www.defra.gov.uk

Process Guidance Note 1/04 (11)

Statutory Guidance for Gas Turbines 20 – 50MW Thermal Input

Revised October 2011

Department of the Environment

www.doeni.gov.uk

Defra would like to acknowledge the work of the Environment Agency's Local Authority Unit in the drafting of this guidance note.

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR

Tel: 020 7238 6000
Website: www.defra.gov.uk

Information about this publication and copies are available from:

Atmosphere and Local Environment
Defra
Area 5F
Ergon House
Horseferry Road
London
SW1P 2AL

Email: Control.Pollution@defra.gsi.gov.uk

This document is available on the Defra website:

Published by the Department for Environment, Food and Rural Affairs

Revision of the Guidance

The electronic version of this publication is updated from time to time with new or amended guidance. The table below is an index to the latest changes (minor amendments are generally not listed).

Date of amendment	**Section/paragraph where amendment can be found**	**Nature of amendment** what paragraphs have been inserted, deleted or amended what subject matter is covered by amendment

Contents

1. Introduction

Legal basis

1.1 This note applies to the whole of the UK. It is issued by the Secretary of State, the Welsh Assembly Government, the Scottish Government and the Department of the Environment in Northern Ireland, (DoE NI), to give guidance on the conditions appropriate for the control of emissions into the air from gas turbine 20-50MW rated thermal input sector. It is published only in electronic form and can be found on the Defra website. It supersedes PG1/04 (95) as amended by AQ 24(04).

1.2 This guidance document is compliant with the Code of Practice on Guidance on Regulation page 6 of which contain the "golden rules of good guidance". If you feel this guidance breaches the code or you notice any inaccuracies within the guidance, please contact us.

1.3 This is one of a series of statutory notes[1] giving guidance on the Best Available Techniques (BAT)[2]. The notes are all aimed at providing a strong framework for consistent and transparent regulation of installations regulated under the statutory Local Air Pollution Prevention and Control (LAPPC) regime in England and Wales, Scotland and Northern Ireland. The note will be treated as one of the material considerations when determining any appeals against a decision made under this legislation.

1.4 In general terms, what is BAT for one installation in a sector is likely to be BAT for a comparable installation. Consistency is important where circumstances are the same. However, in each case it is, in practice, for regulators (subject to appeal) to decide what is BAT for each individual installation, taking into account variable factors such as the configuration, size and other individual characteristics of the installation, as well as the locality (e.g. proximity to particularly sensitive receptors).

1.5 The note also, where appropriate, gives details of any mandatory requirements affecting air emissions which are in force at the time of publication, such as those contained in Regulations or in Directions from the Government. In the case of this note, at the time of publication there were no such mandatory requirements.

[1] this and other notes in the series are issued as statutory guidance in England and Wales under regulation 64(2) of the Environmental Permitting Regulations. The notes are also issued as statutory guidance in Northern Ireland and as guidance in Scotland.
[2] further guidance on the meaning of BAT can be found for England and Wales, Scotland, and Northern Ireland.

1.6 In Section 4 and Section 5, arrows are used to indicate the matters which should be considered for inclusion as permit conditions. It is important to note, however, that this should not be taken as a short cut for regulators to a proper determination of BAT or to disregard the explanatory material which accompanies the arrows. In individual cases it may be justified to:

- include additional conditions
- include different conditions
- not include conditions relating to some of the matters indicated.

In addition, conditions will need to be derived from other parts of the note, in particular to specify emission limits, compliance deadlines and mandatory requirements arising from directions or other legislation.

Who is the guidance for?

1.7 This guidance is for:

Regulators

- local authorities in England and Wales, who must have regard to the guidance when determining applications for permits and reviewing extant permits;
- the Scottish Environment Protection Agency (SEPA) in Scotland, and district councils or the Northern Ireland Environment Agency, (NIEA), in Northern Ireland.

Operators who are best advised also to have regard to it when making applications and in the subsequent operation of their installation.

Members of the public who may be interested to know what the Government considers, in accordance with the legislation, amounts to appropriate conditions for controlling air emissions for the generality of installations in this particular industry sector.

Updating the guidance

The guidance is based on the state of knowledge and understanding, at the time of writing, of what constitutes BAT for this sector. The note may be amended from time to time to keep up with developments in BAT, including improvements in techniques, changes to the economic parameters, and new understanding of environmental impacts and risks. The updated version will replace the previous version on the Defra website and will include an index to the amendments.

1.8 Reasonable steps will be taken to keep the guidance up-to-date to ensure that those who need to know about changes to the guidance are informed of any published revisions. However, because there can be rapid changes to matters referred to in the guidance – for example to legislation – it should not be assumed that the most recent version of this note reflects the very latest legal requirements; these requirements apply.

Consultation

1.9 This note has been produced in consultation with relevant trade bodies, representatives of regulators including members of the Industrial Pollution Liaison Committee, and other potentially-interested organisations.

Policy and procedures

1.10 General guidance explaining LAPPC and setting out the policy and procedures is contained in separate documents for England and Wales, Scotland and Northern Ireland.

When to use another note rather than PG1/04

1.11 This note covers gas turbines:

- on their own,
- in CHP, with supplementary firing
- in CHP, without supplementary firing

1.12 PG1/3 applies to boilers and furnaces, (individual appliances not aggregated 20-50MWth, and site less than 50MWth aggregated)

1.13 PG1/5 applies to compression ignition engines, (individual appliances not aggregated 20-50MWth, and site less than 50MWth aggregated).

2. Timetable for compliance and reviews

Existing processes or activities

2.1 This note contains all the provisions from previous editions which have not been amended or removed. For installations in operation at the date this note is published, the regulator should have already issued or varied the permit having regard to the previous editions. If they have not done so, this should now be done.

2.2 The new provisions of this note and the dates by which compliance with these provisions is expected are listed in the table below, together with the paragraph number where the provision is to be found. Compliance with the new provisions should normally be achieved by the dates shown. Permits should be varied as necessary, having regard to the changes and the timetable.

Table 1: Compliance timetable

Guidance	Relevant Paragraph/Row in this Note	Compliance Date
No new provisions		

2.3 Replacement plant should normally be designed to meet the appropriate standards specified for new installations/activities.

2.4 Where provisions in the preceding guidance note have been deleted or relaxed, permits should be varied as necessary as soon as reasonably practicable. Section 6 provides a summary of all changes.

2.5 For new activities, the permit should have regard to the full standards of this guidance from the first day of operation.

2.6 For substantially changed activities, the permit should normally have regard to the full standards of this guidance with respect to the parts of the activity that have been substantially changed and any part of the activity affected by the change, from the first day of operation.

2.7 The following are examples of changes to a turbine likely to be substantial for the purposes of the permit legislation:

- conversion from gas firing to oil firing;
- A significant increase in the number of operational hours per calendar year, such as a change from emergency to base load use.

Permit Reviews

2.8 Under LAPPC the legislation requires permits to be reviewed periodically but does not specify a frequency. It is considered for this sector that a frequency of once every eight years ought normally to be sufficient for the purposes of the appropriate Regulations[3]. Further guidance on permit reviews is contained in the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland. Regulators should use any opportunities to determine the variations to permits necessitated by paragraph 2.2 above in conjunction with these reviews.

2.9 Conditions should also be reviewed where complaint is attributable to the operation of the process and is, in the opinion of the regulator, justified.

[3] For details see England and Wales chapter 26, Scotland, Practical guide section 10, Northern Ireland Part B Guidance page 9, Northern Ireland Part C Guidance chapter 17.

3. Activity description

Regulations

3.1 This note applies to LAPPC installations for the gas turbine 20-50MW sector. The activities are listed for regulation as follows.

Table 2: Regulations listing activities

LAPPC	Activity	England and Wales	Scotland	Northern Ireland
		EPR Schedule 1 reference	**PPC Schedule 1 reference**	**PPC Schedule 1 reference**
Part A	Combustion 50MW or more rated thermal input, on one site	Section 1.1 Part A1	Section 1.1 Part A	Section 1.1 Part A
Part B	Gas turbine, 20MW or more net rated thermal input, in one appliance, but less than Part A	Section 1.1 Part B	Section 1.1, Part B	n/a
Part C	Gas turbine, 20MW or more net rated thermal input, in one appliance, but less than Part A	n/a	n/a	Section 1.1 Part C
The links are to the original version of the Regulations. A consolidated version is not available on www.legislation.co.uk				

3.2 This Note refers to the burning of any fuel in a gas turbine with a net rated thermal input of 20 MW or more, but less than 50 MW rated thermal input.

- The figure of 20 MW net rated thermal refers to the individual rating of a single gas turbine; it is not aggregated; it is net rated thermal input
- The figure of 50 MW rated thermal refers to the aggregate rating of one or more combustion appliances on the same site; it is aggregated; it is rated thermal input.

3.3 Where a gas turbine is used in a combined heat and power scheme, and the net rated thermal input of either the turbine or the supplementary firing to the waste heat boiler exceeds 20 MW, a permit will be necessary.

3.4 However, if the 20 MW threshold is only reached by aggregation of the net rated thermal inputs of the turbine and the supplementary firing to the waste heat boiler then a permit will not be necessary.

3.5 If there is:

- more than one turbine on site and their aggregate net rated thermal inputs exceed 50 MW, or
- there is more than one waste heat. boiler on site and their net rated thermal inputs exceed 50 MW, or
- there is an individual turbine or an individual waste heat boiler on site with a net rated thermal input in excess of 50 MW, then the whole installation will fall within the Part A definition in Table 2.

3.6 "Net rated thermal input" should be taken as the rate at which fuel can be burned, at maximum continuous rating, multiplied by the net calorific value of the fuel and expressed as megawatts thermal (MWth). If the combustion appliance has been derated by physical modification which prevents fuel consumption taking place at the previous rate without further modification, then the maximum continuous rating may be taken as being that rating which can be achieved by the appliance in its derated form.

Gas turbine

3.7 The industrial gas turbine is an internal combustion engine which produces power by the controlled burning of fuel. A compressor draws in clean filtered ambient air and compresses it. Fuel is mixed into a proportion of this air in a combustion chamber and ignited. The heat produced creates a rapid expansion of the gas. Controlled addition of further compressed air forms the flame and controls the temperature at a level compatible with the materials of construction of the turbine.

3.8 The expanding gases are fed through a turbine which drives the air compressor and the remaining power is used to drive a load such as an alternator, compressor or pump. Although most of the energy is removed from the gas flow by the turbines, the exhaust gases leaving the turbine are still hot, typically about 500°C. In a combined cycle plant some of this energy is recovered in a waste heat boiler. The steam raised is directed to an additional steam turbine and alternator , increasing the overall efficiency. If the heat contained in the turbine exhaust is insufficient to meet the steam raising duty, additional fuel may be fired in the gas turbine exhaust. The burning of additional fuel is often referred to as supplementary firing

Combined Heat and Power (CHP)

3.9 In combined heat and power (CHP) installations the heat in the turbine exhaust is used, for example, to generate steam or hot water in a waste heat boiler or directly in the drying of process materials. Additional fuel can be fired in the turbine exhaust. Overall efficiencies of up to about 85% are possible. Gas turbines in the range covered by this Note may be used as prime movers for CHP installations such as in hospitals and universities.

Light and heavy turbines

3.10 There are two basic types of industrial gas turbine-the lightweight, aero-derived unit and the heavyweight units derived from steam turbine technology. Turbines in the range 20-50 MW th are likely to fall into the former category.

3.11 The aero-derived type of gas turbine is more adaptable to variable loads than the heavyweight and is therefore used for electrical peaking applications. It is also widely used for base load gas and oil pumping, electrical power generation and CHP applications. The turbine may contain more than one output shaft to obtain optimum performance from different stages of gas expansion and air compression.

3.12 Heavyweight gas turbines are used mainly for electrical generation and CHP plants. They are often built with the compressor, turbine and power turbine on a single shaft. On start-up the complete rotor assembly is accelerated to a self-sustaining speed, usually by a diesel engine or electric motor. They are used for power generation as they can maintain good speed control in the event of loss of electrical load. The single shaft machine is not suitable in situations where loads are variable, such as gas pumping. Some heavyweight gas turbines therefore have a two shaft configuration which allows greater flexibility.

4. Emission limits, monitoring and other provisions

4.1 Emissions of the substances listed Table 3 below should be controlled.

4.2 The emission limit values and provisions described in this section are achievable using the best available techniques described in Section 5. Monitoring of emissions should be carried out according to the method specified in this section or by an equivalent method agreed by the regulator. Where reference is made to a British, European, or International standard (BS, CEN or ISO) in this section, the standards referred to are correct at the date of publication. (Users of this note should bear in mind that the standards are periodically amended, updated or replaced. The latest information regarding the monitoring standards applicable can be found at the Source Testing Association website. Further information on monitoring can be found in Environment Agency publications (M1) and (M2)).

4.3 All activities should comply with the emission limits and provisions with regard to releases in Table 3.

The reference conditions for limits in Section 4 are: 273.1K, 101.3kPa, dry gas, 15%v/v oxygen

Table 3 should be considered in conjunction with the monitoring paragraphs found later in this section

Table 3: Emission limits, monitoring and other provisions

Row	Substance	Source	Emission limit/ provisions	Type of monitoring	Monitoring frequency
Natural gas fired turbines (not CHP)					
1	NOx expressed as NO2	Turbines operating less than 100hours a year from date of initial permit	400mg/m3	quantitative	6 monthly
2	NOx expressed as NO2	Turbines operating for more than 100 hours per year and "existing" at 6 October 2004	125mg/m3 note 1	quantitative	6 monthly
3	NOx expressed as NO2	Other gas fired turbines operating more than 100 hours a year	60mg/m3 note 1	quantitative	6 monthly
4	CO		60mg/m3 note 1 and note 3	quantitative	6 monthly
5	Sulphur dioxide	Turbines burning gas oil as standby	0.1 w/w sulphur in oil	Sulphur content of fuel is regulated by other arms of government	
Liquid Fuel or Petroleum Derived Gas Fired (not CHP)					
6	NOx expressed as NO2	Turbines operating for less than 100 hours per year from date of initial permit	600mg/m3	quantitative	6 monthly
7	NOx expressed as NO2	Turbines operating for more than 100 hours per year and "existing" at 6 October 2004.	165mg/m3 note 1	quantitative	6 monthly
8	NOx expressed as NO2	Other liquid or lpg fired turbines operating for more than 100 hours per year	125mg/m3 note 1	quantitative	6 monthly
9	CO		60mg/m3 note 1 and 3	quantitative	6 monthly
10	Particulate matter			Continuously indicative monitor and record smoke and particulate	
11	Sulphur dioxide	Turbines burning gas oil	0.1 w/w sulphur in oil	Sulphur content of fuel is regulated by other arms of government	

	Source	Substance	Emission limit/ provisions	
Combined Heat and Power - Turbines and supplementary firing see note 6; note 1 is not used				
12	Natural gas fired turbines	NOx expressed as NO_2	100mg/MJ	Calculate NOx every 3 months Measure particulate every
13	Liquid and lpg fired turbines	NOx expressed as NO_2	150mg/MJ	
14	Supplementary firing using natural gas	NOx expressed as NO_2	30mg/MJ	

15	Supplementary firing using liquid fuels inc gas oil - note 4	NOx expressed as NO2	50mg/MJ	12 months if both: Oil is burnt, and Particulate abatement is needed to meet the limit
16	Supplementary firing using liquid fuels such as heavy oil in plant that was new plant from 1 September 1995- note 5	NOx expressed as NO2	75mg/MJ	
17	Supplementary firing using liquid fuels such as heavy oil in plant that was existing plant before 1 September 1995- note 5	NOx expressed as NO2	100mg/MJ	

Note 1 Based upon an efficiency of 30%. For more efficient turbines the emission limit (EL) may be calculated using the following formula:

Corrected EL mg/ m3 = EL mg /m3 x ISO net base efficiency %

30

Note 2 Where turbines normally fired by gas are fired by standby liquid fuel because of an interruption to the gas supply, emissions of nitrogen oxides (expressed as N02) should not exceed 600mg/m3 for the period of the interruption. All such periods should be recorded in the log book.

Note 3 The carbon monoxide limit should be applied when the plant is operating at over 70% of capacity

Note 4 paraffin, kerosene and gas oil that is BS2869 classes C1, C2, D1, and D2 distillate fuels

Note 5 light medium and heavy fuel oils, that is BS 2869 classes E, F, G and H residual fuel oils

Note 6 The total nitrogen oxides emission limit for the combined heat and power scheme with supplementary firing is calculated in terms of mg NO, per MJ of energy input as follows:

Nitrogen oxides emission limit (mg/MJ) =

$$\frac{\text{Allowable nitrogen oxides (from gas turbine)} + \text{Allowable nitrogen oxides (from supplementary firing)}}{\text{Maximum continuous rating (MW th) of gas turbine} + \text{Maximum continuous rating (MW th) of the supplementary firing}}$$

-where

"allowable nitrogen oxides from the gas turbine" = nitrogen oxides emission limit from Row 12 or 13 of this Appendix, multiplied by the maximum continuous rating in MW (th) of the turbine,

-and

"allowable nitrogen oxides from the supplementary firing" = nitrogen oxides emission limit from Row 14, 15, 16, or 17 of this Appendix, multiplied by the maximum continuous rating in MW (th) of the supplementary firing.

Monitoring, investigating and reporting

4.4 The operator should monitor emissions, make tests and inspections of the activity. The need for and scope of testing, (including the frequency and time of sampling), will depend on local circumstances.

- The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. The records should be:
  - kept on site
  - kept by the operator for at least two years; and
  - made available for the regulator to examine

4.5 Monitor readings should be on display to operating staff,.

Information required by the regulator

4.6 The regulator needs to be informed of monitoring to be carried out and the results. The results should include process conditions at the time of monitoring.

- The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used.
- The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of completion of the sampling.
- Adverse results from any monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained. The operator should:
  - identify the cause and take corrective action
  - clearly record as much detail as possible regarding the cause and extent of the problem, and the remedial action taken.
  - re-test to demonstrate compliance as soon as possible; and inform the regulator of the steps taken and the re-test results.

Visible Emissions

4.7 Emissions from gas turbines and combustion should in normal operation be free from visible smoke. During start up and shut down the emissions should not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742: 2009

- All other releases to air, other than condensed water vapour, should be free from persistent visible emissions.
- All emissions to air should be free from droplets.
- the monitor for visible emissions should be calibrated to sound an audible alarm in the event of smoke emissions exceeding the equivalent of Shade 1 on the Ringelmann chart. Events when this limit is exceeded should be recorded

Where there are problems that, in the opinion of the regulator, may be attributable to the installation, such as local complaints of visual emissions the operator should inspect in order to find out which operation(s) is the cause.

If this inspection does not lead to correction of the problem then the operator should inform the regulator in order to determine whether ambient air monitoring is necessary. Ambient monitoring may either be by a British Standard method or by a method agreed with the regulator.

Whilst problems are ongoing, a visual check should also be made once per day when an installation is being operated. The time, location and result of these checks, along with weather conditions such as indicative wind direction and strength, should be recorded. Once the source of the emission is known, corrective action should be taken without delay and where appropriate the regulator may want to vary the permit in order to add a condition requiring the particular measure(s) to be undertaken.

Emissions of Odour

4.8 The overall aim should be that all emissions are free from offensive odour outside the site boundary, as perceived by the regulator. And good combustion should achieve that aim.

Abnormal Events

4.9 The operator should respond to problems which may have an adverse effect on emissions to air.

- In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions the operator should:
  - investigate and undertake remedial action immediately
  - adjust the process or activity to minimise those emissions; and
  - promptly record the events and actions taken
- The regulator should be informed without delay, whether or not there is related monitoring showing an adverse result:
  - if there is an emission that is likely to have an effect on the local community; or
  - in the event of the failure of key arrestment plant, for example, bag filtration plant or scrubber units
- The operator should provide a list of key arrestment plant and should have a written procedure for dealing with its failure, in order to minimise any adverse effects

Start up and shutdown

4.10 Higher emissions may occur during start-up and shut-down of a process. These emissions can be reduced, by minimising, where possible, the number of start-ups and shut-downs and having adequate procedures in place for start-up, shut-down and emergency shut-downs.

- The number of start-ups and shut downs should be kept to the minimum that is reasonably practicable.
- All appropriate precautions must be taken to minimise emissions during start-up and shutdown.

Continuous Monitoring

4.11 Continuous monitoring can be either “quantitative” or “indicative”. With quantitative monitoring the discharge of the pollutant(s) of concern is measured and recorded numerically. For pollution control this measurement is normally expressed in milligrams per cubic meter of air, (mg/m3). Where discharge of the pollutant concerned is controlled by measuring an alternative parameter, (the “surrogate” measurement), this surrogate is also expressed numerically.

Continuous indicative monitoring is where a permanent device is fitted, for example, to detect leaks in a bag filter, but the output, whether expressed numerical or not, does not show the true value of the discharge. When connected to a continuous recorder it will show that emissions are gradually (or rapidly) increasing, and therefore maintenance is required. Alternatively it can trigger an alarm when there is a sudden increase in emissions, such as when arrestment plant has failed.

Where continuous indicative monitoring has been specified the information provided should be used as a management tool. Where used the monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions and emissions are complying with the requirements of the permit. Where used to trigger alarms the instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit. Thus the alarms are activated in response to this significant increase in pollutant loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

4.12 Where continuous monitoring is required, it should be carried out as follows:

- All continuous monitoring readings should be on display to appropriately trained operating staff.
- Instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction.
- The activation of alarms should be automatically recorded.
- All continuous monitors should be operated, maintained and calibrated (or referenced, in the case of indicative monitors) in accordance with the manufacturers' instructions, which should be made available for inspection by the regulator. The relevant maintenance and calibration (or referencing, in the case of indicative monitors) should be recorded.
- Emission concentrations may be reported as zero when the plant is off and there is no flow from the stack. If required a competent person should confirm that zero is more appropriate than the measured stack concentration if there is no flow.
- Any continuous monitor used should provide reliable data>95% of the operating time, (i.e. availability >95%). A manual or automatic procedure should be in place to detect instrument malfunction and to monitor instrument availability

Calibration and compliance monitoring.

4.13 Compliance monitoring can be carried out either by use of a continuous monitor (CEM), or by a specific extractive test carried out at a frequency agreed with the regulator.

4.14 Where a CEM is used for compliance purposes it must be periodically checked, (calibrated), to ensure the readings being reported are correct. This calibration is normally done by carrying out a parallel stand-alone extractive test and comparing the results with those provided by the CEM.

4.15 For extractive testing the sampling should meet the following requirements:

- If fitted, supplementary firing should be at maximum continuous rating, and the turbine at least 70% of its maximum continuous rating
- For all activities the sampling period should be sufficient such that at least 3 results are obtained.

4.16 Should the activity either be continuous, or have a batch cycle that is not compatible with the time available for sampling, then the data required should be obtained over a minimum period of 2 hours in total.

- For demonstration of compliance where a CEM is used no daily mean of all 15-minute mean emission concentrations should exceed the specified emission concentration limits during normal operation (excluding start-up and shut-down); and
- no 15-minute mean emission concentration should exceed twice the specified emission concentration limits during normal operation (excluding start-up and shut-down).
- For extractive testing, no result of monitoring should exceed the emission limit concentrations specified.

4.17 Exhaust flow rates should be consistent with efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.

- The introduction of dilution air to achieve emission concentration limits should not be permitted.

Dilution air may be added for waste gas cooling or improved dispersion where this is shown to be necessary because of the operational requirements of the plant, but this additional air should be discounted when determining the mass concentration of the pollutant in the waste gases.

Varying of monitoring frequency

4.18 A reduction in monitoring frequency should not be permitted where continuous quantitative or indicative monitoring is required. These types of monitoring are needed to demonstrate at all times when the plant is operating, that either the emission limits are being complied with or the arrestment equipment is functioning correctly.

4.19 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. However, any significant process changes that might have affected the monitored emission should be taken into account in making the decision.

4.20 The following should be considered when deciding whether compliance is consistent:

a. the variability of monitoring results, for example, results which range from 15 - 45 mg/m3, against an emission limit of 50 mg/m3 might not qualify for a reduction in monitoring.

b. the margin between the results and the emission limit, for example, results which range from 45 - 50 mg/m3 when the limit is 50 mg/m3 might not qualify for a reduction in monitoring.

Consistent compliance should be demonstrated using the results from at least;

- three or more monitoring exercises within two years; or
- two or more monitoring exercises in one year supported by continuous monitoring.

Where a new or substantially changed process is being commissioned, or where emission levels are near to or approach the emission concentration limits, regulators should consider increasing the frequency of testing.

4.21 Where continuous quantitative or indicative monitoring is required it is not appropriate that reduced monitoring be applied as the monitoring is required to demonstrate either compliance with emission limits on an ongoing basis or to demonstrate correct functioning of arrestment equipment.

Monitoring of unabated releases

4.22 Where emission limit values are consistently met without the use of abatement equipment, the monitoring requirement for those pollutants should be dispensed with subject to the “Varying of monitoring frequency” paragraphs above.

Sampling provisions

4.23 Care is needed in the design and location of sampling systems in order to obtain representative samples for all release points. The operator should ensure that adequate facilities for sampling are provided on vents or ducts. Sampling points on new plant should be designed to comply with the British or equivalent standards.

4.24 Where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported as well as an estimation of the error involved.

4.25 Whether sampling on a continuous or non-continuous basis care is needed in the design and location of sampling systems in order to obtain representative samples for all release points.

- Sampling points on new plant should be designed to comply with the British or equivalent standards, (see paragraph above).
- The operator should ensure that relevant stacks or ducts are fitted with facilities for sampling which allow compliance with the sampling standards.

5. Control techniques

Summary of best available techniques

5.1 The following table provides a summary of the best available techniques that can be used to control the process in order to meet the emission limits and provisions in Section 4. Provided that it is demonstrated to the satisfaction of the regulator that an equivalent level of control will be achieved, then other techniques may be used.

Table 4 Summary of control techniques

Sources of emissions	Control techniques
Gas turbine, other combustion CO Odour TOC	• Good combustion
Particulate from oil combustion	Good combustion
Sulphur dioxide	• Lower sulphur fuels

Techniques to control emissions from contained sources

Air Quality

Dispersion & Dilution

5.2 Pollutants that are emitted via a stack require sufficient dispersion and dilution in the atmosphere to ensure that they ground at concentrations that are deemed harmless. This is the basis upon which stack heights are calculated using HMIP Technical Guidance Note (Dispersion) D1. The stack height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure.

The calculation procedure of D1 is usually used to calculate the required stack height but alternative dispersion models may be used in agreement with the regulator. An operator may choose to meet tighter emission limits in order to reduce the required stack height.

5.3 Where an emission consists purely of air and particulate matter, (i.e. no products of combustion or any other gaseous pollutants are emitted) the above provisions relating to stack height calculation for the purpose of dispersion and dilution should not normally be applied. Revised stack height calculations should not be required as a result of publication of this revision of the PG note, unless it is considered necessary because of a breach or serious risk of breach of an EC Directive limit value or because it is clear from the detailed review and assessment work that the permitted process itself is a significant contributor to the problem.

Ambient air quality management.

5.4 In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the permitted process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the standard that is in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BAT to meet it. Decisions should be taken in the context of a local authority's Local Air Quality Management action plan. For example, where a permitted process is only responsible to a very small extent for an air quality problem, the authority should not unduly penalise the operator of the process by requiring disproportionate emissions reductions. Paragraph 59 of the Air Quality Strategy 2007 [Volume 1] gives the following advice:

"...In drawing up action plans, local authority environmental health/pollution teams are expected to engage local authority officers across different departments, particularly, land-use and transport planners to ensure the actions are supported by all parts of the authority. In addition, engagement with the wider panorama of relevant stakeholders, including the public, is required to ensure action plans are fit-for-purpose in addressing air quality issues. It is vital that all those organisations, groups and individuals that have an impact upon local air quality, buy-in and work towards objectives of an adopted action plan."

Stacks, vents and process exhausts

5.5 Liquid condensation on internal surfaces of stacks and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission. Adequate insulation will minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint. A leak in a stack/vent and the associated ductwork, or a build up of material on the internal surfaces may effect dispersion:

- Flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme.

5.6 When dispersion of pollutants discharged from the stack (or vent) is necessary, the target exit velocity should be 15m/sec under normal operating conditions, (but see paragraph below regarding wet plumes). In order to ensure dispersion is not impaired by either low exit velocity at the point of discharge, or deflection of the discharge, a cap, or other restriction, should not be used at the stack exit. However, a cone may sometimes be useful to increase the exit velocity to achieve greater dispersion.

5.7 An exception to the above is where wet arrestment is used as the abatement. Unacceptable emissions of droplets could occur from such plant where the linear velocity in the stack exceeds 9 m/sec. To reduce the potential of droplet emissions a mist eliminator should be used. Where a linear velocity of 9m/sec is exceeded in existing plant consideration should be given to reducing this velocity as far as practicable to ensure such droplet entrainment and fall out does not happen.

Management

Management techniques

5.8 Important elements for effective control of emissions include:

- proper management, supervision and training for process operations;
- proper use of equipment;
- effective preventative maintenance on all plant and equipment concerned with the control of emissions to the air; and
- ensuring that spares and consumables - in particular, those subject to continual wear – are held on site, or available at short notice from guaranteed local suppliers, so that plant breakdowns can be rectified rapidly. This is important with respect to arrestment plant and other necessary environmental controls. It is useful to have an audited list of essential items.

Appropriate management systems

5.9 Effective management is central to environmental performance; it is an important component of BAT and of achieving compliance with permit conditions. It requires a commitment to establishing objectives, setting targets, measuring progress and revising the objectives according to results. This includes managing risks under normal operating conditions and in accidents and emergencies. It is therefore desirable that installations put in place some form of structured environmental management approach, whether by adopting published standards (ISO 14001 or the EU Eco Management and Audit Scheme [EMAS]) or by setting up an environmental management system (EMS) tailored to the nature and size of the particular process. Operators may also find that an EMS will help identify business savings.

5.10 Regulators should use their discretion, in consultation with individual operators, in agreeing the appropriate level of environmental management. Simple systems which ensure that LAPPC considerations are taken account of in the day-to-day running of a process may well suffice, especially for small and medium-sized enterprises. Authorities are urged to encourage wider adoption of EMS by operators, but it is outside the legal scope of an LAPPC permit to require an EMS for purposes other than LAPPC compliance. For further information/advice on EMS refer to the appropriate chapter of the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland.

Training

5.11 Staff at all levels need the necessary training and instruction in their duties relating to control of the process and emissions to air. In order to minimise risk of emissions, particular emphasis should be given to control procedures during start-up, shut down and abnormal conditions. Training may often sensibly be addressed in the EMS referred to above.

- All staff whose functions could impact on air emissions from the activity should receive appropriate training on those functions. This should include:
  - awareness of their responsibilities under the permit
  - steps that are necessary to minimise emissions during start up and shut down
  - actions to take when there are abnormal conditions, or accidents or spillages that could, if not controlled, result in emissions.
- The operator should maintain a statement of training requirements for each post with the above mentioned functions and keep a record of the training received by each person. These documents should be made available to the regulator on request.

Maintenance

5.12 Effective preventative maintenance plays a key part in achieving compliance with emission limits and other provisions. All aspects of the process including all plant, buildings and the equipment concerned with the control of emissions to air should be properly maintained. In particular:

- The operator should have the following available for inspection by the regulator:
  - A written maintenance programme for all pollution control equipment; and
  - A record of maintenance that has been undertaken

6. Summary of changes

The main changes to this note, with the reasons for the change, are summarised below in Table 5. Minor changes that will not impact on the permit conditions e.g. slight alterations to the Process Description have not been recorded.

Table 5: Summary of changes

Section / Paragraph / Row	Change	Reason	Comment
Introduction			
	Simplification of text	Make Note clearer	
	Addition of links	Change to electronic format	Removes need for extensive footnotes/references
Emission limits, monitoring and other provisions			
Control techniques			
Air Quality	Clarification of exhaust velocity requirements		

7 Further information

Sustainable consumption and production (SCP)

Both business and the environment can benefit from adopting sustainable consumption and production practices.

Estimates of potential business savings include:

- £6.4 billion a year UK business savings from resource efficiency measures that cost little or nothing
- 2% of annual profit lost through inefficient management of energy, water and waste
- 4% of turnover is spent on waste.

When making arrangement to comply with permit conditions, operators are strongly advised to use the opportunity to look into what other steps they may be able to take. Local authority regulators may be wiling to provide assistance and ideas, although cannot be expected to act as unpaid consultants.

Health and safety

Operators of processes and installations must protect people at work as well as the environment:

- requirements of a permit or authorisation should not put at risk the health, safety or welfare of people at work or those who may be harmed by the work activity;
- equally, the permit or authorisation must not contain conditions whose only purpose is to secure the health of people at work. That is the job of the health and safety enforcing authorities.

Where emission limits quoted in this guidance conflict with health and safety limits, the tighter limit should prevail because:

- emission limits under the relevant environmental legislation relate to the concentration of pollutant released into the air from prescribed activities;
- exposure limits under health and safety legislation relate to the concentration of pollutant in the air breathed by workers;
- these limits may differ since they are set according to different criteria. It will normally be quite appropriate to have different standards for the same pollutant, but in some cases they may be in conflict (for example, where air discharged from a process is breathed by workers). In such cases, the tighter limit should be applied to prevent a relaxation of control.

Further advice on responding to incidents

The UK Environment Agencies have published guidance on producing an incident response plan to deal with environmental incidents. Only those aspects relating to air emissions can be subject to regulation via a Part B (Part C in NI) permit, but regulators may nonetheless wish to informally draw the attention of all appropriate operators to the guidance.

It is not envisaged that regulators will often want to include conditions, in addition to those advised in this PG note, specifying particular incident response arrangements aimed at minimising air emissions. Regulators should decide this on a case-by-case basis. In accordance with BAT, any such conditions should be proportionate to the risk, including the potential for harm from air emissions if an incident were to occur. Account should therefore be taken of matters such as the amount and type of materials held on site which might be affected by an incident, the likelihood of an incident occurring, the sensitivity of the location of the installation, and the cost of producing any plans and taking any additional measures.