

# **the IPPC directive, refinery BREF, and european refineries – a guidance manual**

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## ABSTRACT

This report has been prepared as a guidance manual for refining environmental and planning personnel who must prepare for the permitting and operational implications of the IPPC regulations which become applicable to existing operations in October 2007. New operations must already comply. The IPPC regulations have to be interpreted and enacted into national legislation and detailed compliance will vary from country to country. A common resource for relevant technical information will be the series of Reference documents for Best Available Techniques (BREF documents) prepared by the European Integrated Pollution Prevention and Control Bureau (EIPPCB) in Seville.

This guidance manual introduces the IPPC Directive and BREF document relevant to mineral oil and gas refineries. It aims to clarify critical points and to provide checklists of actions and debating points that those responsible for advocacy, refinery operations, permitting, and/or planning can use in preparing to most effectively manage the IPPC permitting process in their country and at their site.

## KEYWORDS

Air emissions, BAT, BAT Associated Levels, Best Available Techniques, BREF, Bubble, cost, effluents, Emission Limit Values, EQO, EQS, gas, IPPC, oil, pollutants, Process BAT, refinery, waste, water

## INTERNET

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## SUMMARY

This report provides guidance to personnel of oil and gas refineries responsible for obtaining operating permits under the Integrated Pollution Prevention and Control (IPPC) European Directive. These permits will be required from October 2007 for existing installations and are already mandated for new facilities as well as major modifications.

IPPC regulations will be enacted at national level with possibly different interpretations for permit requirements. To what extent national (and even local) conditions will affect the final interpretation is not yet clear. This report cannot provide guidance at this level of detail. It instead provides overall guidance to the reader to the IPPC Directive and some general principles on how to optimise activities associated with IPPC permitting at the refinery level. In addition, there is a detailed review of some of the Best Available Technique (BAT) processes which were given in the Refinery BAT Reference Document (BREF) produced by the European IPPC Bureau.

It should be stressed that to determine the Best Available Techniques for a **SPECIFIC** installation requires knowledge of the current state of plant and operations and the local environment. The onus on preparing an application is very much down to the local operator.

This report is structured to provide:

- A general introduction to IPPC and its purpose as it applies to the mineral oil and gas refineries;
- Some key details about the IPPC Directive and some of the concepts as BAT and BREF. Technical terms used in the IPPC such as BAT Associated Levels, Achievable Emission Levels and Emission Limit Values are also elaborated (**Section 2**);
- General guidance to a refinery operator for the IPPC permitting process (**Section 3**);
- A discussion of BAT entries in the Refinery BREF that are in CONCAWE's view either controversial or unreasonable (**Section 4**).

## 1. INTRODUCTION

The Integrated Pollution Prevention and Control (IPPC) Directive [1], described in **Section 2**, requires Member States to issue permits for major industrial installations, such as oil refineries.

The purpose of the IPPC Directive is to introduce a more integrated approach to pollution control from industries and it aims to achieve:

*“a high level of protection to the environment taken as a whole by, in particular, preventing or, where that is not practicable, reducing emissions into the air, water and land”.*

This is done by determining and enforcing permit conditions based on Best Available Techniques (BAT) for the installation.

In submitting an application for a permit (described in **Section 3**), the “operator”<sup>1</sup> must address several environmental issues whether the “installation” is new or existing. These include:

- assessment of polluting releases from the installation,
- compliance with Local, National and European Standards,
- adequate compliance modelling,
- satisfactory environmental management,
- demonstration of energy efficiency and waste minimisation.

Before granting the permit, the regulator must be satisfied that the operator has addressed the above points. It is the operator’s responsibility to demonstrate that this is the case.

Information on what may be considered BAT is given in a series of BAT Reference Documents (BREF). For refineries, this is the Refinery BREF document [2]. **Section 4** of this report reviews some of these BATs that CONCAWE considers require explanation or clarification.

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<sup>1</sup> Some of the words used like operator and installation have a specific meaning and the reader should refer to Appendix 2 for definitions

## 2. THE IPPC DIRECTIVE

### 2.1. BACKGROUND

The Integrated Pollution Prevention and Control (IPPC) Directive [1] was adopted in September 1996 and came into force on 30<sup>th</sup> October 1996. It requires Member States to issue permits for major industrial installations (such as oil refineries) to promote the use of Best Available Techniques (BAT) for reducing emissions of specified pollutants. The aim is to achieve *“a high level of protection to the environment taken as a whole by, in particular, preventing or, where that is not practicable, reducing emissions into the air, water and land”*.

The word “Integrated” in the title of the Directive means that the permit must consider emissions to all environmental media, as well as the use of raw materials and energy. The Directive is already in force for new installations as well as for significant overhauls or upgrades but does not apply to existing installations until October 2007.

IPPC is a Directive, not a regulation. It has to be enacted by each Member State in its own national legislation. Member States are permitted to go beyond the minimum requirements of the Directive, and to adapt its provisions to fit in with their own legislative customs and structures. As a consequence, the resulting legislation will vary somewhat from country to country. This guidance manual only deals only with the IPPC Directive as such and does not consider any national variations.

### 2.2. CONTENT OF THE DIRECTIVE

The activities covered by the Directive are listed in its Annex I. One entry in this Annex is *“Mineral oil and gas refineries”*.

The Directive lays down measures for these activities which are designed to prevent or, where that is not practicable, to reduce emissions to the air, water and land of the pollutants specified in Annex III to the Directive (**see Appendix 1**). It also includes measures concerning waste, use of raw materials and energy efficiency.

Where it is felt necessary, the Commission can propose and the Council can set EU wide Emission Limit Values (ELV) for any of the polluting substances referred to in Annex III. So far, there have been no such proposals for EU wide ELVs to be set under the IPPC Directive. However, in their absence, relevant ELVs contained in other environmental Directives and in other Community legislation shall be applied as ELVs. Member States can impose their own. These environmental Directives are listed in Annex II of the Directive which is reproduced in **Appendix 1** of this report. However, this list covers the legislation in force at the time the Directive was adopted and is no longer up to date – this list changes with time and the latest is published at [http://europa.eu.int/index\\_en.html](http://europa.eu.int/index_en.html).

An important element of the Directive is that the whole process has to be open to scrutiny by the public.

The various terms used in the Directive are defined in **Appendix 2** and more details on the content of the Directive are given in **Appendix 3**.

### 2.3. BEST AVAILABLE TECHNIQUES (BAT)

The Directive clearly states that to achieve the required level of protection of the environment, BAT is to be used. However, BAT is not a fixed concept and in any particular case, BAT has to be determined taking into account a number of factors including cost / benefit. This issue is discussed in **Section 3.6**. The definition of BAT given in the Directive is:

- **Techniques** shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.
- **Available** techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, **under economically and technically viable conditions, taking into consideration the costs and advantages**, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator.
- **Best** shall mean most effective in achieving a high general level of protection of the environment as a whole. In determining the best available techniques, special consideration should be given to the items listed in Annex IV to the Directive (see **Appendix 2, Table 2**).

BAT has to be established locally on a case by case basis. The technique should be selected as the best for all environmental compartments including minimising the use of energy and raw materials. BAT may well vary from place to place depending on the relative sensitivity of the different environmental media. The cost also has to be commensurate with the benefits achieved.

A number of factors have to be taken into account generally or in specific cases when determining BAT as defined above. As well as these considerations, there is a very important proviso, viz.:

***“bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention.”***

Therefore, the determination of what is BAT for any particular process or pollutant does not involve the imposition of any specific technique or technology. Rather, the performance of available techniques which might be considered as BAT needs to be determined. The operator is then free to achieve an equivalent performance (provided that the cost versus benefit is justified) in any way that is appropriate.

### 2.4. ENVIRONMENTAL QUALITY OBJECTIVES AND STANDARDS

The Directive also refers to Environmental Quality Objectives (EQO). These are descriptions of the quality of a receiving environmental media which it is desired to achieve. Environmental Quality Standards (EQS) are then set which are the concentrations of pollutants which should not be exceeded if the EQO is to be met. Such EQS can be set at the European level, the national level or even at a local level. There are many air quality EQS set by the Air Quality Framework Directive and its daughter Directives. EQS for certain pollutants to water are currently being set at the European level through the Water Framework Directive but there are already many national EQS for water covering a wider range of pollutants.



Whether or not the receiving environment of a refinery complies with relevant EQO / EQS is important in determining what actually would be BAT for that refinery. However, the Directive is quite clear that where the EQO / EQS would not be achieved even if the techniques normally considered to be BAT were applied, then the installation has to go beyond BAT. Going beyond 'Best' may appear impossible but the implication is that in this case, cost issues are ignored and excessive costs might have to be borne.

The IPPC Directive also regulates energy efficiency through Article 3(d), which requires Competent Authorities to take into account the basic obligation of the operator to use energy efficiently when determining the conditions of the IPPC permit.

## 2.5. BAT REFERENCE DOCUMENTS (BREF)

Article 16 of the IPPC Directive requires that a process of information exchange between the main stakeholders takes place. The outcome of this exchange is the production of a so-called Best Available Technique Reference document (BREF) for each major industrial sector. The BREFs are intended to give guidance to regulators on each sector and its emissions, what can be considered as BAT for the sector, the levels of pollution abatement achievable, the cross-media implications, energy use, costs, etc.

To understand what BREFs are, it is easiest to outline what they are not:

- BREFs are NOT prescriptive (though, as written, they sometimes appear that way)
- They are NOT a legal interpretation of the IPPC Directive
- They do NOT in any way relieve the Member States from their obligations to protect the environment
- They are NOT exhaustive
- They do NOT take into account local conditions
- They CANNOT determine BAT at regional or national level.

What they are is a record of the information exchange process and a collation of information for the guidance of decision makers involved in the implementation of the IPPC Directive [3,4]. For the purpose of producing the BREFs, the European Commission established the European IPPC Bureau (EIPPCB) based in Seville. EIPPCB staff members manage the BREF process, collate all the information and draft the documents. To establish the *potential* content of each BREF, a Technical Working Group (TWG) is established. The membership is drawn from Member State experts, industry and environmental organisations. TWG members are expected to provide the majority of the information for the development and update of the BREF. For each TWG, EIPPCB produces a draft BREF incorporating TWG comments on the collective work. This is submitted to the Information Exchange Forum (IEF) - a joint EU Commission, Member States, Industry, NGO discussion forum for final adoption.

There are two sorts of BREF, Vertical which apply only to one industry sector (such as the Refinery BREF – the subject of this guidance document) and so called Horizontal BREFs which describe common activities across a number of sectors. Many of these are of relevance to refineries. In particular:

- Cooling systems
- Monitoring
- Storage
- Economics and Cross Media
- Waste Treatments
- Energy Efficiency

Only the first two have so far been published (July 2003).

## 2.6. BREF STRUCTURE

The Refinery BREF (typical of a vertical BREF for an industrial sector) contains the following sections:

- **Executive Summary**
- **Preface** – A common text for all vertical BREFs.
- **Chapter 1, General Information** – Provides general information on the mineral oil and gas refineries.
- **Chapter 2, Applied Processes and Techniques** - Provides general information on the production processes and related activities that are found within the sector.
- **Chapter 3, Current Emission and Consumption Levels** – Provides data and information on current emissions and consumption levels.
- **Chapter 4, Techniques to Consider in the Determination of BAT** – Describes the prevention and control activities that are considered the most relevant for determining BAT.
- **Chapter 5, Best Available Techniques (BAT)** – Presents the techniques and the emission and consumption levels that are considered to be compatible with BAT.
- **Chapter 6, Emerging Techniques** – Briefly describes techniques that may be applied in the future.
- **Chapter 7, Concluding Remarks** – Summary of the conclusions and recommendations of the document.
- **References, Glossary and Annexes** – Include a summary of the relevant legislation, of the different types of refinery configuration, and descriptions of the main products and intermediates generated within refineries.

**It is important that the operator understands that the BREF should be treated as a whole and in particular, that Chapter 5, which includes the BAT conclusions, is read in conjunction with Chapter 4, which contains details of the various techniques, the associated costs, limitations as to the BAT's use, cross-media impacts, etc.**

## 2.7. EMISSION LEVELS

Various types of emission levels are quoted in the document. These levels are usually expressed in terms of ranges rather than single values. These fall into four main categories:

- Current Emissions Levels (covered in Chapter 3 of the BREF),
- Achievable Emission Levels (for each candidate BAT process covered in Chapter 4 of the BREF),
- BAT Associated Levels (reported in Chapter 5 of the BREF),
- Emission Limit Values (the only regulatory limits).

### 2.7.1. Current Emission Levels

The levels of emissions to air, water, etc. under existing permits.

### 2.7.2. Achievable Emissions Levels

These are defined as the levels that may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using the relevant techniques.

### 2.7.3. BAT Associated Emissions Levels (AEL)

These are meant to represent the environmental performance that could be anticipated as a result of the application of the BAT in question in the refinery sector. In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross-media considerations, such schemes are not considered to be appropriate as BAT for the refinery sector as a whole. The definition in the document includes the statement:

*"such levels may be considered to be justified in more specific cases where there are special driving forces".*

The BAT Associated Emissions Levels and Achievable Emission Levels are derived from information originating from a variety of sources. These include published material, equipment suppliers, Member State regulatory bodies, industrial sites operating the relevant processes and environmental organisations.

### 2.7.4. Emission Limit Values

It is important to realise that none of the levels described above is meant to represent an Emission Limit Value *i.e.* a regulatory control value, nor are they intended to be used as such. The only ELVs mentioned in the BREF are examples from Member State legislation.

ELVs are to be set by the local Competent Authority (CA) on a site specific basis. To quote from the Directive:

*"The emission limit values and the equivalent parameters and technical measures have to be based on the Best Available Techniques. However, they should not*

*prescribe the use of any technique or specific technology, and should also take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions.”*

It follows that ELVs are not to be set generally for an industrial sector. However, in most cases, there will obviously be similarities in the ELVs for particular pollutants and the BAT Associated Level. However, the CA may set less severe standards if they can be convinced that the cost of achieving more stringent levels provided that the EQO / EQS levels are achieved. Conversely, they can set more stringent levels where the EQO / EQS levels are not being achieved.

## 2.8. THE REFINERY BREF

CONCAWE participated in the Refinery TWG as a member, and a large part of the technical information submitted to the Refinery TWG was from CONCAWE Report No. 99/01 [5].

The structure of the Refinery BREF document does not reflect the opinion of CONCAWE or several member states. We had proposed treating the refinery as an integrated whole using a media by media, pollutant by pollutant approach. There were obviously exceptions where there exist significant emission types specific to a particular process (e.g. catalytic cracking). Instead the EIPPCB opted for a process by process approach rather than the pollutant / media approach.

CONCAWE and many other stakeholders, consider the Refinery BREF document has many deficiencies. There are 27 “split-views” where either industry or Member States disagreed with the EIPPCB.

Much of the document (particularly the technical chapters) is a useful description of current day practices in Europe and guidance to refineries on measures they should consider when planning to improve their environmental performance. **There is, however, serious concern that the BREF will be misconstrued as a blue-print for all refineries that would have to exclusively use the techniques described and be able to achieve the best of the emissions levels quoted. This is of course not in accordance with either the letter or the spirit of the IPPC Directive, but Member Companies and Refinery Management will have to be prepared to answer such claims.**

Chapter 5 of the BREF is where some 200 BATs are briefly described. In many cases the explanation is weak. A single line of text defines the BAT. There is no indication of the context in which the technology has been conceived as BAT and no indication of possible limitations.

Consequently, CONCAWE has severe reservations on a number of them. These are further described in **Section 4**. In particular, the BAT identifications where there are concerns about:

- the values quoted for the BAT achievable emission levels
- BATs quoted with little or no supporting detail in Chapter 4
- a few BATs which CONCAWE considers are simply wrong.

In the majority of cases however, CONCAWE's position was that although the BAT described was acceptable in most circumstances, not enough weight was given to the difficulties, such as retrofitting costs in Europe's mature refining industry nor was there enough consideration given to the cross media effects and energy use of alternative techniques.

One of the main areas of disagreement was the setting of the various emission levels quoted in the document. Much of the information on the performance that could be expected from abatement techniques was provided by CONCAWE. Additional information was provided by Member States and published data. In most cases, this resulted in a range of values. The EIPPCB (supported by some Member States) maintained that only the best performers in this range should be taken to indicate achievable levels. CONCAWE's position was that "best" performance might have been due to special circumstances such as low throughput, favourable crude type, etc., that did not necessarily apply to the majority of refineries. Therefore, to avoid over-optimistic expectations, the whole range should be taken as the achievable level, except perhaps where the "poor" end of the range clearly results from less than optimal operational practices.

### **3. PRACTICAL GUIDANCE FOR OPERATORS PREPARING PERMIT APPLICATIONS**

The IPPC Directive requires Competent Authorities to issue permits to sites based upon the use of BAT. Therefore, the main requirement is to determine what is BAT in a particular location. There are two aspects to the determination of what is BAT:

- What constitutes “Best” or “Among the Best” based on emission reduction technological potential,
- What constitutes “Best” based on achieving defined “environmental objective(s)” for an individual plant in the most cost-effective manner.

The first focuses on “technical capability”, the second on “environmental need”.

The IPPC Directive recognises both aspects. In its requirement to develop an exchange of information based on a “catalogue of BAT” it is focussing on the first aspect (Art 16.2). In acknowledging the local site-dependent considerations (including environmental needs) when determining a local BAT within the licensing process, the second aspect is in view (Art 9.4).

#### **3.1. OVERVIEW OF STEPS**

This guidance for the operator consists of a number of logical steps. In fact, many of these steps will be undertaken simultaneously and there will be an iterative process where data gaps will be identified and further data gathering undertaken. The main steps are:

STEP 1 – Understand the requirements of the Competent Authority and legislation.

STEP 2 – Collect and prepare data on the site and its operations.

STEP 3 – Know the local conditions.

STEP 4 – Compare the refinery performance with legislative standards.

STEP 5 – Determine the ‘Site Specific’ BAT

Two other sections are also included, namely, section on other considerations and a detailed background to the bubble concept. Check the Emission Bubble Approach.

#### **3.2. STEP 1 - UNDERSTAND THE REQUIREMENTS OF THE COMPETENT AUTHORITY AND LEGISLATION**

The operator should:

- assess how the Authorities are likely to progress IPPC and use the BREF document. For instance, the Member States can provide their own IPPC Guidance or rely on interpretation of the full BREF by their Authorities,
- review the local, regional, national, international programmes, policies, and legislation concerning the present and future environmental conditions. He

should be fully aware of the rules and regulations that are already in place and that his installation needs to adhere to,

- be aware of the main recommendations included in the Refinery BREF or in the national guidance note,
- where emissions are currently controlled by the 'Bubble' method, confirm that this method will still be used in the IPPC permit and whether the conditions are unchanged.

Throughout this whole process, it is advisable for the operator establish close relations with the local Competent Authority.

### **3.3. STEP 2 - COLLECT AND PREPARE THE REFINERY DATA**

When applying for permits (see Article 6 of the IPPC Directive [1]) the application to the competent Authority has to include descriptions of:

- the installation and its activities,
- the raw and auxiliary materials,
- other substances and the energy used in or generated by the installation,
- the sources of emissions from the installation,
- the conditions of the site of the installation,
- the nature and quantities of foreseeable emissions from the installation into each medium as well as identification of significant effects of the emissions on the environment,
- the proposed technology and other techniques for preventing or, where this not possible, reducing emissions from the installation,
- where necessary, measures for the prevention and recovery of waste generated by the installation,
- further measures planned to comply with the general principles of the basic obligations of the operator as provided for in Article 3,
- the measures planned to monitor emissions into the environment.

An application for a permit shall also include a non-technical summary of the details referred to in the above points. Where information supplied in accordance with the requirements of the Environmental Impact Assessment Directive 85/337/EEC [6] or in a safety report prepared in accordance with the COMAH (Seveso) Directive 82/501/EEC [7], or in response to other legislation, fulfils any of the requirements of this article, that information may be included in, or attached to, the application.

This information is designed to inform the competent Authority and the public on the impact of the installation and also on the means by which the impact is to be controlled. Of course not all of this information will be ready at the start of the process. In reviewing these data, the operator will probably find that some data are missing. It is useful to undertake some data gathering in cases where an understanding of current performance is lacking to ensure that these data can be used as support in any discussions with the permitting authority.

To summarise, the operator has to:

- collect the basic data required for the permit application. It is at this point, that “gaps” in the data will become apparent,
- make arrangements to collect sufficient data by testing or monitoring to establish any pollutant loads.

### **3.4. STEP 3 – KNOW THE LOCAL CONDITIONS**

Within the provisions of the Directive there is a clear recognition of the need to account for the specific local situation of a given plant in determining an appropriate ‘site specific BAT’ (Article 9.4). This article includes the obligation for the Member States’ Competent Authority to account for the contribution of emissions from the plant not only at the local level, but also at the trans-boundary level. Whether or not the site is in area where the EQS are exceeded should have an influence on the site specific BAT.

It is therefore imperative that the operator appreciates the local, regional, national and international programmes, policies and protocols influencing the present and future environmental conditions of the installation such as:

- do the concentration of air pollutants in the refinery area comply with air quality standards?
- do the level of pollutants in any receiving waters comply with water quality objectives and standards?

Of course, few if any refineries will be the only contributor of emissions in their particular area. Thus, the refinery will also need to have some knowledge of the emissions of other contributors and the importance of the refinery in relation to these. In some countries, there may be scope for emissions trading so that the greatest gains may be made in the most efficient manner. Any such discussions should only be made with the full cooperation of the competent Authority.

### **3.5. STEP 4 - COMPARE THE REFINERY PERFORMANCE WITH LEGISLATIVE STANDARDS**

By this stage, the operator will have a clear picture as to how his refinery is performing compared to legislative constraints. The upper boundary is the minimum obligation to meet the emission limit values enshrined in other Directives. In the case of large combustion plants, this means compliance with the emission limit values for SO<sub>2</sub>, NO<sub>x</sub> and dust mandated in the recent update of the Large Combustion Plant (LCP) Directive [8]. In addition, for refineries, it means compliance with the SO<sub>2</sub> bubble mandated in the Sulphur in Liquid Fuels Directive [9]. Other European standards will be set under forthcoming daughter Directives to the Water Framework Directive [10]. The refinery will also be a contributor to the national allowable loads for SO<sub>2</sub> and NO<sub>x</sub> set by the National Emissions Ceiling Directive [11] which will also affect the degree of pressure that the refinery is under to reduce emissions of these pollutants.



The lower boundary would then be defined by the lowest emissions achievable from commercially available abatement techniques for the various units in refineries as outlined in the Refinery BREF document. This may give a wide range within which the final emission standards will be set. Refinery operators should know where their existing operations or any new designs fall in the BAT AEL ranges. If they are already well within the ranges, they will be able to claim that they are already at "BAT". Conversely, those outside the high end of the range will have to determine how they can most cost-effectively change their operations to achieve emission levels inside the range.

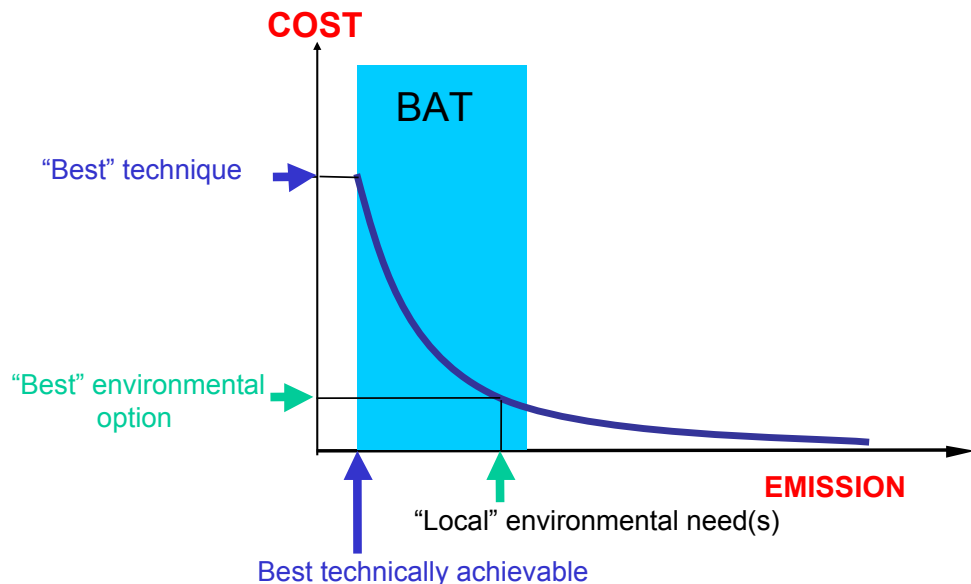
**3.6. STEP 5 - DETERMINE THE 'SITE SPECIFIC' BAT**

To determine where to aim for within the range described above (Step 4) will also require the operator to assess the local environmental quality (Step 3). If local conditions do not conform to the EQOs, then the refinery is likely to be under severe pressure to reduce its emissions. If the environment around the refinery meets the local standards, the refinery will be able to invoke cost effectiveness in its arguments about emission standards and what is the appropriate BAT.

Detailed assessment of the site specific situation should determine where in the resultant AEL range for a particular parameter the site specific ELV should be. To be consistent with the environmental target driven approach, this should include an assessment of the cost effectiveness of available techniques corresponding to the range of AELs (i.e., incremental cost divided by incremental emission reduction or the "marginal cost"). This is in-line with the guidance provided by the EU [12] and provides an important perspective on what constitutes 'Best' among the range of available techniques.

To identify the best site specific BAT it is important to recognise two aspects in the consideration of BAT, viz. What constitutes 'Best' or 'Among the Best' based on emission reduction potential and what constitutes 'Best' based on achieving defined environmental objectives for an individual plant in a cost-effective manner. The first focuses on technical capability, the second on environmental need. This is illustrated in **Figure 1**.

**Figure 1** Selection of BAT



The operator should be aware of the danger of incorrect cost-benefit accounting that does not take into account reductions of pollutants from controls already in place. This should be considered in both bubble and non bubble situations when determining the appropriateness of applying a certain control. For example, the benefit of ultra-low NO<sub>x</sub> burners is much reduced where low NO<sub>x</sub> burners are already in place. Information on costs is in CONCAWE document 99/01 [5] as well as the BREF document itself [2]. Site-specific cost estimates are preferable taking due account of the inevitable additional costs of retrofitting over and above the cost of a stand alone unit.

### **3.7. USING THE REFINERY BREF DOCUMENT**

#### **3.7.1. Emission Levels**

Although the application of BAT is mandatory, none of the emission levels quoted is intended to be translated directly into permit levels. Nevertheless, local regulators will use them as a starting point for discussions with installations such as refineries. In any such discussions, it will be important to refer back to Chapter 4 of the BREF for the supporting rationale, or lack thereof, when local regulators are in the process of determining what might constitute BAT for a new or existing facility. There are also cases in Chapter 4 where the data exists to show that a broader AEL may well have been justified than appeared in Chapter 5. This is particularly true where the best available technology is in place (exists) but is not achieving the emission levels quoted for new equipment. FCCU cyclones would be a good example.

#### **3.7.2. Cross Media Effects and Energy Efficiency**

While cross-media effects are acknowledged in the BREF (Chapter 4), there is very little information on either their scale or relative importance. This also applies to the energy required for a technique. In a number of cases, the choice of what is BAT for a certain pollutant has been made after only a very superficial analysis of the implications for emissions of other pollutants, usage of resources or safety considerations. Furthermore, there is very little information in the document on noise emissions and odour. Such implications are often site-specific. All these issues will need to be addressed in discussions with permitting Authorities.

The use of energy is also tied up with carbon dioxide emissions, which although not a specified pollutant under IPPC falls within the IPPC's broad definition of pollution. Therefore, energy consumption and the maximisation of energy efficiency will be key elements in any BAT discussions. Unfortunately, many of the BATs for other pollutants are likely to increase the demand for energy, and this factor must always be considered. The operator should be prepared to undertake energy reviews of alternate technologies.

There are proposals to amend the IPPC Directive so that where emissions of a greenhouse gas from an installation is covered by the emissions trading scheme, the IPPC permit relating to that installation does not set a limit on its emissions. This would mean that emissions from one site do not necessarily have to conform to BAT but that over two (or more) sites, the emissions of greenhouse gases would be minimised.

### 3.7.3. Costs

The BREF contains very limited information on costs and what there is was mostly supplied by CONCAWE [5].

It is important to remember that the costs quoted in the document are often **vendor** costs rather than **installed** costs. In its submission to the TWG, CONCAWE gave examples showing that installed costs are often well above the simple cost of the equipment. There is no simple relationship between these two sets of costs which depend heavily on local circumstances such as availability of space, requirement to move existing equipment, integration into control systems, etc. When discussing modifications to achieve BAT, refinery operators will have to obtain reasonable cost estimates of the actual installed costs, rather than rely on the very general figures in the BREF.

Normally, refineries will already have some type of abatement equipment installed. The improvement to BAT is therefore not the BAT emission level minus the uncontrolled level, but rather the BAT level minus the existing level. When calculating the cost / benefit, it is this **incremental** improvement which needs to be set against the cost.

### 3.7.4. Retrofits and Space Limitations

There is very little in the Refinery BREF about retrofitting and space limitations. Most refineries are already closely integrated so that fitting in new technology particularly if the equipment is large, brings its own problems of demolition, use of additional land, perhaps with waste issues or providing utilities to a new area which is not currently served. All these have potential environmental impacts and costs and must be addressed in the early analysis phase. Changes in plant layout may also affect permitting from a safety point of view.

## 3.8. USE OF THE BUBBLE CONCEPT

Refinery emissions, particularly those of sulphur compounds to air, are controlled in many Member States by what is known as the 'bubble concept', where a limit is set on the emissions of the refinery as a whole, rather than imposing limits on individual units and/or emission sources. At first sight, this concept is incompatible with the concept of BAT which implies that emissions from all sources should be controlled to the maximum extent possible. However, given that cost / benefit is included in the definition of BAT, the bubble concept allows a flexible means of achieving an overall emission limit from a group of plants at minimum cost.

Many Member States, supported by CONCAWE, insisted that the bubble concept should be included in the BREF which now states that "*it can be used as an effective management tool to prioritise the application of environmental techniques.*" Section 4.15.2 of the BREF Document discusses the bubble concept in some detail.

The bubble concept is in practice related to air emissions from combustion. It is applied in single refineries covering all emissions from furnaces, boilers and incinerators/regenerators (e.g. FCC, SRU). It is already an accepted regulatory tool in several EU countries, mainly for SO<sub>x</sub>, but in some cases is also applied for NO<sub>x</sub>, particulates and nickel. Some articles of existing EU Directives also refer to the bubble concept. However different Member States have different interpretations of

the units to be included and also in some countries it is expressed as a concentration in flue gas, where as in others it is expressed as a load of pollutant released.

Countries that apply the bubble concept have recognised that refineries must use their own residual fuels, the composition of which depends on their crude slate. This is very different from other industries that buy specified fuels from outside. The bubble approach is accepted as a proper regulatory instrument to set environmentally driven air emission limit values. At the same time it guarantees that the refinery can still respond to market opportunities on the crude oil, the supply/demand situation for oil products and can operate effectively in a very competitive environment. It can be linked to the BAT concept in the same way that an Environmental Management System (EMS) provides a fuel management approach to achieve a desired environmental performance at optimal cost. However, the more severe the limit of the bubble is, the less the operational flexibility and room for making alternative choices of fuels. Also a strict bubble will restrict the use of other flexible instruments available to the regulators (such as emissions trading).

**Table 1** gives a typical set of values in which to establish the levels in place at the refinery.

**Table 1** Range of Associated Emission Limit Values (Total Refinery Bubble Basis recommended by CONCAWE)

Bubble AELV (mg/Nm <sup>3</sup> )	Lower	Upper
SO <sub>2</sub>	250	1700
NO <sub>x</sub>	150	450
Dust	15	50

The resultant ranges are appropriately wide since they represent a suitably comprehensive catalogue of techniques aimed at covering all specific situations; e.g. new or existing plant, the range of refinery fuels, the full range of existing (not obsolete) techniques including those aimed at achieving maximum emission reduction.

It should be noted that the BAT range for SO<sub>2</sub> in the BREF is given as 50 to 850 mg/Nm<sup>3</sup>. However, at a very late stage, the Commission added a comment:

*“The Commission has noted the divergent views of the TWG concerning the average sulphur dioxide emission levels when burning liquid fuels, associated with the use of BAT. The Commission further notes that the Council Directive 1999/32/EC on the sulphur content of certain liquid fuels prescribes a maximum emission limit value of 1700 mg/Nm<sup>3</sup>, which equates to 1% sulphur in heavy fuel oil, as a monthly mean value averaged over all plant in the refinery from January 2003. In addition, the more recently adopted Directive 2001/80/EC on large combustion plants provides for emission limit values in the range of 200 to 1700 mg/Nm<sup>3</sup> depending on the characteristics of plants covered by that Directive.”*

In this perspective, the Commission believes the range of 50 to 850 mg/Nm<sup>3</sup>, as average sulphur dioxide emission levels when burning liquid fuels to be consistent with BAT. In many cases, achieving the lower end of this range would incur costs and cause other environmental effects which outweigh the environmental benefit of the lower sulphur dioxide emission (reference in Section 4.10.2.3). A driver towards the lower end could be the national emission ceiling for sulphur dioxide as fixed in Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants or if the installation is located in a sulphur sensitive area.”

This text although confirming the BREF values, does at least point out that there may well be strong **environmental** reasons for NOT choosing values at the low end of the range.

#### **4. DETAILED BAT FOR REFINERIES (CHAPTER 5 OF THE BREF)**

**All page numbers referred to in this section refer to Chapter 5 of the Refinery BREF.**

Chapter 5 of the Refinery BREF describes over 200 BATs. It is not the intention of this section to critique every one of those BATs but to focus on those BATs where there had been split views or where CONCAWE felt that there were some errors. Many of the BATs are non-contentious and operators will find that they are already using many of these BATs. Other BATs may be worth considering in the event that progress towards an environmental quality objective is required. Indeed, many were suggested by CONCAWE as examples of good environmental practice in the refining industry. It must be stressed that these BATs are not all applicable in every case and some are even mutually exclusive. Where no comment is made, it therefore does not mean that BAT can or should always be applied. They should be considered against other alternatives available to meet the desired EQO.

CONCAWE considered that many of the BATs presented in this chapter were not well enough supported technically or economically during the BREF drafting process to justify their inclusion. CONCAWE's proposals were that BAT's should meet at least the following criteria:

- Demonstrated technical capability with at least two years full scale applicability at two sites,
- Cross media effects such as energy usage and waste produced are fully accounted for,
- Good cost data were available and the ability to retrofit was demonstrated,
- Demonstrated possibility of retrofitting in existing installations.

#### **4.1. COMMENTS ON GENERIC BAT (SECTION 5.1 OF THE BREF)**

##### **4.1.1. Environmental Management Systems (EMS)**

Refer to page 396 of the Refinery BREF. There is a generic BAT on how to implement and adhere to an EMS system. This has not been defined as a specific commercial EMS such as ISO 14001 or EMAS. The elements given on page 396 are suggestions for an EMS and are not, of course, mandatory. When planning for IPPC permitting, sites should anticipate the importance of having an EMS but can strongly resist any attempt by the permitting authority to require compliance with ISO 14001 or EMAS, or any particular element of an EMS listed in the BAT. This is particularly true of things like 3rd party auditing or public reporting. The record of the TWG is clear that it was not intended that all the listed elements be required.

##### **4.1.2. Using Clean Refinery Fuel Gas (RFG)**

Refer to page 397 of the Refinery BREF. This bullet point was registered as a split view by Industry in the final draft. The contentious word was "and" after "RFG". CONCAWE suggested the word "or" instead. The view was that the word "and" prescribes a priority and removed the freedom of choice element for the operator to

choose his fuels to meet his bubble for air emissions. The operator should be prepared to argue that he can meet his obligations in several ways.

#### 4.1.3. Reducing SO<sub>2</sub> Emissions

Refer to page 397 of the BREF. Reducing SO<sub>2</sub> Emissions by “reducing SO<sub>2</sub> emissions” (fourth sub-bullet point) was argued by CONCAWE as not being a legitimate BAT as it offered no technique or back up recommendations. “Small” and “significant” are relative terms. It seems likely that these small contributors in refineries are already disposed of safely by either flaring or burning as a waste gas. It is, however, recommended that the operator be aware of all such streams and can account for them in his sulphur balance.

#### 4.1.4. Bubble Range of Emissions

Refer to page 397 and 398 of the BREF. The text clearly shows a wide variation in the range of emissions. However, this does not detract from the legitimacy of this top-down approach. Sites should feel empowered to actively pursue the use of bubbles with their permitting Authority. The fact that it was introduced into the BREF at the request of several countries indicates the desire to consider this a legitimate means of permitting under IPPC to meet the EQO (see also additional text added by the Commission, **Appendix 4**).

#### 4.1.5. Reducing VOC Emissions

Refer to page 399 of the BREF. Three issues in this section are worth noting.

DIAL was accepted as a valid technique for the monitoring of VOCs but the availability of this technique is limited. It has little relevance to emissions control. As far as CONCAWE is aware, there are only a few operators in the whole of Europe who offer this service making its availability somewhat limited for the 100+ European refineries. Any attempt by a permitting authority to impose DIAL as BAT would be inappropriate. The record of the TWG meetings will confirm that the debate on this led to the consensus that DIAL is one of the options (not **the** BAT option) of monitoring VOC.

Leak Detection and Repair (LDAR) or equivalent was left to the operator to define.

It should also be stressed that the use of maintenance drain out system does not imply permanent fittings when a temporary one for unit shutdown is appropriate.

#### 4.1.6. BAT for Reduction of Discharges to Water

Refer to page 399 of the BREF. It should be noted that the ranges given in the water consumption table represent **benchmarks** and not BAT levels. Even so, the top of the range figures quoted are the average for a number of European refineries, but some refineries actually use considerably more. CONCAWE maintained that the benchmark range should be wider and that 1 m<sup>3</sup> per tonne throughput was a more realistic figure for the process effluent volume. This is still not the maximum value for all refineries.

#### 4.1.7. Table of BAT Associated Emission Values for water

##### 4.1.7.1. Load Figures

Refer to page 400 of the BREF. CONCAWE maintained that the load figures in the third column should be calculated using a process volume of 1 m<sup>3</sup>/t which would approximately double the values. Further, CONCAWE believes that the load values set here should not be AELs at all, but rather benchmark values since they were calculated from benchmark figures (**Section 4.1.6** above) and not AELs.

##### 4.1.7.2. Total Hydrocarbon Content

Refer to page 400 of the BREF. CONCAWE disagreed with the upper value of 1.5 mg/l for hydrocarbons for two reasons.

Firstly, the method that has been used for a number of years to analyse oil in water is no longer allowed because of restrictions on the use of the solvent (Freon). At present, there is no agreed replacement method. The results obtained for oil in water are very dependent on the method used and it is possible that a new method will give different answers with no simple relationship between the values measured by the new method and the old one. Hence, the data used to determine the AELVs may not be comparable to the future situation.

Secondly CONCAWE does not accept that 1.5 mg/l is an acceptable figure. This value was based on preliminary refinery effluent survey data provided by CONCAWE. Only refineries using the accepted BAT currently in place (3-step Waste Water Treatment Plant) were considered. Although many refineries did discharge an effluent which conformed to the 1.5 mg/l standard, there were many which do not. CONCAWE therefore proposed a value of 3 mg/l which is attained by the majority (but not all) of refineries so equipped.

##### 4.1.7.3. Averaging Time

CONCAWE maintained that the averaging time for water analysis should be annual. Although all data submitted by the TWG were either daily or annual, monthly average limits have been specified. All the data submitted by CONCAWE on actual industry performance were annual. One cannot use yearly values to set monthly or daily averages without transforming those values to reflect much wider variation that will occur over the shorter averaging time. Attempts by permittees to use these numbers as anything but annual averages should be challenged.

##### 4.1.7.4. Total Nitrogen

CONCAWE maintained that the figures given (1.5-25 mg/l total nitrogen) are only applicable to areas where eutrophication in the receiving water has to be prevented. Where nitrogen is not a pollutant of concern in the receiving waters, (and this may have to be checked by the operator) denitrification cannot be BAT as the environmental benefit to the receiving water is very low. However, the cross-media effects (energy use and CO<sub>2</sub> emissions) are large. Also, the cost, both in capital and for operation is high.



## **4.2. COMMENTS ON PROCESS BAT (SECTION 5.2 OF THE BREF)**

CONCAWE argued from the outset of this BREF that many of the BATs in the process section were not BATs at all but legitimate choices of alternative process techniques. Each needed to be evaluated on its own merits in the local situation. Moreover, if a plant already exists, its replacement by an alternative technology is very unlikely to be justifiable simply on marginal environmental gains.

### **4.2.1. BAT for Base Oil Production**

#### **4.2.1.1. Triple Effect Evaporation**

Refer to page 403 of BREF. Use of triple effect evaporation in a new unit may be BAT in the appropriate local setting, as this would allow lower utility usage than the alternatives. However, whether it is feasible to convert existing units to triple effect evaporation is more problematic with the change of temperature/pressure gradients and retrofitting additional kit in the process area. It should be noted that in the example given on page 166 of the BREF has a simple payback of 19 years – a poor choice of resource use for a small advantage.

#### **4.2.1.2. NMP versus Furfural**

CONCAWE's view was that no case has been made for NMP over furfural as both had advantages detailed in Chapter 4 of the BREF and were offered as equal contenders for solvent choices. No case was made to favour one over the other. Certainly, a switch of solvent from furfural to NMP would be difficult using the existing hardware so a rebuild would probably be the only option and no case made in the BREF documentation for any clear environmental benefit.

#### **4.2.1.3. Waste Water Stripping from Aromatic Extraction**

CONCAWE was not convinced with any information offered that special waste water stripping was needed for either NMP or Furfural after the process unit as this BAT suggests. A site check by sampling should confirm the view that solvent carryover in the waste water stream to the waste treatment is negligible and would not necessitate separate treatment. CONCAWE was not convinced that the next bullet: "consider the effects of solvents...." was anything more than data examination – and should not be classified as a BAT.

#### **4.2.1.4. Apply Leakage Prevention Measures**

CONCAWE's view was that is not a BAT for process at all but one of storage therefore specific to the production of base oils.

### **4.2.2. Bitumen Production**

Refer to page 403 of the BREF. CONCAWE is unaware of anyone using an ESP for the removal of any liquid portion of the aerosol. The last bullet point suggests there is a recovery method for condensables from bitumen blowers. To the best of CONCAWE's knowledge, any small quantities of condensate are normally incinerated as they can be malodorous. Indeed, the reference given on Section 4.4.2.2 (not 4.4.22 as printed in the BREF) suggests just that. This BAT is not supported by any text elsewhere in the BREF. In CONCAWE's opinion, these are

simply incorrect BATs that do not seem to be supported by the UK reference material quoted.

#### **4.2.3. Catalytic Cracker NOx AELs**

Refer to page 404 of the BREF – 1<sup>st</sup> bullet point. This was an industry split view. CONCAWE still remains of the view that the NOx range should be 100-500 mg/Nm<sup>3</sup> consistent with the support data provided in Chapter 4, Section 4.5.3. No technical rationale has been offered to support the upper limit suggested (300 mg/Nm<sup>3</sup>) as being realistic under all conditions and feed types experienced in Cat Crackers (FCCs).

#### **4.2.4. Catalytic Cracker NOx Reduction BATs**

Refer to page 404 of the BREF. None of the so called BATs for reducing NOx emissions are easy options to undertake and would require major changes.

The first one, “modify the design and operation ...”, has not even been clearly defined in terms of what would precisely be required or what expected environmental benefits, including cross media effects would actually be.

The second one, “hydrotreat the feedstock” is a possible way to reduce sulphur in the feed. However, the relationship with nitrogen oxide formation (Not only fuel NOx but also thermal NOx plays a part) is more problematical.

This would be a key area where the operator could prepare a case by collecting data and costs relevant to his cat cracker prior to discussing with his permitting Authority.

#### **4.2.5. Catalytic Crackers ESPs and Scrubbers**

Refer to page 404 of the BREF. CONCAWE argued that ESPs operate with a particulates emission range of 10- 50 mg/Nm<sup>3</sup> and there are ESPs in service that do just that. To try and crop the range to 10-40 mg/Nm<sup>3</sup> would render those ESPs as non BAT, a clear nonsense. The final wording of this BAT is an acceptance of that view.

Refer to page 405 of the BREF – 2<sup>nd</sup> bullet point. This was an original industry split view. CONCAWE still remain of the view that the efficiency range should be consistent with the support data provided in Chapter 4 in Section 4.5.9.2 & 4.5.10.2. Mixing two techniques with one set of efficiency range has not helped. The lower end of the range for scrubbers is quite clearly reported as 85%. To imply that the associated level is 95-99% is disingenuous (even though a subsequent piece of text contains the comment that high efficiency percentages have not been reported with scrubbers) and is not helpful to the operator.

As in the case above, these items would be major items to retrofit, so collating data relevant to these BATs would be worthwhile.

#### **4.2.6. Catalytic Reforming Wet Scrubbing**

Refer to page 405 of the BREF. To the best of CONCAWE's knowledge, wet scrubbing is not widely used to treat the flue gases from regenerating cat reformer catalyst – certainly not semi-regenerative catalytic reformers. The main product from regeneration is carbon dioxide from the coke on the catalyst. There should certainly not be sulphur products (see Sections 4.6.4 & 4.6.5 of the BREF document) as sulphur is a poison to the catalysts and strenuous efforts are made to clean the feed to the reformer of such sulphur compounds. There may be some trace chloride products as chlorinated agents are used as a promoter on reformer catalysts. CONCAWE argued (unsuccessfully) that the dioxin question should be moved from the BAT section to Section 6 – emerging techniques. There is, as yet, insufficient evidence to conclude that dioxin is a problem.

As a precautionary measure, the operator might consider arranging to collect some data on the regenerator flue gas to check that dioxin is not present.

#### **4.2.7. Cat Cracking FGD**

Refer to page 405 of the BREF. There is one government-subsidised FGD unit in a refinery in the whole of Europe and this is not on a Fluid Cat Cracker. In CONCAWE's view this does not make FGD a proven BAT for sulphur dioxide clean up in cat crackers.

#### **4.2.8. Coking – Reducing SO<sub>2</sub> Emissions**

Refer to page 406 of the BREF – The point about FGD made above applies here too. This BAT also implies a limit in the feed to the calciner as both the efficiency and required outlet conditions are defined.

#### **4.2.9. Coking – Water Streams**

Refer to page 406 of the BREF. Re-use of waste water is not necessarily appropriate for cutting water nor may it be practical. Unfortunately, data supporting this BAT is not given in Chapter 4. The second BAT in this section seems to have confused waste water with sour water, but that may be a typographical error. Sour water should be stripped to remove dissolved gaseous pollutants, and waste water should be cleaned up.

#### **4.2.10. BAT for Energy Systems**

Refer to pages 407-409 of the BREF. There are some 50+ so called BATs listed here. Many are repetitions of BATs stated elsewhere and many could be collated as good practices – *“use efficient combustion techniques, reduce fuel consumption, optimise the use of stripping steam and stream traps, increase energy efficiency etc.”* Support evidence in the BREF document is fairly meagre.

Many of these practices are already accepted practices in refineries. The operator will therefore need to demonstrate that at least some of these good practices are in place at his site.

Some BATs in this section are particularly all embracing in their format – *upgrading and cleaning heavy fuel oil used in the refinery, use ESPs or filters in the flue gas of furnaces, apply FGD etc.* This should be challenged through the bubble concept described earlier in the document.

A particular BAT challenged by CONCAWE was the 50-850 mg/Nm<sup>3</sup> range for the total refinery liquid fuel pool. The figure of 850 corresponds to 0.5% m sulphur in the refinery liquid fuel pool, or half that allowed to be marketed to the general public. In other words, an industry in the same locality could use a fuel with a higher sulphur content than the refinery could if this BAT were implemented.

There is no basis that CONCAWE is aware of for requiring a reduction from 1.0% m to 0.5% m within the refinery. The maximum sulphur content of in-land commercial fuel oils is 1.0% m as of 2003. Refinery fuel may have a sulphur content significantly higher than 1.0% m since co-burning with essentially sulphur-free refinery fuel gas enables the operator to meet SO<sub>2</sub> emissions limits. Moreover, the only supporting reference in Chapter 4 (see Section 4.10.2.3) is to 1.0% m sulphur. Sweden produces 0.5% m sulphur fuel oil but this is currently the only country in Europe to do this.

#### **4.2.11. BAT for Primary Distillation**

Refer to page 411 of the BREF. The BREF states that maximising the use of liquid ring pumps in vacuum units is BAT. CONCAWE suggested that the term “maximise” should be replaced by “consider”. The rationale was that if ejectors were already in place switching requires extra energy with its associated environmental cross media effects (extra CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>) with little benefit to the waste water treatment (the final routing of sour condensate from ejector systems) as it is already handling that waste water. Steam ejectors are also widely used as a sink for LP steam. The operator would need to assess the local situation.

#### **4.2.12. BAT for Visbreaking**

Refer to page 412 of the BREF. To the BAT for reducing coke formation, CONCAWE offered the provision “as long as it has no impact on unit operations”. The rationale was that visbreakers are not operated to produce minimum coke but optimum product.

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## APPENDIX 1

### KEY TEXTS FROM THE IPPC DIRECTIVE

#### ***ANNEX III - Indicative list of the main polluting substances to be taken into account if they are relevant for fixing emission limit values***

##### **AIR**

1. Sulphur dioxide and other sulphur compounds
2. Oxides of nitrogen and other nitrogen compounds
3. Carbon monoxide
4. Volatile organic compounds
5. Metals and their compounds
6. Dust
7. Asbestos (suspended particulates, fibres)
8. Chlorine and its compounds
9. Fluorine and its compounds
10. Arsenic and its compounds
11. Cyanides
12. Substances and preparations which have been proved to
13. Possess carcinogenic or mutagenic properties or properties which may affect reproduction via the air
14. Polychlorinated dibenzodioxins and polychlorinated dibenzofurans

##### **WATER**

1. Organohalogen compounds and substances which may form such compounds in the aquatic environment
2. Organophosphorus compounds
3. Organotin compounds
4. Substances and preparations which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction in or via the aquatic environment
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances
6. Cyanides

7. Metals and their compounds
8. Arsenic and its compounds
9. Biocides and plant health products
10. Materials in suspension
11. Substances which contribute to eutrophication (in particular, nitrates and phosphates)
12. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc.).

***Considerations for determining BAT (Annex IV to the IPPC Directive)***

1. the use of low-waste technology;
2. the use of less hazardous substances;
3. the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
4. comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
5. technological advances and changes in scientific knowledge and understanding;
6. the nature, effects and volume of the emissions concerned;
7. the commissioning dates for new or existing installations;
8. the length of time needed to introduce the best available technique;
9. the consumption and nature of raw materials (including water) used in the process and their energy efficiency;
10. the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;
11. the need to prevent accidents and to minimise the consequences for the environment;
12. the information published by the Commission pursuant to Article 16 (2) or by international organisations.

***The Directives referred to in Articles 18 (2) and 20***

1. Directive 87/217/EEC on the prevention and reduction of environmental pollution by asbestos
2. Directive 82/176/EEC on limit values and quality objectives for mercury discharges by the chlor-alkali electrolysis industry
3. Directive 83/513/EEC on limit values and quality objectives for cadmium discharges
4. Directive 84/156/EEC on limit values and quality objectives for mercury discharges by sectors other than the chlor-alkali electrolysis industry



5. Directive 84/491/EEC on limit values and quality objectives for discharges of hexachlorocyclohexane
6. Directive 86/280/EEC on limit values and quality objectives for discharges of certain dangerous substances included in List 1 of the Annex to Directive 76/464/EEC, subsequently amended by
7. Directives 88/347/EEC and 90/415/EEC amending Annex II to Directive 86/280/EEC and Directive 89/369/EEC on the prevention of air pollution from new municipal waste-incineration plants
8. Directive 89/429/EEC on the reduction of air pollution from existing municipal waste-incineration plants
9. Directive 94/67/EC on the incineration of hazardous waste
10. Directive 92/112/EEC on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium oxide industry
11. Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants, as last amended by Directive 94/66/EC
12. Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community
13. Directive 75/442/EEC on waste, as amended by Directive 91/156/EEC
14. Directive 75/439/EEC on the disposal of waste oils
15. Directive 91/689/EEC on hazardous waste

## APPENDIX 2

### GLOSSARY OF TERMS

**ACHIEVABLE EMISSION LIMITS** This is a term used in the Refinery BREF without definition but is a sub-set of the next definition – Associated Emission Limits

**ASSOCIATED EMISSION LIMITS** The range of emissions of a particular technique of technology. See Section 2.4 of this document for a full discussion

**BEST AVAILABLE TECHNIQUES** shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

**techniques** shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned

**available** techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator

**best** shall mean most effective in achieving a high general level of protection of the environment as a whole.

**CHANGE IN OPERATION** shall mean a change in the nature or functioning, or an extension, of the installation which may have consequences for the environment; substantial change shall mean a change in operation which, in the opinion of the competent authority, may have significant negative effects on human beings or the environment.

**COMPETENT AUTHORITY** shall mean the authority or authorities or bodies responsible under the legal provisions of the Member States for carrying out the obligations arising from this Directive.

**EMISSION** shall mean the direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into the air, water or land.

**EMISSION LIMIT VALUES** shall mean the mass, expressed in terms of certain specific parameters, concentration and/or level of an emission, which may not be exceeded during one or more periods of time. Emission limit values may also be laid down for certain groups, families or categories of substances, in particular for those listed in Annex III. The emission limit values for substances shall normally apply at the point where the emissions leave the installation, any dilution being disregarded when determining them. With regard to indirect releases into water, the effect of a water treatment plant may be taken into account when determining the emission limit values of the installation involved, provided that an equivalent level is guaranteed for the protection of the environment as a whole and provided this does not lead to higher levels of pollution in the environment, without prejudice to Directive 76/464/EEC or the Directives implementing it.

**ENVIRONMENTAL QUALITY OBJECTIVE (EQO)** A goal or target necessary to meet a particular requirement in the receiving media, be that air, water or land.

**ENVIRONMENTAL QUALITY STANDARD (EQS)** shall mean the set of requirements which must be fulfilled at a given time by a given environment or particular part thereof, as set out in Community legislation.

**EPER** - European Pollution Emission Register. For further information see References 13 and 14.

**EXISTING INSTALLATION** shall mean an installation in operation or, in accordance with legislation existing before 30/10/1996; an installation authorised or in the view of the competent authority the subject of a full request for authorisation, provided that that installation was put into operation no later than 30/10/1997.

**INSTALLATION** shall mean a stationary technical unit where one or more activities listed in Annex I are carried out, and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution.

**OPERATOR** shall mean any natural or legal person who operates or controls the installation or, where this is provided for in national legislation, to which decisive economic power over the technical functioning of the installation has been delegated.

**PERMIT** shall mean that part or the whole of a written decision (or several such decisions) granting authorization to operate all or part of an installation, subject to certain conditions which guarantee that the installation complies with the requirements of this Directive. A permit may cover one or more installations or parts of installations on the same site operated by the same operator.

**POLLUTION** shall mean the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment.

**SUBSTANCE** shall mean any chemical element and its compounds, with the exception of radioactive substances and genetically modified organisms.

## APPENDIX 3

### MORE DETAIL ON THE CONTENT OF THE DIRECTIVE

The competent authorities have to ensure that IPPC installations are operated in such a way that:

- all the appropriate preventive measures are taken against pollution, in particular through application of the best available techniques
- no significant pollution is caused
- waste production is avoided in accordance with Council Directive 75/442/EEC on waste [13]; where waste is produced, it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment
- energy is used efficiently
- the necessary measures are taken to prevent accidents and limit their consequences
- the necessary measures are taken upon definitive cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state.
- When applying for permits, the application to the competent authority has to include full descriptions of the installation and its activities and all inputs to and emissions from the site.

The permit has to include emission limit values for pollutants, in particular, those listed in Annex III to the Directive (see **Appendix 1; Table 1**) which are likely to be emitted from the installation concerned in significant quantities, having regard to their nature and their potential to transfer pollution from one medium to another (water, air and land). If necessary, the permit should include appropriate requirements ensuring protection of the soil and ground water and measures concerning the management of waste generated by the installation. Where appropriate, emission limit values may be supplemented or replaced by equivalent parameters or technical measures.

The Directive establishes that emission limit values or the equivalent parameters and technical measures have to be based on Best Available Techniques. However IPPC permits should not prescribe the use of any technique or specific technology, and must also take into account the technical characteristics of the installation concerned, its geographical location the local environmental conditions and, where changes to operations are involved, the cost-effectiveness of the change. In all circumstances, the conditions of the permit shall consider the minimisation of long-distance or transboundary pollution and ensure a high level of protection for the environment as a whole. The permit should also contain measures relating to conditions other than normal operating conditions, e.g. start-up, leaks, malfunctions, momentary stoppages and definitive cessation of operations.

When any significant changes are made to installations which are likely to result in increased impact to the environment, the operator has to inform the competent authorities of any changes planned in the operation of the installation. Where appropriate, the competent authorities have to update the permit.

This also needs to be done when:

- the pollution caused by the installation is of such significance that the existing emission limit values of the permit need to be revised or new such values need to be included in the permit

- substantial changes in the best available techniques make it possible to reduce emissions significantly without imposing excessive costs; (this needs to be qualified to include that there is a EQO that merits such further reductions at the anticipated (or any) cost otherwise we are suggesting the IPPC does require BAT for BATs sake)
- the operational safety of the process or activity requires other techniques to be used
- new provisions of Community or national legislation so dictate.

When a permit has been granted, the competent authority has to ensure that:

- the conditions of the permit are complied with by the operator when operating the installation
- the operator regularly informs the competent authority of the results of the monitoring of releases and without delay of any incident or accident significantly affecting the environment
- the operator of installations gives the competent authority all necessary assistance to enable them to carry out any inspections within the installation, to take samples and to gather any necessary information.

The Directive also calls for the public to have access to information and to participate in the permitting procedure. Applications for permits for new installations or for substantial changes have to be made available for an appropriate period of time to the public, to enable it to comment on them before the competent authority reaches its decision. That decision, including at least a copy of the permit, and any subsequent updates, must be made available to the public. Also, the results of monitoring of releases as required under the permit conditions and held by the competent authority must be made available to the public. Where an installation is likely to have significant negative effects on the environment of another Member State, the application for a permit also must be sent to the other Member State with an opportunity for consultation.

In addition, the Directive calls for an inventory of the principal emissions and sources responsible to be published every three years. To this end, the European Pollutant Emissions Register (EPER) has been established under the remit of the IPPC Directive to collect and make publicly available details of emissions of certain pollutants from IPPC sites. The scheme was established under the EPER Decision [14] and is fully explained in a Guidance Document prepared by the EU Commission [15].

As IPPC sites, refineries have to report to their member state emissions to both air and water of the specified pollutants. For each pollutant, there is a threshold value, and if annual emissions are below this threshold, no report has to be made. Where once through cooling water is concerned, then it is only the quantities of pollutants added to the water in the refinery that has to be reported.

The member states have to report emissions from all IPPC sites in their country to the European Commission in an electronic format so that they can be published on a central website to be established by the Commission. The first round of reporting has to be made in 2003 for the year 2001 (or 2000 or 2002) if only these are available. The results are to be published in the second half of 2003.

The Directive also calls for the Commission to organise an exchange of information between Member States and the industries concerned on BAT, associated monitoring, and developments in them. This has been implemented by the establishment of a branch of the Joint Research Council called the European IPPC Bureau (EIPPCB) based in Seville. This organisation is also producing "horizontal BREFs" covering issues such as Storage, Cooling Systems, Monitoring, etc. which are common to a number of industrial sector BREFs.