered economic to fit FGD to LCP taking this LCPD option. Sector-level BAT to minimise emissions of SO₂ will therefore be use of low sulphur coal. We have undertaken work assessing its availability²³, indicating it is widely available for import down to about 0.5% sulphur and supply becomes somewhat more limited below about 0.35%. (This is consistent with the qualities of coal now being fired).

3.1.2 Hence, LCP taking this route will need to meet at least the LCPD ELV, which corresponds to coal sulphur content of about 0.35%. Sector-level BAT would be delivered using the compliance requirements of LCPD Article 14 regarding the **800 mg/m³ SO₂ ELV** set out in Article 5.1 of the Directive. Compliance will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs. See definitions of start-up and shutdown in Annex D.

ELV for NO_x

3.1.3 Sector-level BAT for these LCP is use of low NO_x burners and OFA (or equivalent measures).

3.1.4 LCP burning high volatile coal would have a sector-level BAT based annual ELV of **1.8 t NO_x/GWh** generated, set to achieve performance equivalent to 500 mg NO_x/m³ (at 6% O₂, dry); i.e. use of OFA.

3.1.5 They will also need to meet at least the requirements of LCPD Article 14 regarding the **600mg/m³ ELV** set out in note 2 of Annex VIA of the

²³ Hugh M Lee for OXERA (2003), 'The Availability of Low Sulphur Coal', July 28th with associated spreadsheets Conx982coalp on coal ports & Conx985 on coal supplies, and PPA for OXERA (2003), 'Briefing Note on the Impact of Coal Composition on the Operation of a Coal-fired Power Station, with Particular Reference to Sulphur', July.

Directive²⁴. Compliance will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.

ELV for Particulates

- 3.1.6 Sector-level BAT for these LCP is use of electrostatic precipitators. This gives an emission benchmark of 50 mg/m³ (monthly average).
- 3.1.7 Hence, sector-level BAT would be met through the compliance requirements of LCPD Article 14 regarding the **50 mg/m³** particulate ELV set out in Annex VIIA of the LCPD. Compliance will typically be assessed using a load-weighted average of the validated 48 hourly averages from all the operational boilers comprising the LCP¹⁶. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs. An interpretative protocol will be developed.

3.2 B Limits from 1 January 2008

See section 2.3 for arrangements for B Limits.

SO₂ B-Limits

- 3.2.1 Transferable Operator SO₂ B-Limits would be allocated to operators at **9.0 kt/year per GWe** of net installed capacity. This gives parity with all the other coal-fired LCP covered here. This limit excludes emissions during start-up and shutdown.

NO_x B-Limits

- 3.2.2 Transferable Operator NO_x B-Limits would be allocated to these LCP at **5.6 kt/year per GWe**. This corresponds to the annual load factor possible within the SO₂ allocation, assuming use of OFA (or equivalent). This limit excludes emissions during start-up and shutdown.

²⁴ See Note 3 of Annex VIA of the LCPD for derogation for low volatile coals.

4. LCP THAT MEET THE REQUIREMENTS OF LCPD ARTICLE 4(3)(b): THE 'NERP OPTION' (OPTED-IN)

These LCP primarily must meet the requirements of the IPPC Directive, notably through having ELVs based upon the application of BAT. They must also meet the requirements of Article 4(3)(b) and other Articles of the LCPD. They will be contributors to the SO₂, NO_x and particulate bubbles allocated by Defra⁶ according to Article 4(6) of the Directive.

B Limits will be unnecessary for LCP under a NERP, as the allocation methodology produces smaller allocations than the BAT-base B Limit approach.

No oil-fired LCP are expected to fall into this category, so they are not considered.

4.1 ELV from 1 January 2008

ELV for SO₂

4.1.1 We consider that by 1 Jan 2008 operators should have had sufficient time to upgrade these LCP to FGD (or an equivalent), i.e. as close as possible to BAT for new plant¹⁴. Sector-level BAT is based on use of FGD at 90% collection efficiency on a UK coal of 1.75% sulphur to give 400 mg SO₂/m³, giving an annual emission benchmark of 1.8 t SO₂/GWh generated.

4.1.2 From 1 January 2008, LCP under a NERP would have to meet an annual ELV of **1.8 t SO₂/GWh** generated, corresponding to a benchmark concentration of 400 mg/m³. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs. See definitions of start-up and shutdown in Annex D.

ELV for NO_x

4.1.3 For coal-fired LCP, the BREF¹⁰ indicates that low NO_x burners plus Selective Catalytic Reduction (SCR) is sector-level BAT. We have concluded that SCR and Reburn are not economic to retrofit on existing coal and oil-fired LCP at the present time. We consider sector-level BAT for all opted-in and opted-out LCP firing high volatile coal to be low NO_x burners and OFA (or equivalent measures). It is not feasible to require OFA earlier than 2008.

4.1.4 LCP under a NERP would have to meet an annual ELV of **1.8 t NO_x/GWh** generated, to emit at a benchmark concentration of 500 mg/m³ corresponding to use of OFA. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.

4.1.5 BAT for NO_x control on opted-in LCP at Aberthaw designed to operate on low volatile coal will be determined on the basis of its PPC application. It may comprise some combination of the established technique of Thermal Input Biasing; the dynamic classifier technology currently being trialed; SCR; and/or other techniques. An annual ELV will be set based on BAT.

ELV for Particulates

- 4.1.6 Electrostatic precipitators and FGD¹⁸ will continue to be regarded as sector-level BAT for particulate control on coal-fired LCP. This gives emission benchmarks of 25 mg/m³ for LCP with FGD and 50 mg/m³ for LCP without FGD (monthly averages). These benchmarks will be used as reference points in determining installation specific BAT and corresponding ELV. An interpretative protocol will be developed.
- 4.1.7 The LCP at Uskmouth has bag filters. A BAT-based ELV would be set in determining its PPC application, at least matching LCPD requirements.

4.2 NERP Limits from 1 January 2008

Detailed arrangements will be developed for managing NERP Limits. Our initial proposals are as follows:

- Initial NERP allocations will be made by Defra and the Welsh Assembly Government and allocated to an operator in their PPC permit as *Operator NERP Limit*.
- Operator NERP Limits will be transferable between operators of LCP in the electricity and other sectors in the NERP.
- Operator NERP Limits will be divided amongst the qualifying NERP LCP they operate, as *LCP NERP Limits*. Thus, the NERP system will have some strong similarities in the way they are set in permits and administered to B Limits.
- However, NERP Limits are not interchangeable with B Limits, as they are allocated on a different basis.
- Transfers between operators will be notified to us in a standard declaration made jointly, copied to the public registers.
- Changes in the division of NERP amongst the operator's portfolio of LCP will be notified to us using a standard form.
- NERP transfers can only occur within the calendar year concerned.
- Compliance with NERP Limits will be assessed at calendar year-end; i.e. there is no reconciliation period after year-end.
- Compliance against the limits will be assessed using CEMs.
- NERP Limits do not include emissions during start-up and shutdown.
- Temporary closure or expansion of an LCP would not cause a change in NERP allocation but complete closure would result in a corresponding reduction in the NERP allocation for its Operator.
- A NERP registry will be established and published.

5. LCP OPTED OUT UNDER ARTICLE 4(a) OF THE LCPD

Operators may make a declaration under Article 4(a) of the LCPD, stating they will not operate an LCP for more than 20,000 hours starting from 1 January 2008 and ending no later than 31 December 2015. That LCP must then close.

5.1 ELV from 1 January 2008

ELV for SO₂

- 5.1.1 It is not considered economic to fit FGD to LCP taking this LCPD option. Sector-level BAT to minimise emissions of SO₂ will therefore be use of low sulphur coal. Rather than set a limit on coal sulphur content, BAT would be achieved in a more flexible way by setting an annual ELV and a B Limit, along with other measures. They would have an annual ELV of **7.5 t SO₂/GWh** generated. This corresponds to about 0.9% sulphur coal (if burning coal only) and an SO₂ emission concentration of about 2,000 mg/m³ (at 6% O₂, dry). (Note that we expect the B Limit to be a more limiting constraint for these LCP). Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.
- 5.1.2 All existing oil-fired LCP will have to meet the requirements of the SCLF, see Table 2. It is not therefore considered necessary to set an SO₂ ELV for oil-fired opted-out LCP. (Note 1% sulphur heavy fuel oil is equivalent to 5.5 t SO₂ per GWh).

ELV for NO_x

- 5.1.3 Opted-out LCP burning high volatile coal would have a BAT-based annual ELV of **1.8 t NO_x/GWh** generated. This corresponds to about 500 mg NO_x/m³ (at 6% O₂, dry), i.e. use of OFA (or equivalent). Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.
- 5.1.4 For oil-fired LCP, the BREF¹⁰ states that low NO_x burners plus SCR or other end-of-pipe techniques are sector-level BAT. However, load factors at oil-fired power stations are very low and therefore only low NO_x burners are considered as being economic. Hence, we consider sector-level BAT for opted-out oil-fired LCP to be based on the use of low NO_x burners to emit at a benchmark concentration of up to 1400 mg NO_x/m³ (dry), as implemented through an annual ELV of **4.4 t NO_x/GWh** generated. Emissions during start-up and shutdown will be excluded for the purposes of reporting and assessing compliance with ELVs.

ELV for Particulates

- 5.1.5 Sector-level BAT for these LCP is use of electrostatic precipitators. This gives an emission benchmark of **50 mg/m³** (monthly average). A monthly ELV will be set having regard to this benchmark. An interpretative protocol will be developed.

- 5.1.6 Sector-level BAT for an opted-out oil-fired LCP at significant load factors would be use of electrostatic precipitators and emission at a benchmark concentration of **30 mg/m³** (monthly average). However, assessment of BAT at low load factors will be necessary as part of determining the PPC application before setting an ELV.

5.2 B Limits from 1 January 2008

See section 2.3 for arrangements for B Limits.

SO₂ B-Limits

- 5.2.1 For opted-out LCP, use of low sulphur coals is sector-level BAT. Transferable Operator SO₂ B-Limits would be allocated to operators of opted-out LCP at the same level as opted-in, to give a degree of FGD equivalence: at **9.0 kt/year per GWe** of net installed capacity. With this level of allocation, an opted-out LCP could use coals with an average sulphur content of 0.43% to run at an annual load factor of 28.5%, i.e. 20,000h spread evenly over 8 years. This is an operator limit so higher load factors would be achievable through a number of strategies at this or other LCP, including use of lower sulphur coals, biomass co-firing and obtaining more B Limit (from within an operator's portfolio or by purchase). This limit excludes emissions during start-up and shutdown.
- 5.2.2 Transferable Operator B Limit allocations for opted-out oil-fired LCP would be based on 5% load factor (allowing for some increased demand on these LCP), giving **2.4 kt SO₂/year per GWe** (calculated from 5.5 t SO₂/GWh). This limit excludes emissions during start-up and shutdown.

NO_x B Limits

- 5.2.3 Opted-out LCP are expected to invest in OFA (or equivalent). There is little common scope to reduce emissions further without yet more investment in LCP that is being run down (in capital investment terms) for closure. In assessing sector-level BAT it is also recognised that if the NO_x cap were more restrictive on load factor than the SO₂ cap this would be counterproductive, given SO₂ emissions are a higher priority. Hence, from 1 January 2008, transferable Operator NO_x B Limits would be allocated to opted-out coal-fired LCP at **6.5 kt NO_x/year per GWe**. This is what is achievable with OFA (or equivalent) and if operators use say 0.3% sulphur coal to maximise their load factor to 41% within the SO₂ cap. This limit excludes emissions during start-up and shutdown.
- 5.2.4 Transferable B Limit allocations for oil-fired LCP would be based on 5% load factor (allowing for some increased demand on these LCP), giving **1.9 kt NO_x/year per GWe** (from 4.4 t NO_x/GWh). This limit excludes emissions during start-up and shutdown.

6. PROTECTION OF LOCAL AIR QUALITY

6.1 Emissions of SO₂, NO_x and, to a lesser extent particulates, have an effect on local air quality. These will continue to be addressed through:

1. A permit condition requiring that emissions from a station must not cause a breach of EU air quality standards or contribute significantly to a local failure to meet national air quality objectives.
2. Annual mass limits on emissions of SO₂ (A-Limits) and NO_x (Site Annual Release Limits).
3. An Air Quality Management Plan (AQMP).
4. Monitoring of air quality in the vicinity of stations.

6.2 AQMP have been in operation at the coal and oil-fired power stations since 2001 and aim to ensure that emissions do not result in a breach of EU air quality standards or contribute significantly to a local failure to meet national air quality objectives²⁵. The main features of the AQMP are:

1. Demonstration that the anticipated generation scenario and anticipated fuel sulphur for future years will be compliant with air quality objectives by dispersion modelling.
2. A continuous comparison of the number of exceedences monitored at sites close to maximum impact locations with the number anticipated for the planned compliant operational scenario and an assessment of the implications for year end compliance.
3. The development of a number of methodologies for monitoring impacts, dispersion modelling of both retrospective and future station operation, to judge compliance with AQS objectives and to manage the risk of non-compliance associated with load and fuel-sulphur options.
4. An annual review which includes: an appraisal of actual impacts during the preceding year; an update on anticipated impacts for the next year using the latest information on anticipated operating pattern and fuel burn; and proposed management actions which might be required to ensure compliance.

²⁵ JEP (2005), *Managing power station ambient air quality compliance – an overview of the Air Quality Management Plan process.*

7. OTHER LEGISLATIVE REQUIREMENTS

The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000

- 7.1 Sulphur in oil fuels is limited by Statutory Instrument 2000 No. 1460, The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000 (SCLF) – see Table 2.

Table 2: Limits on S content of liquid fuels (%w)

Fuel	Limit
Heavy fuel oil	1.0 ¹
Gas oil	0.1 ²

Note: 1. Or a permit condition setting an ELV of 1700 mg/m³.

2. The limit for S in gas oil drops from 0.2 to 0.1 from 1 January 2008

National Emissions Ceiling Directive

- 7.2 The NECD sets targets for the UK in 2010 of 585 kt SO₂ and 1167 kt of NO_x emissions. The LCP in Table 1 are the biggest source of SO₂ in England and Wales. Road transport is the largest source of NO_x but large (coal-fired) LCP are also a major source.

Habitats Directive

- 7.3 The introduction of PPC will require assessments under the Habitats Directive and may lead to tighter limitations on releases of SO₂ and NO_x at specific stations to protect Natura 2000 sites.

Other LCPD provisions

- 7.4 This document highlights the major LCPD provisions. However, the Directive contains a range of other provisions for which protocols will be developed separately. These include:
- the LCPD includes emission monitoring requirements. These have been incorporated into IPC Authorisations and are being implemented under a timetable agreed between us and industry. This joint work will also produce National Guidance for the use of Continuous Emissions Monitors to determine compliance with regulatory requirements.
 - a protocol that is being developed to deal with circumstances in which an operator wishes to continue to run a LCP where the abatement equipment has broken down³. Conditions will be imposed which deliver the requirements of Article 7 of the LCPD. There will be no increase in B Limit or NERP in the event of FGD breakdown. The 120-hour criterion within Article 7 will only be triggered when the LCP fails to comply with emission limits due to abatement equipment malfunction.

8. CONCLUSIONS

- 8.1 A Framework has been developed to deliver significant reductions in emissions of SO₂, NO_x and particulates from LCP at coal- and oil-fired power stations through to 31 December 2015, consistent with the legal requirements.
- 8.2 The approach contributes to our modernising agenda by setting long-term goals and the use of market mechanisms, as far as consistent with the legal requirements.
- 8.3 The Framework gives site-specific requirements which taken together provide a sector cap on emissions of SO₂ and NO_x, which will facilitate the Government meeting UK obligations for emission reductions under the NECD.
- 8.4 The Framework should allow coal and oil fired stations to play a full role in meeting electricity demand in the run up to 31 December 2015.

APPENDIX A: GLOSSARY OF TERMS

AQMP	Air Quality Management Plan
BAT	Best Available Techniques
BREF	BAT reference document prepared and published by the European Commission.
CEM	continuous emissions monitors
ELV	emission limit value
EU ETS	EU Emissions Trading Scheme
FGD	Flue-Gas Desulphurisation
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
JEP	Joint Environmental Programme of coal- and oil-fired power station operators
LCPD	Large Combustion Plants Directive
NECD	National Emissions Ceiling Directive
NERP	National Emission Reduction Plan
OFA	Over Fire Air
SCLF	The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000
SCR	Selective Catalytic Reduction

APPENDIX B: SUMMARY OF PROPOSED CONTROLS FROM 1 JANUARY 2008

Control	Reason	ELV	2,000h ELV	NERP	Opted-out
COAL-FIRED LCP					
Sulphur dioxide					
FGD (or equivalent) or use low S coal	IPPC – BAT	♦	♦	♦	♦
Annual ELV ¹ (t SO ₂ /GWh)	IPPC – BAT			♦	♦
AQMP	Deliver air quality compliance	♦	♦	♦	♦
Station A Limit (t SO ₂ /year)	Control for air quality, Habitats Directive.	♦	♦	♦	♦
Transferable B Limit allocated at 9.0 kt SO ₂ /year per GWe	Minimise acidification under PPC	♦	♦		♦
2,000 operating hours (5 y rolling average)	LCPD requirement		♦		
20,000 operating hours between 1/1/2008 and 31/12/2015.	LCPD requirement				♦
Monthly and 48h ELV	IPPC – BAT but which cannot be less stringent than those set out in the LCPD	♦	♦		
A tradable NERP bubble set by Defra	LCPD option			♦	
Nitrogen oxides					
OFA (or equivalent)	IPPC - BAT	♦	♦	♦	♦
Annual ELV ¹ (t NO _x /GWh)	IPPC - BAT		♦	♦	♦
AQMP	Deliver air quality compliance	♦	♦	♦	♦
Site NO _x Release Limit (t NO _x /year)	Control for air quality, Habitats Directive.	♦	♦	♦	♦
Transferable NO _x B Limit	Minimise acidification & eutrophication under PPC	♦	♦		♦
Monthly and 48h ELV	IPPC – BAT but which cannot be less stringent than those set out in the LCPD	♦	♦		
A tradable NERP bubble set by Defra	LCPD option			♦	
Particulates					
Electrostatic precipitators	IPPC – BAT	♦	♦	♦	♦
ELV of 25 mg/m ³ (FGD)	IPPC – BAT	♦	♦	♦	♦

or 50 mg/m ³ (non-FGD) ⁷					
Monthly and 48h ELV	IPPC – BAT but which cannot be less stringent than those set out in the LCPD	◆	◆		
AQMP	Deliver air quality compliance	◆	◆	◆	◆
A tradable NERP bubble set by Defra	LCPD option			◆	
OIL-FIRED LCP					
Sulphur dioxide					
Sulphur in fuel	SCLF ³ & IPPC - BAT				◆
AQMP	Deliver air quality compliance with a minimum of constraints & BAT	These LCP are expected to be opted-out. If operators approach us with plans to use another route, then we will address it after 3 February 2006.			◆
Station A Limit (t SO ₂ /year)	Control for air quality, Habitats Directive ^{1,2}				◆
Transferable Operator B Limit allocated at 2.4 kt SO ₂ /GWe	Minimise acidification under PPC				◆
20,000 operating hours between 1/1/2008 and 31/12/2015.	LCPD requirement				◆
Nitrogen oxides					
BAT technique: low NOx burners	IPPC - BAT				◆
Annual ELV ¹ (t NOx/GWh)	IPPC - BAT				◆
AQMP	Deliver air quality compliance				◆
Site NOx Release Limit (t NOx/year)	Control for air quality, Habitats Directive				◆
Transferable NOx B Limit	Minimise acidification & eutrophication under PPC				◆
Particulates					
Electrostatic precipitators ⁴	IPPC - BAT				◆
AQMP	Deliver air quality compliance				◆
ELV ⁴ of 30 mg/m ³	IPPC - BAT				◆

Notes:

1. Delivery of BAT and protection of environmental quality standards under PPC will use a package of technical measures to supplement ELV for SO₂, NOx and particulates.
2. An appropriate assessment is required under the Habitats Directive before the PPC permit can be issued. This may be implemented by reducing the corresponding Station A Limit and/or Site NOx Release Limit.
3. Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000, SI2000 No 1460.

4. Oil-fired LCP has very low load factor. This has implications in assessing site specific BAT, i.e. the need for electrostatic precipitators. Where precipitators are not justified then higher ELV may be set, with corresponding limitations on load factor.