ENVIRONMENTAL PROTECTION AGENCY

BATNEEC GUIDANCE NOTE

Class 9.4

CARBONATION, GASIFICATION ETC.

OF

COAL, LIGNITE, OIL AND BITUMINOUS SHALE

(Draft 3)

Page

1. INTRODUCTION

This Guidance Note is one of a series issued by the Environmental Protection Agency and is designed to provide guidance to those applying for integrated pollution control licences under the EPA Act. It should also be read in conjunction with *Application Guidance Notes*, available under separate cover.

It should be noted at the outset, that noise is not included within the scope of this work and guidance on this parameter has been issued separately.

This Guidance Note is comprised of seven main sections and an appendix. Following this introduction, Section 2 contains a general note on the interpretation of BATNEEC. The industrial activity covered by the terms of this note is given in Section 3. In Section 4, the technologies to control emissions are tabulated and in Section 5 the specific emission limit values (ELVs) are given. Section 6 contains comments on compliance monitoring requirements.

The Appendix gives the main sources of emissions, and the principal releases from such sources.

All applicants for Integrated Pollution Control licences, in the sector covered by this note, should carefully examine the information laid down in this Guidance Note, and should use this information to assist in the making of a satisfactory application for an Integrated Pollution Control licence to the Agency. It should be clearly understood that achieving the emission limit values does not, by itself, meet the overall requirements in relation to I.P.C. In addition to meeting such values the applicant will also be required to demonstrate that waste minimisation is a priority objective and to put in place particular abatement measures to reduce overall mass emissions and pollutant load where this is necessary to protect the ambient environment.

The technologies and the associated emission limit values (ELVs) identified in this Guidance Note are, at the time of writing, regarded as representing BATNEEC for new activities. BATNEEC is not a static quality and will change as technologies, environmental factors and costs alter with the passage of time. The Agency may amend or update the guidance contained in this note should such amendments seem appropriate. The information contained in this Guidance Note is intended to be used only as a tool to assist in determining the BATNEEC for an operation in this sector and should not be taken to be a definitive authority on the BATNEEC for this sector**.** This Note should not be considered as a legal document**.**

2. INTERPRETATION OF BATNEEC

BATNEEC means '*the best available technology not entailing excessive costs'*. The technology in question should be **Best** at preventing pollution and **Available** in the sense that it is procurable by any person. **Technology** itself is taken as the techniques and the use of the techniques, including training and maintenance etc.
NEEC addresses the balance between environmental benefit and financial expense.

The objective of the Best Available Technology Not Entailing Excessive Costs (BATNEEC) Guidelines is to provide a list of technologies which will be used by the EPA to determine BATNEEC for a scheduled activity. The BATNEEC identified in this Guidance Note is used as a basis for setting emission limit values. It is intended to update these guidelines as required in order to incorporate technological advances as they occur.

In the identification of BATNEEC, emphasis is placed on pollution prevention techniques, including cleaner technologies and waste minimisation, rather than end-of-pipe treatment.

Technologies identified in the BATNEEC guidelines are considered to be the current best practice for the purposes of setting emission limit values. These technologies are representative of a wide range of currently employed technologies appropriate to particular circumstances. However, the guidance issued in this note in respect of the use of any technology, technique or standard does not preclude the use of any other similar techniques which may achieve the same emission. The entire range would not necessarily be appropriate in specific cases. The specific choice depends on a wide range of circumstances but the crucial factor is that the selected regime achieves BATNEEC. In applying BATNEEC, Environmental Quality Objectives (EQOs) must be respected where set. Measures such as in-plant changes, raw material substitution, process recycling and improved material handling and storage practices, may also be employed to effect reductions in emissions. As well as providing for the installation of equipment and the operation of procedures for the reduction of possible emissions, BATNEEC will also necessitate the adoption of an on-going programme of environmental management and control, which will focus on continuing improvements aimed at prevention, elimination and/or progressive reduction of emissions.

As described in the EPA Act of 1992, BATNEEC will be used to prevent, eliminate or, where that is not practicable, limit, abate, or reduce an emission from an activity which is listed in the first schedule to the Act. The use of BATNEEC is construed in the Act to mean the provision and proper maintenance, operation, use and supervision of facilities which are the most suitable for the purposes.

In determining BATNEEC for an activity, regard shall be had to :

- the current state of technical knowledge;
- the requirements of environmental protection;

- the application of measures for these purposes, which do not entail excessive costs, having regard to the risk of significant environmental pollution which, in the opinion of the agency, exists.

For existing facilities, additional regard shall be had to :

- the nature, extent and effect of the emission concerned;

- the nature and age of the existing facilities connected with the activity and the period during which the facilities are likely to be used or to continue in operation, and

- the costs which would be incurred in improving or replacing these existing facilities in relation to the economic situation of activities of the class concerned.

The technologies and the associated emission limit values (ELV) identified in this Guidance Note are regarded as representing BATNEEC. It is generally envisaged that these emission limit values will gradually be extended to existing facilities. However, the specific licence requirements and associated time frames will be identified when the licence is processed. Additional and more stringent requirements may be specified on a site-specific basis.
Where an operator of an existing facility predicts that it will be difficult to meet the emission limit value within the specified time-frame, he will be required to satisfy the Agency as to the reasons why the requirements cannot be met. The applicant will be required to submit an environmental management plan which will give consideration to the following, in order of priority:

- waste reduction/source elimination;
- waste recovery;
- proposed and alternative treatment technologies and predicted performance data;
- proposed and alternative waste disposal options.

This management plan must propose a revised time-frame for the achievement of emission limit values as set out in this Guidance Note.

The BATNEEC guidelines are not the sole basis on which licence emission limit values are to be set, since information from other sources will also be considered; including site-specific environmental and technical data, plant financial data and other relevant information.

3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers SECTOR 9.4 of the activities specified in the First Schedule to the EPA Act, 1992. These are:

9.4. The pyrolysis, carbonisation, gasification, liquefaction, dry distillation, partial oxidation or heat treatment of coal, lignite, oil or bituminous shale, other carbonaceous materials or mixtures of any of these installations which a processing capacity exceeding 500 tonnes per day.

4. CONTROL TECHNOLOGIES

4.1 INTRODUCTION

As explained in Section 2, this Guidance Note identifies BATNEEC but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note, but does not exclude additional requirements which may form part of the granting of a licence for a specific site.

The approach to be used in selecting BATNEEC is based on the following hierarchy:

- Process design / redesign changes to **eliminate** emissions and wastes that might pose environmental problems.
- **Substitution** of materials (e.g. low sulphur fuel) by environmentally less harmful ones.
- Demonstration of waste **minimisation** by means of process control, inventory control and end-of-pipe technologies etc.

The existing or possible measures for reducing and controlling emissions are described in this section. These range from relatively simple containment measures to sophisticated recovery and end-of-pipe technologies and include:

(i) Load minimisation
(ii) Containment
(iii) Recovery/recycle
(iv) Emission reduction
(v) Waste treatment and disposal.

The technical feasibility of the measures listed below has been demonstrated by various sources. Used singly or in combination, the measures represent BATNEEC solutions when implemented in the appropriate circumstances. The circumstances depend on plant scale, materials used, grade of product made, etc. A summary of the treatments for various emissions is given at the end of the section.

Note that where flammable/explosive vapours or dust are handled, safety procedures (acceptable to HSA) should be adopted and nothing in this note should be construed as advice to the contrary.

4.2 TECHNOLOGIES FOR LOAD MINIMISATION

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints).

- Coal charging via double lock system to reactors, with reinjection into crude gas or treatment as appropriate.
- Optimisation of energy recovery and usage.
- Inventory control.
- Optimisation of water and condensate usage.
- Separation of cooling water, storm water and process effluents of different origin in order to permit appropriate treatment options.
- Use of low sulphur fuels when economically feasible.
- Design of receiving hoppers and of finished product loading systems to minimise fugitive dust releases.
- Process and relief vents to be directed to flare (knock-out may be necessary) or incinerator as appropriate.
- CO_2 removal, where H_2S residuals occur, to be incinerated if necessary to prevent odour nuisance.
- Removal of residual tar and oils from aqueous quenching by means of a suitable separator.
- Heavy metal removal from process liquors to be considered where appropriate.

4.3 CONTAINMENT OF EMISSIONS:

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints).

- Save for bulk tanks and raw material stockpiles, enclosure of materials, storage, handling, processing and transfer within a suitable building.
- Closed transfer systems for raw and process materials.
- Bunding of tanks.
- Slag, ash and dry particulate removal systems to be designed to prevent loss of process gases (e.g. double lock hoppers).
- Overground pipelines and transfer lines.
- Slag and ash handling to be designed to avoid dust emissions.
- Overfilling protection on bulk storage tanks.
- Prevention of rain ingress, wind entrainment etc. for stored materials.
- Heat recovery to be used where practicable.
- Local extract systems as appropriate.
- Condensers on all appropriate process equipment.
- Screening, crushing and briquetting to be suitably enclosed and extracted to assessment plant.
- Vent gases from liquid feedstocks to be scrubbed/incinerated etc. as appropriate.
- Oil handling facilities to be designed so that any run-off, spillage etc. is directed to an interceptor.
- Design of gasification plant to ensure optimum containment of gases, odours etc.
- Steam/gas arising from aqueous liquor removal to be directed to treatment (or combined with acid gas stream and directed to sulphur recovery plant).

4.4 TECHNOLOGIES FOR RECOVERY AND RECYCLE:

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints).

- Reuse of collected dusts.
- Recycle of effluent storm water run-off streams where appropriate.
- Acid gas streams to undergo sulphur recovery as appropriate (99% recovery possible). Incineration may also be required prior to final discharge.
- Reuse of aqueous phase from separator systems (as quench water).
- Tars, oils and particulates from separator systems (aqueous quench) to be reinjected to gasifier.
- Recycle of purification fly slag.

4.5 TECHNOLOGIES FOR TREATING AIR EMISSIONS:

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints). (Symbols refer to table 4.1).

- Flares (T1).
- Electrostatic precipitators.

4.6 TECHNOLOGIES FOR TREATING WATER EMISSIONS

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints). (Symbols refer to table 4.2)

4.6.1 Primary Treatment

- Activated sludge (F1).
- pH Correction/neutralisation (F1).
- Coagulation/flocculation/precipitation (F2).
- Sedimentation/filtration/floatation (F3).
- Centrifugation (F4).

4.7 TECHNOLOGIES FOR THE TREATMENT AND DISPOSAL OF WASTES:

(No priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints).

4.7.1 Sludge Treatment

- Gravity thickening.
- Dissolved air floatation.
- Filtration.
- Centrifugation.

4.7.2. Disposal

- Reuse of solid feedstock wastes.
- Engineered landfill (slags/ash).

Table 4.1 - Summary of Technologies for Treating Emissions to Air (Symbols refer to section 4.5)

Emission Type	Technology
Organics Combustible gases	T1

Table 4.2 - Summary of Technologies for Treating Water Emissions (Symbols refer to section 4.6)

Emission Type	Technology
Organics	F1
Phenols	F1
Nitrates/Ammonia	F1

5. EMISSION LIMIT VALUES

5.1 REFERENCE CONDITIONS

The reference conditions for concentrations of substances in emissions to air from contained sources are:

Combustion gases: dry; temperature 273 K; 101.3 kPa; 6% O_2.

Non-combustion gases: temperature 273 K; Pressure 101.3 kPa; no correction for water vapour content.

These units and reference conditions may not be suitable for continuous monitoring methods and may, by agreement with the Agency, be converted, for day to day control purposes, into values more suitable for the available instrumentation.

5.2 INTERPRETATION OF COMPLIANCE

Unless otherwise detailed in the licence, the following interpretation of compliance with limit values should apply:

(Achievement of ELV concentrations by the introduction of dilution air is not permitted.).

5.2.1 Emissions to Air

For **continuously monitored** emissions, the following will be required for compliance with measurements based on 30 minute mean values based on actual operating hours including start-up and shut-down (unless otherwise stated):

(i) 95% of all 30 minute mean measurements of each 24 hour rolling average shall be below the emission limit.

(ii) No 30 minute mean measurement shall exceed 3.0 times the emission limit.

Where **periodic monitoring** is used to check compliance, all samples should meet the consent conditions.

5.2.2 Emissions to waters

The limit values for discharges to water are based on 24 hour flow proportional composite samples unless otherwise specified.

5.3 EMISSIONS TO AIR

Emission Limit Values representing BATNEEC are given in Table 5.1 below.

Table 5.1 - Emission Limit Values for Emissions to Air

Emission	Limit Value
SO_2	2250 mg/m^3
Sulphur recovery plants	>98% Recovery
NO_x (as NO_2)	650 mg/m^3
Particulates	50 mg/m^3
H_2S	1 mg/m^3
Organic Sulphur (as S)	1 mg/m^3

Note : Achievement of ELV concentration by the introduction of dilution air is not permitted

5.4 Releases to Water

Effluent should be minimised by recovery of materials wherever practicable. The use of lower quality water may be possible for some parts of the process rather than fresh water.

All releases to waters are subject to a licence from the Agency. However, any discharge to a sewer, will require the consent of the sanitary authority. BATNEEC to minimise the release of substances will generally include minimisation at source and either specific treatment of contaminated waste streams to remove particular substances or co-treatment of combined effluent streams or both. The Emission Limit Values for effluent discharges to waters are set out in Table 5.2.

Table 5.2 - Emission Limit Values for Discharges to Water*

(These values apply prior to any dilation with e.g. uncontaminated stormwaters or cooling waters)

Constituent Group or Parameter	Limit Value	Notes
pH	6 - 9	3
BOD (mg/l)	25	3
Toxic Units	5	1,3
Total Nitrogen (as N)**	>80% Removal **or** 15 mg/l	3,4
Total Phosphorous (as P)**	>80% Removal **or** 2 mg/l	3,4
Hydrocarbons (mg/l)	5	3
Fish Tainting	No Tainting	2,3
Metals	As per Licence (based on presence in raw materials)	

* All values refer to daily averages, except where otherwise stated to the contrary, and except for pH which refers to continuous values.

** Only applicable to waters subject to eutrophication. One or both parameters may be applied depending on the local situation.

Notes for Table 5.2:

1. The toxicity of the effluent shall be determined on an appropriate aquatic species. The number of Toxicity Units (TU) = 100/96 hr LC50 in percentage vol/vol. so that higher TU values reflect greater levels of toxicity.

2. No substances shall be discharged in a manner which, or at a concentration which, following initial dilution causes tainting of fish or shellfish, interferes with normal patterns of fish migration or which accumulates in sediments or biological tissues to the detriment of fish, wildlife or their predators.

3. Consent conditions for these parameters for discharge to municipal treatment plants can be established with the Licensing Authority, and different values may apply.

4. Reduction in relation to influent load. Total nitrogen means the sum total of Kjeldahl-Nitrogen plus nitrate-nitrogen plus nitrite-nitrogen.

6. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from these sectors are set out below.

6.1 EMISSIONS TO AIR

1. Continuous dust emission monitoring from calciner.

2. Periodic monitoring for other parameters as per licence.

6.2 WASTE WATER DISCHARGES:

1. Establish existing conditions prior to start-up, of key emission constituents and salient flora and fauna.

2. Daily monitoring of flow and volume, continuous monitoring of pH. Monitoring of other relevant parameters as deemed by the Agency taking account of the nature, magnitude and variability of the emission, and the reliability of the control technologies.

3. Monitoring of influent and effluent from the waste water treatment plant to establish an early warning of any difficulties in waste water treatment plant, or unusual loads.

4. The potential for the treated effluent to have taining and toxic effects should be assessed and if necessary measured by established laboratory techniques.

6.3 SOLID WASTE MONITORING:

1. The recording in a register of the types, quantities, date and manner of disposal of all wastes.

2. Leachate testing of sludges and other material, as appropriate, being sent for landfilling.

3. Annual waste minimisation report showing efforts made to reduce pecific consumption together with material balance and fate of all waste materials.

APPENDIX 1

MAIN EMISSIONS

1 INTRODUCTION:

In this section, the major sources of emissions to air and water are identified, as are the principal sources of waste from the sector. It should be borne in mind that the identified list of sources is not all encompassing, nor will every plant falling within an individual sector have every one of the emissions which are associated with the sector as a whole.

Emissions are considered under the following headings: fugitive and unscheduled emissions, and specific process emissions. Some of the latter are considered to have little potential environmental significance and these are designated as minor (m). (However, obviously there could be specific plants where this designation of minor may not be correct. Such emissions must then be examined on a one-off basis).

2 SOURCES OF EMISSION TO AIR FROM:

2.1 Fugitive and Unscheduled Emissions

- Fugitive emissions of particulate matter from loading, unloading, storage and handling of solid materials.
- Leakages from flanges, pumps, seals, valve glands etc.
- Building losses (through door, window, etc.).
- Odours from production process (e.g. digestion etc.)
- Steam releases.

2.2 Process Emissions (Symbols refer to Table A1)

- Crude gas (gasifier) (S1).
- Steam vents (m).

3 SOURCES OF EMISSIONS TO WATER FROM:

3.1 Spills and Diffuse Sources etc.

- Contaminated stormwaters (process area).
- Storage tank leaks.
- Pipework leaks.
- Spillages.
- Bund Drains.
- Leakages from flanges, pumps, seals, valve glands etc.

3.2 Process Emissions (Symbols refer to Table A2)

- Gasification Process (E1).
- Boiler blowdown (E1).
- Contaminated stormwater from engineered landfill (E2).
- Water treatment plant (m).
- Contaminated water arising from washing of product (E3).
- Laboratory effluent (m).
- Storage area/tanks/skips/haulage vehicles etc. washdown (m).
- Equipment cleaning (E4).

4. SOURCES OF WASTE (SYMBOLS REFER TO TABLE A3)

- Particulates (Solid Feedstocks) (W1).
- Gasifier bottom (W2).
- Contaminated drums, equipment, packaging and protective clothing (m).
- Sludges from WWTP (W3).
- Purification fly slag (W4).

Table A1 - Summary of Sources and Emissions to Air
(Symbols refer to section 2.2 of Appendix)

Source	Emissions
S1	CO Hydrogen Methane CO_2 (H_2S, Carbonyl Sulphide, HCN, NH_3, Tars, Oils, Particulates depending on process and feedstock)

Table A2 - Summary of Sources and Emissions to Water
(Symbols refer to section 2.2 of Appendix)

Sources	Emissions
E1	Organics (m) Ammonia Nitrates Carbonates Sulphides Chlorides Thiocyanates Phenols
E2	Acid, Aluminium

Table A3 - Summary of Other Releases
(Symbols refer to section 4 of Appendix)

Source	Emission
W1	Coal etc.
W2	Slag/ash
W3	Organics Settled Solids
W4	Carbon/Organics

7. PRINCIPAL REFERENCES

7.1 U.K. H.M.I.P

7.1.1 Chief Inspectors Guide to Inspectors - Process Guidance Note IPR 1/11 (Gasification Processes - Gasification of Solid and Liquid Feedstocks).

7.1.2 Chief Inspectors Guide to Inspectors - Process Guidance Note IPR 1/10 (Carbonisation and Associated Processes, - Smokeless Fuel, Activated Carbon and Carbon Black Manufacture).

7.1.3. Chief Inspectors Guide to Inspectors - Process Guidance Note IPR 1/9 (Carbonisation and Associated Processes - Coke Manufacture).