



**A GUIDANCE NOTE ON THE
BEST PRACTICABLE MEANS**

FOR

ELECTRICITY WORKS

**(COAL-FIRED PLANT, GAS-FIRED GAS TURBINE, AND
OIL-FIRED GAS TURBINE (PEAK LOPPING PLANT))**

BPM 7/1 (2018)

Environmental Protection Department
Air Policy Group

December 2018

1. Introduction

This note lists the minimum requirements for meeting the best practicable means for Electricity Works (coal-fired plant, gas-fired gas turbine and oil-fired gas turbine (peak lopping plant)). It should be noted that in granting a licence under the Air Pollution Control Ordinance, the Authority, i.e. the Director of Environmental Protection, will also consider all other relevant aspects and may impose more stringent and/or additional control requirements.

The requirements in this note are applicable to all generation units constructed after 1 January 1991 with the following overall installed generation capacity:

- (a) Coal-fired Power Plants : Equal to or more than 200 MW (electrical output; aggregate generating capacity)
- (b) Gas-fired Gas Turbines : Equal to or more than 15 MW (electrical output)
- (c) Oil-fired Gas Turbines (Peak Lopping Plant) : Equal to or more than 15 MW (electrical output)

Upgrading of control on the older generation units to meet the requirements should, however, be made whenever they can be achieved technically and economically. Discussion would be arranged by the Authority to agree on the details and time schedule of implementation when the need arises.

2. Design of Chimney

(a) Chimney height

To be determined by mathematical or physical dispersion modelling techniques acceptable to the Authority. The aims are to ensure:-

- (i) the relevant Air Quality Objectives (AQO) will not be threatened;
- (ii) the emission of non-AQO pollutants, in particular, heavy metals and carcinogenic organic compounds, will not cause any adverse effect to human health or environment; and
- (iii) no undue constraint will be incurred to existing and future development or land use.

The final chimney height should be agreed with the Authority but as a general guideline, the chimney height in a flat terrain situation, should not be less than the sum of the Building Height and 1.5 times of the lesser of the Building Width or the Building Height. Suitable adjustment should be made to take into account local meteorological data, local topography and background air pollutant concentrations.

For non-combustion processes, the same guideline should be observed as far as practicable and in any case, the chimney height should not be less than 3 metres plus the building height.

(b) Efflux velocity

Not less than 15 m/s (at full load condition).

(c) Exit temperature

Not less than 80°C (at full load condition).

(d) Mode of discharge

Releases to air from chimneys should be directed vertically upwards and not restricted or deflected by the use of, for example, plates, caps or cowls. The weather protection device of a chimney, if used, should be properly designed so as not to restrict the upward movement of the gas flow.

In order to obtain maximum advantage from thermal buoyancy, hot emissions should take place from the minimum practicable number of chimneys, i.e. a multi-flue chimney design should be used as far as practicable.

Chimneys for release of hot emissions should, wherever necessary, be insulated with materials which should be free of asbestos.

3. Emission Limits

The emission limits stipulated below shall be applicable to all emissions during normal operations including soot blowing and load change. For smoke emission, the emission limits shall also be applicable to the start-up and shut-down periods.

(a) Coal-fired Power Plants (for existing coal-fired generation unit only^{t1)})

(All figures, other than smoke emission or those specified below, are based on an hourly averaging period and expressed as at 6% O₂ (or 12% CO₂ as the case may be), 0°C, 101.325 kilopascals and dry conditions)

Combustion process:

Particulates : 50 mg/m³ (2-hourly average)

Sulphur dioxide : 90% removal of the potential emission from burning of coal with a maximum allowable sulphur content of 1% by weight (air dry basis)
(Approximate equivalent concentration: 200 mg/m³)

Nitrogen oxides : 670 mg/m³
(as NO₂)

^{t1} As coal-fired generation unit emits more pollutants than gas-fired generation unit, the Authority, since 1997, prohibits the installation of new coal-fired generation unit to control the emissions from power generation sector.

Mercury and its Compounds (expressed as mercury) : 10 $\mu\text{g}/\text{m}^3$ (Average value over the sampling period of around 2 hours)

Smoke : (i) Less than Shade 2 on the Ringelmann Chart for start-up from cold; and
(ii) Less than Shade 1 on the Ringelmann Chart for other period

Non-combustion process :

(The following figure is expressed as at 0°C, 101.325 kilopascals and undiluted conditions)

Particulates : 50 mg/m^3

(b) Gas-fired Gas Turbines (Other Than Peak Lopping Plant)

(All figures, other than smoke emission or those specified below, are based on an hourly averaging period and expressed as at 15% O₂, 0°C, 101.325 kilopascals and dry conditions)

Combustion process :

Particulates : 5 mg/m^3 (2-hourly average)

Sulphur dioxide : 15 mg/m^3

Nitrogen oxides (as NO₂) : (i) for plant installed on or before 19 January 2014: 90 mg/m^3 ; and

(ii) for plant installed on or after 20 January 2014 (including the modification or change of gas-fired peak lopping gas turbines to baseload operation): 5 mg/m^3 at 70% loading and above

Ammonia : 8 mg/m^3 for plant installed on or after 20 January 2014 and with the use of ammonia for NO_x control

Smoke : (i) Less than Shade 2 on the Ringelmann Chart for start-up from cold; and
(ii) Less than Shade 1 on the Ringelmann Chart for other period

(c) Oil-fired Gas Turbines (Peak Lopping Plant)

(All figures, other than smoke emission or those specified below, are based on an hourly averaging period and expressed as at 15% O₂, 0°C, 101.325 kilopascals and dry conditions)

Combustion process:

Particulates	:	10 mg/m ³ (2-hourly average)
Sulphur dioxide	:	Potential emission from burning of fuel oil with sulphur content of not more than 0.005% by weight
Nitrogen oxides (as NO ₂)	:	150 mg/m ³
Smoke	:	(i) Less than Shade 2 on the Ringelmann Chart for start-up from cold; and (ii) Less than Shade 1 on the Ringelmann Chart for other period

(d) Gas-fired Gas Turbines (Peak Lopping Plant)

(All figures, other than smoke emission or those specified below, are based on an hourly averaging period and expressed as at 15% O₂, 0°C, 101.325 kilopascals and dry conditions)

Combustion process:

Particulates	:	5 mg/m ³ (2-hourly average)
Sulphur dioxide	:	15 mg/m ³
Nitrogen oxides (as NO ₂)	:	30 mg/m ³ at 70% loading and above
Smoke	:	(i) Less than Shade 2 on the Ringelmann Chart for start-up from cold; and (ii) Less than Shade 1 on the Ringelmann Chart for other period

4. Fugitive Emission Control

(a) Boundary Ambient Standards

Respirable Suspended Particulates (RSP) and Fine Suspended Particulates (FSP)^[2] : The latest AQOs of RSP & FSP

Odour : 2 odour units^[3]

(b) Engineering Design/Technical Requirements

To be agreed with the Authority. As a general guideline, the loading, unloading, handling and storage of fuel, raw materials, wastes or by-products should be carried out so as to prevent the release of:-

- (i) visible dust emissions; and/or
- (ii) emissions of organic vapours; and/or
- (iii) other noxious or offensive emissions

and to render these emissions harmless and inoffensive when released.

5. Material / Fuel Restriction

(a) Solid Fuel

Sulphur content : Not more than 1% by weight

(b) Liquid Fuel

Sulphur content : Not more than 0.005% by weight

Viscosity : Not more than 6 centistokes at 40°C

^[2] Please refer to EPD's website for the latest air quality objectives of RSP and FSP.

(https://www.epd.gov.hk/epd/english/environmentinhk/air/air_quality_objectives/air_quality_objectives.html).

^[3] An odour unit is the measuring unit of odour level and is analogous to pollution concentration. It shall be determined by dynamic olfactometry in accordance with BS EN 13725 or other similar methods acceptable to the Authority. In this context, the odour level is defined as the ratio of the volume which the sample would occupy when diluted with air to the odour threshold, to the volume of the sample. In other words, one odour unit is the concentration of odorant which just induces an odour sensation.

6. Monitoring Requirements

Parameters and sampling frequency will be determined by the Authority. However, the following parameters should be monitored continuously. The in-stack monitoring data should also be transmitted to the Authority instantaneously by telemetry.

(a) Coal-fired Power Plant

In-stack monitoring

Oxygen, carbon monoxide, particulates (opacity), sulphur dioxide, nitrogen oxides, stack temperature.

Process monitoring

Generation output, essential operating parameter(s) which may significantly affect the emission of air pollutants of air pollution control equipment.

Ambient monitoring

At site boundary : Respirable suspended particulates
(24-hour sample on daily basis)

At location(s) acceptable to the Authority : Sulphur dioxide, nitrogen dioxide
and nitric oxide

(b) Gas-fired Gas Turbines (Other Than Peak Lopping Plant)

In-stack monitoring

Nitrogen oxides, sulphur dioxide, ammonia (for plant installed on or after 20 January 2014 and with the use of ammonia for NO_x control), oxygen, carbon monoxide, stack temperature.

Process monitoring

Generation output, water-to-fuel injection ratio, and/or essential operating parameter(s) which may significantly affect the emission of air pollutants of air pollution control equipment.

Ambient monitoring

At location(s) acceptable to the Authority : Nitrogen dioxide

(c) Oil-fired Gas Turbines / Gas-fired Gas Turbines (Peak Lopping Plant)

Process monitoring

Generation output, water-to-fuel injection ratio, and/or essential operating parameter(s) which may significantly affect the emission of air pollutants of air pollution control equipment.

7. Event and Action Plan

Should the average mercury emission concentrations of all samples taken in a coal-fired generating unit over a calendar year exceeds the alert level specified in Annex I, the licence holder shall take actions according to the Event and Action Plan at Annex I.

8. Commissioning

Commissioning trials (to be witnessed by the Authority whenever appropriate) should be conducted to demonstrate performance capability of the air pollution control measures and a report of commissioning trial should be submitted to the Authority within 1 month after completion of the trial.

9. Operation and Maintenance

Requirements include not only the provision of the appliances, but the proper operation and maintenance of equipment, its supervision when in use and the training and supervision of properly qualified staff. Specific operation and maintenance requirements may be specified for individual equipment.

Malfunctioning and breakdown of the process or air pollution control equipment which would cause exceedance of the emission limits or breaches of other air pollution control requirements should be reported to the Authority within three working days.

ANNEX I EVENT AND ACTION PLAN

Alert Level	Actions by Licensee
<p>Average mercury emission concentration of all samples taken over a calendar year exceeds 7 µg/m³</p>	<ol style="list-style-type: none"> 1. Notify the Authority as soon as practicable. 2. Conduct investigation into the operation of the coal-fired generation unit(s) concerned to identify the causes. The investigation should cover coal properties, operation and maintenance of air pollution control equipment, the sampling equipment and procedures. 3. Report investigation findings to the Authority and proposed remedial measures, if any. 4. Implement the proposed remedial measures or any other measures agreed with the Authority, if applicable. 5. Evaluate the effectiveness of the remedial measures and report to the Authority.