

EPR Permit - Stack Height Assessment

1. Introduction

This document discusses options for assessing whether a proposed stack height represents best available techniques (BAT).

A BAT assessment for stack height is not required for all applications. However where we have a concern over the height of a stack this document sets out options for the method of assessing BAT.

The main focus of this document is on stacks for **incineration plants** but it could also apply to other sectors such as combustion.

Incineration plants and combustion plants emit pollutants to air via a stack. The stack is usually designed to ensure that the facility does not have a significant impact on air quality for key pollutants such as oxides of nitrogen (NO_x), acid gases and particulates. The height of the stack is key to this, with a higher stack resulting in better dispersion and therefore a lower impact on receptors.

IED requires plants to use BAT which is defined as:

*'the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce **emissions** and the **impact** on the environment as a whole'.*

It is clear from the above definition that BAT is about minimising the impact of emissions as well as the quantity of emissions that are emitted in the first place. The stack height is therefore relevant when considering BAT.

In addition to BAT requirements, Article 47 of the Industrial Emissions Directive (2010/75/EU) (IED) also requires that *'Waste gases from incineration plants or combustion plants shall be discharged in a controlled way by means of a stack, containing one or more flues, the height of which is calculated in such a way as to safeguard human health and the environment.*

If we are satisfied that the plant will not have a significant effect on the environment then we will normally consider the Article 47 requirements to have been met.

2. Other measures to reduce emissions

If a BAT assessment for stack height is required, it is important to also take into account the effect of any other measures which the applicant might propose to reduce the impact of emissions from the plant, including primary measures and abatement which lower the amount of pollutants being emitted.

3. How stack height is assessed

For most incinerator and combustion applications the applicant will submit an air dispersion modelling report. The modelling is used to predict the process contribution (PC) at nearby receptors. Once the PCs have been calculated they are compared with Environmental Standards (ES).

For key pollutants such as NO_x, Ambient Air Directive (AAD) limit values are set. We would not issue a permit if a facility would cause a breach of an AAD limit value.

The first step of the assessment is to consider insignificant emissions.

PCs are considered **Insignificant** if:

- the **long-term** process contribution is less than **1%** of the relevant ES; and
- the **short-term** process contribution is less than **10%** of the relevant ES.

Where an emission is screened out as insignificant, we would normally consider that the Applicant's proposals, including the stack height, to be BAT. That is because if the impact of the emission is already insignificant, it follows that any further reduction in this emission will also be insignificant.

For those pollutants which do not screen out as insignificant, we determine whether exceedences of the relevant ES are likely when combined with the background level. Where a significant contribution to an exceedance of an AAD limit value is identified we may refuse the application.

Our approach is clear where:

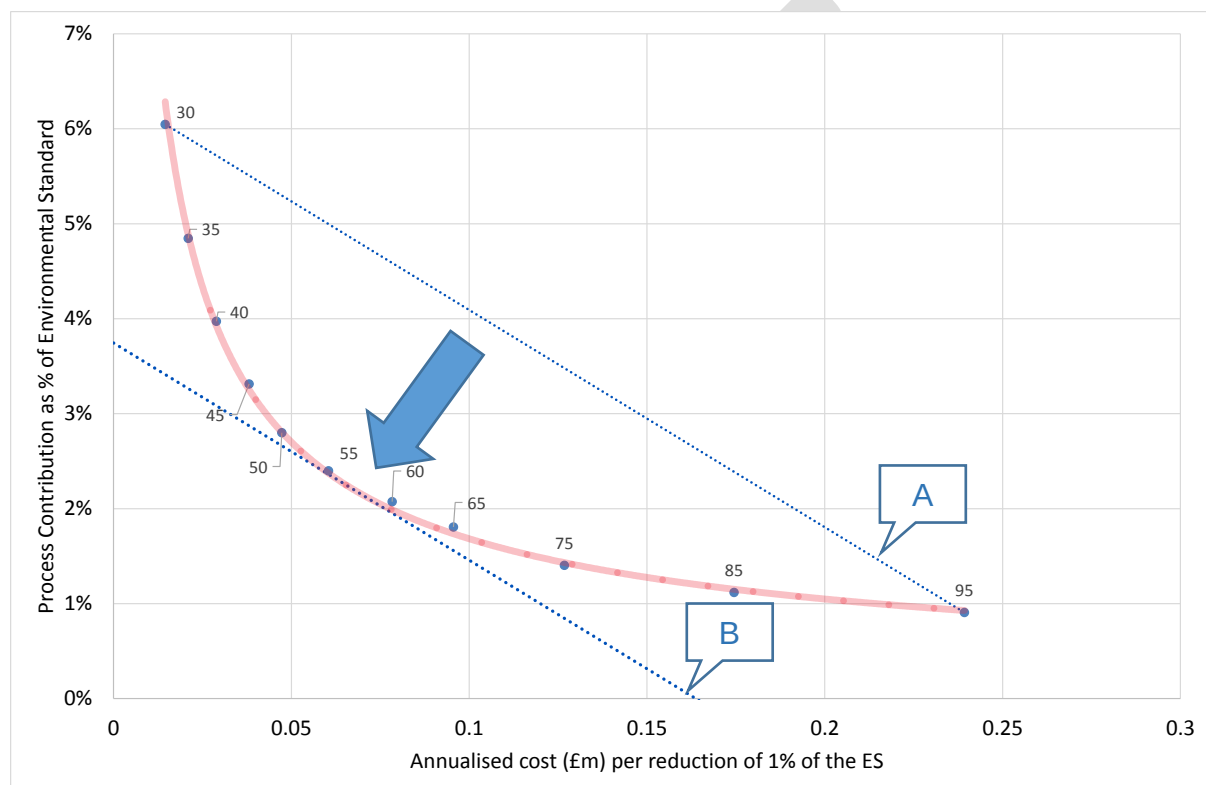
- impacts are insignificant; or
- an exceedance of an ES is predicted.

For impacts above the insignificant level but below the ES we scrutinise the applicant's proposals to determine whether they are using BAT. Applications often contain a cost benefit analysis of abatement techniques such as SNCR vs SCR. However applications often fail to include a BAT assessment of the stack height.

Usually the applicant proposes a stack of sufficient height to bring the PC near to the insignificance threshold, but for sites with lower stacks and/or higher PCs, determining BAT is more difficult.

4. BAT assessment method

Our definition of BAT is the stack height at which the costs to the applicant and the benefits to local people and the environment are equal. To calculate this we ask the applicant to produce a marginal cost curve. This shows the relationship between extra money spent to increase the stack height and the improvement in the process contribution as a percentage of the environmental standard (PC) that occurs as a result. It will often look similar to the red line in the chart below. What this shows is that there are diminishing returns to making the stack taller. Moving from 30m to 35m produces over a 1% decrease in the PC for a small increase in costs. But moving from 85m to 95m gives only a very small improvement at a significant cost.



It could be argued that the curve on the chart starts to level out at a stack height of approximately 55 m. However the PC still continues to drop at heights greater than 55m which makes it difficult to determine the exact point at which the stack height may be considered to be BAT.

To determine this point, the applicant needs to draw a straight line that connects the two endpoints of the graph (line A). This gives a slope that shows the average change in PC as cost increases. The advantage of using this straight line is that it does not rely on the units of the graph, only on the values of the two end-points.

The definition of BAT set out above can be restated as the point at which the slope of the marginal cost curve is equal to that of line A. The slope of a curve at any particular point can be worked out by calculating the curve's first derivative. This in turn can be used to calculate the precise stack height at which the slope of the curve is equal to the slope of the straight line. The result is a straight line that touches the marginal cost curve at the point where the stack height is BAT (line B).

Because the endpoints of the cost curve are still arbitrary to some extent, the difference that they make should be examined as part of a sensitivity analysis. The result is that this method does not give a single answer, but instead produces a range of possible stack heights that could be considered to be BAT. Choosing the exact stack height is a judgement call for the site inspector in consultation with other Environment Agency experts. The stacks of other similarly-sized plants can be considered to help form a view of what is 'available' for the sector in the context of BAT and to give an indication of whether the proposed stack height of the plant in question is within the range which would normally be expected.

5. Planning restrictions and low stacks

Applications with low stacks can be due to planning restrictions. We need to consider how much this can be taken into account in making a permitting decision on a case-by-case basis. Does a planning restriction affect the 'available' part of the BAT consideration?

For some applications there may be a local reason for why the stack height cannot be increased such as a nearby airport. Visual impact can also be a reason for the stack height being restricted through planning. However, such restrictions do not necessarily mean that a taller stack would not be an available technique in the generic terms of the definition. The detailed assessment of impact of emissions from the installation is carried out under permitting, not planning. So while a stack height may have been set under planning, it does not necessarily mean that the planning authority would not accept a different stack height, or that we are bound to conclude that that height is acceptable just because it is specified in the planning and the ES will not be breached.

An objective approach needs to be adopted in assessing BAT. Where a particular technique (such as stack height) is BAT within a particular sector, then that should normally be required for all installations in that sector, whilst taking into account any site-specific circumstances.

6. Conclusion

Where a stack height BAT assessment is required, the method set out in section 4 can be used. Applicants may also propose their own method. The choice will be site specific and it will be up to applicants to justify the method that they use.

Appendix 1

While we can determine the trade-off point graphically, we can also calculate it by working out at what value of x (where x = extra cost of an increase in stack height) the slope of the curve is equivalent to that of line A.

First, Excel needs to be used to fit a curve to the data. This curve will not be a complete match to the data but should be close enough for these purposes. For example, Excel might calculate the following equation for the marginal cost curve:

$$y = 383.17x^{-0.948}$$

If the first endpoint of the line is marked by a point with coordinates (x_1, y_1) and the second by a point (x_2, y_2) , then the slope of line A is simply:

$$\frac{y_2 - y_1}{x_2 - x_1}$$

If, for example, the slope of the line is -0.02, then we need to solve the following equation using a process called differentiation:

$$-0.02 = \frac{d}{dy} 383.17x^{-0.948}$$

If an equation is in the form of $f(x) = ax^n$

Then the first derivative is $f'(x) = nax^{n-1}$

So using the rule for calculating the first derivative:

$$-0.02 = -363.25x^{-1.948}$$

And now solving for x gives:

$$0.02 = 363.25x^{-1.948}$$

$$0.0000551 = x^{-1.948}$$

$$18162.5 = x^{1.948}$$

$$x = 153.6$$

This value of x is expressed in the units of the x axis, which will most probably be £ so the final step is to find the stack height that corresponds as closely as possible to this figure. This would be our starting point for taking a view on BAT.