2021-IP12

UK BAT Guidelines for Post-Combustion Capture on Power-Plants

On 2 July, the UK Department for Business, Energy and Industrial Strategy (BEIS) published in its webpages the Environment Agency's BAT guidelines for post-combustion carbon dioxide capture (usually referred to simply as post-combustion capture or PCC), identifying important environmental issues to address and indicating best practice for application to power plants. BAT (or 'Best available techniques') implies the available techniques that are best for preventing or minimising emissions and environmental impacts, and relate to both the technology used and the way the installation is designed, built, maintained, operated and decommissioned. To gain an environmental permit, BAT must normally be applied to the power plant or industrial facility. An alternative technique may be proposed but, in such a case, either the environmental outcome must be the same or better or a persuasive justification made on the basis of a risk assessment and cost benefit analysis.

UK regulators have worked with the UK CCS Research Centre (UKCCSRC), the Carbon Capture and Storage Association (CCSA) and other stakeholders to develop this BAT guidance for PCC. The guidance presented refers to relevant sections in the UKCCSRC's BAT review[1] on the same topic, which summarises the available evidence.

Applying to both new plants and retrofits to existing plants, the guidance is aimed at operators, regulatory staff and other interested parties. It covers:

a) Amine-based technologies to capture CO_2 from the flue gases of power plants; and
b) Combined heat and power (CHP) plants fuelled by natural gas and biomass.

The guidance has five sections, parts of which are summarised below:

a) Power plant selection and integration with the PCC plant

   The thermal energy efficiency of the plant should be maximised to reduce the impact of adding PCC. For example, new unabated CCGT plants can now achieve efficiencies of ≥60% (LHV).

   With the UK electricity system having increasing amounts of intermittent renewable generation, it is becoming more important that thermal power plants, including those with CO_2 capture, are dispatchable, i.e. the power plant operator must be able to call upon the plant at any time to operate at any required output, up to its full load, and to sustain this output indefinitely.

   Where possible, electricity and low-grade heat from the power plant alone should be used to operate the PCC plant. The amounts needed will depend on, e.g. the selected solvent, the PCC plant configuration, the CO_2 capture rate and the CO_2 delivery pressure.

[1] IEAGHG was involved in reviewing UKCCSRC's draft document entitled "*BAT Review for New-Build and Retrofit Post-Combustion Carbon Dioxide Capture Using Amine-Based Technologies for Power and CHP Plants Fuelled by Gas and Biomass as an Emerging Technology under the IED for the UK*".

b) PCC plant design and operation

The PCC plant should be designed for a CO_2 capture rate of at least 95%, although operationally this can vary, up or down.

Air emissions from the PCC plant and their subsequent atmospheric degradation products, e.g. nitrosamines and nitramines, should meet environmental quality standards.

The PCC system should aim to minimise the overall electricity output penalty on the power or CHP plants.

Solvent performance, including reclaiming requirements and emissions to atmosphere, must be determined via realistic pilot (or full scale) tests over a period of at least 12 months.

Depending on the flue gas source and the solvent selected, the impact of SO_2, NOx, aerosols and other impurities in the flue gas will need to be considered and addressed.

All means should be employed to prevent thermal degradation of the solvent and unwanted emissions from the absorber.

Process and emissions should be monitored to show that emissions from the process, primarily to air, are causing no harm to the environment. A leak detection and repair programme, appropriate to the solvent composition, should be proposed.

c) Cooling

To realise the best power and CO_2 capture plant performance, the lowest temperature cooling should be used. This may be achieved by using the following hierarchy of cooling methods:

- direct water cooling (such as seawater)
- wet cooling towers
- hybrid cooling towers
- dry cooling – direct air-cooled condensers and dry cooling towers

d) Discharge to water

Other guidance documentation is available regarding discharge to water.

e) Climate change adaptation

As part of the permit application, a climate change risk assessment must be undertaken if operation is planned to be in excess of five years.

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