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Invited Discussion Paper

EPA's GHG Permitting Guidance and the Power Sector

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Notice to readers: This review reflects a “first look” at EPA’s 97 page guidance document, PSD and Title V Permitting Guidance for GHGs, EPA’s Fact Sheet and “Q&A” documents related to the guidance, and the EPA White Paper on mitigation technologies relevant for coal-fired power plants. This review is written from a technical perspective, and should not be viewed as legal advice. The nature of EPA’s guidance is that many key issues are not explicitly resolved. When addressing these areas of uncertainty, the opinions of the author regarding possible interpretations of the guidance are provided in *italics*, in order to emphasize that they are judgments and not facts.

EPA’s guidance applies to new or modified major stationary sources of GHG emissions. This review addresses only such sources in the electric power sector. The intent of the paper is to provide some general background information related to the determination of “Best Available Control Technology” (BACT) for new and modified power plants, and to discuss how the guidance addresses four questions:

1. Are project developers required to redesign the facility seeking a permit in order to comply with BACT requirements?
2. Is switching to a lower carbon fuel, e.g., from coal to natural gas, part of BACT?
3. Is Carbon Capture and Storage (CCS) considered an “available” technology, and is it required as BACT?
4. How is cost considered in determining BACT? What level of cost is considered an acceptable basis for rejecting a technology as BACT?

Background

On November 10, 2010, EPA made available certain guidance materials and tools related to implementing New Source Review (NSR) and permitting requirements for certain new and modified stationary sources of greenhouse gases (GHGs).¹ NSR rules for GHGs have evolved through a series of court decisions and rulemakings including:

- The April 2, 2007, Supreme Court decision (*Massachusetts v. EPA*, 549 U.S. 497) which found that GHGs fit within the definition of air pollutant in the Clean Air Act.
- EPA's December 15, 2009, "Endangerment Finding," which found that elevated atmospheric concentration of six GHG's (including CO₂ and CH₄), endanger the public health and welfare (74 FR 66496, 12/15/2009).
- EPA's May 7, 2010, regulation limiting GHG emissions from light duty motor vehicles (75 FR 25324, 5/7/2010). This rule was relevant to stationary sources because, along with a regulatory interpretation,² it established a requirement that meant, as of January 2, 2011, GHGs would be pollutants "subject to regulation" under the Clean Air Act, a criterion for invoking applicability of NSR regulations to GHG emissions from large new stationary sources and major modifications of existing stationary sources.
- EPA's June 3, 2010, "tailoring rule," which established minimum emission thresholds for applicability of NSR to GHG emitters, and prescribed a schedule for phasing in the permitting process based on the size of sources and whether they were already regulated for other pollutants under the NSR program (75 FR 31514, 6/3/2010).

An important point regarding the guidance is that it is not a proposed regulation. It is guidance to implement earlier regulations which have completed the regulatory process of proposal/public comment/promulgation, and which take effect on January 2, 2010.

The major element of the guidance document is a discussion of how permitting authorities (generally, state environmental protection agencies), should determine what constitutes "Best Available Control Technology" (BACT) for certain new and modified stationary sources. EPA's regulations require that such sources receive a permit under the NSR program which, among other things, determines and requires BACT for each PSD pollutant (which now includes GHGs). The determination is made on a case-by-case basis, using criteria set forth by the Clean Air Act (CAA) and EPA regulations. As such, BACT may be different under different fact sets, or as determined by different permitting authorities for similar fact sets. BACT for power plants will almost certainly change over time, and become more stringent as technologies continue to

¹ These materials are available at EPA's website for NSR: <http://www.epa.gov/nsr/ghgpermitting.html>. Material reviewed for this paper include: [PSD and Title V Permitting Guidance For Greenhouse Gases](#), "Clean Air Act Permitting for Greenhouse Gases: Guidance and Technical Information – Fact Sheet," "Clean Air Act Permitting for Greenhouse Gases: Guidance and Technical Information – Questions and Answers," and [Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From Coal-Fired Electric Generating Units](#), (All by USEPA, Office of Air and Radiation).

² The policy interpretation was published at 75 FR 17004 (4/2/2010).

advance. The overarching statutory provision is Section 169(3) of the CAA which defines BACT to be:

“an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant...”

The EPA guidance document is written in the context of the Agency’s long standing “Top-down BACT” process, which is described in detail in EPA’s 1990 Draft New Source Review Workshop Manual³ (Workshop Manual). The “Top-down” process begins with identification of all available technologies, and then applies the statutory and regulatory criteria to identify which of the available technologies is “best”. The “Top-down” process consists of 5 steps:

Step 1: Identify all available control technologies.

Step 2: Eliminate technically infeasible options.

Step 3: Rank remaining control technologies.

Step 4: Evaluate most effective controls and document results. (This step is where cost issues can be considered.)

Step 5: Select the BACT.

EPA’s guidance document was careful to note that the Agency does not require states to apply the “Top-down” approach, and that significant deference is granted to the (state) permitting authority:

“EPA has not established the top-down BACT process as a binding requirement through rule. Thus, permitting authorities that implement an EPA-approved PSD permitting program contained in their State Implementation Plans (SIPs) may use another process for determining BACT in permits they issue, including BACT for GHGs, so long as that process (and each BACT determination made through that process) complies with the relevant statutory and regulatory requirements. EPA does not require states to apply the top-down process in order to obtain EPA approval of a PSD program, but EPA regulations do require that each state program apply the applicable criteria in the definition of BACT. Furthermore, EPA has certain oversight responsibilities with respect to the issuance of PSD permits under state permitting programs. In that capacity, EPA does not seek to substitute its judgment for state permitting authorities in BACT determinations, but EPA does seek to ensure that individual BACT determinations by states with approved programs are reasoned and faithful to the requirements of the CAA and the approved state program regulations.”

³ <http://www.epa.gov/ttn/nsr/gen/wkshpman.pdf> .

The Questions & Answers paper released along with the guidance stated that EPA would publish a notice in the *Federal Register* citing the guidance and providing an opportunity for public comment, and that the guidance may be revised prior to January 2, 2011.

The following sections address four key questions regarding the EPA guidance, as it applies to fossil fuel-based electric generating units:

1. Are project developers required to redesign the facilities seeking a permit in order to achieve “Best Available Control Technology” requirements?
2. Is switching to a lower carbon fuel, e.g., from coal to natural gas, part of BACT?
3. Is Carbon Capture and Storage (CCS) considered an “available” technology, and is it required as BACT?
4. How is cost considered in determining BACT? What level of cost is considered an acceptable basis for rejecting a technology as BACT?

Are project developers required to redesign a facility?

In the context of “Step 1,” or identifying all available control technologies, are permit applicants required to include fundamentally different designs for a power plant? For example, must an applicant seeking to build a pulverized coal power plant evaluate an IGCC design as a possible control technology for CO₂? Or, if a subcritical design is proposed, does the applicant have to evaluate a more efficient (lower CO₂-emitting) supercritical design?

The guidance states, “EPA has recognized that a Step 1 list of options need not necessarily include inherently lower polluting processes that would fundamentally redefine the nature of the source proposed by the permit applicant. BACT should generally not be applied to regulate the applicant’s purpose or objective for the proposed facility.” However, there is also further discussion on this point. The guidance places great emphasis on measures that increase the efficiency of a power plant, because that reduces CO₂ emissions. EPA clarifies that “the permitting authority can consider the intended function, if an electric generating facility is a baseload or peaking unit, in assessing the fundamental business purpose of a permit applicant.” *In other words, redesign is not necessarily redefinition of a source, and under some circumstances redesigned options should be included in Step 1, especially if that redesign does not change the business purpose of the proposed project.* Moreover, “in coal-fired permit applications, EPA believes that integrated gasification combined cycle (IGCC) should also be listed for consideration when it is more efficient than the proposed technology.” And, “when a permit applicant proposes to construct a facility using a less efficient boiler design, such as a pulverized coal (PC) or circulating fluidized bed (CFB) boiler using subcritical steam pressure, a BACT analysis for this source should include more efficient options such as boilers with supercritical and ultra-supercritical steam pressures.” In addition, EPA emphasizes that a permitting authority may elect to require inclusion of technologies which redefine a source, even if EPA does not require such a measure.

Please note that inclusion of an emission reduction option in Step 1 of the BACT process does not imply that the technology must be BACT. The technology must pass criteria of feasibility (Step 2) and cost (Step 4) in order to reach selection as BACT in Step 5. Cost consideration is addressed in a subsequent section of this paper.

Is switching to a lower carbon fuel, e.g., from coal to natural gas, part of BACT?

EPA notes that “clean fuels” are among the measures explicitly included in the CAA definition of BACT. However, EPA then states,

“EPA has recognized that the initial list of control options for a BACT analysis [i.e., the Step 1 list of available emission reduction measures] does not need to include “clean fuel” options that would fundamentally redefine the source. Such options include those that would require a permit applicant to switch to a primary fuel type (*i.e.*, coal, natural gas, or biomass) other than the type of fuel that an applicant proposes to use for its primary combustion process. For example, when an applicant proposes to construct a coal-fired steam electric generating unit, EPA continues to believe that permitting authorities can show in most cases that the option of using natural gas as a primary fuel would fundamentally redefine a coal-fired electric generating unit.”

This language seems clear enough, but EPA adds the following: “when a permit applicant has incorporated a particular fuel into one aspect of the project design (such as startup or auxiliary applications), this suggests that a fuel is ‘available’ to a permit applicant. In such circumstances, greater utilization of a fuel that the applicant is already proposing to use in some aspect of the project design should be listed as an option in Step 1 unless it can be demonstrated that such an option would disrupt the applicant’s basic business purpose for the proposed facility.” By footnote, EPA refers readers to an EPA issued order regarding the proposed Cash Creek Generation unit. That December 15, 2009 order, by EPA Administrator Jackson, ruled in favor of a Sierra Club challenge to the permit issued to Cash Creek Generation by the KY Department of Air Quality. The proposed Cash Creek power plant was an IGCC design, and the permit application stated that the unit would operate initially on natural gas, and then later operate on coal. EPA’s order essentially vacated the state permit, in part because the permitting authority did not evaluate the option of operating permanently on natural gas. The guidance also cites a series of decisions by EPA’s Environmental Appeals Board (EAB), which considered the issue of redefining a source. These include the case of Northern Michigan University, in which the EAB ruled on alternative fuels for purposes of SO₂ reduction⁴. In addition to finding the BACT process lacking because of insufficient attention to the possible use of lower sulfur coals, and a higher fuel input share from wood (the AFB unit was to be fueled by wood and coal), the EAB noted that the permit cited natural gas as a startup fuel and faulted the BACT process for not considering natural gas as a primary fuel source since it was “available and technically feasible.” *Hence, the EPA guidance implies that the Agency may expect Step 1 of the BACT process for a coal-fueled power plant (which uses natural gas as a startup fuel) to include switching to natural gas as an available BACT option (which could be rejected in a later Step), unless gas-*

⁴ Northern Michigan University, PSD Appeal No. 08-02, USEPA Environmental Appeals Board decision, February, 18, 2009.

firing disrupts the basic business purpose of the power plant.⁵ As a result, the determination of whether a coal power plant may be required to use natural gas as a primary fuel may rest on the consideration of cost in Step 4 of the BACT determination process.

Is Carbon Capture and Storage (CCS) considered an “available” technology, and is it required as BACT?

The guidance identifies CCS as an available technology for power plants:

“For the purposes of a BACT analysis for GHGs, EPA classifies CCS as an add-on pollution control technology that is “available” for large CO₂-emitting facilities including fossil fuel-fired power plants and industrial facilities with high-purity CO₂ streams (*e.g.*, hydrogen production, ammonia production, natural gas processing, ethanol production, ethylene oxide production, cement production, and iron and steel manufacturing). For these types of facilities, CCS should be listed in Step 1 of a top-down BACT analysis for GHGs.”

The important issues for CCS relate to whether it would be eliminated as “infeasible” under BACT Step 2, or as too costly under BACT Step 4. The guidance states:

“Many other case-specific factors, such as the technical feasibility and cost of CCS technology for the specific application, size of the facility, proposed location of the source, and availability and access to transportation and storage opportunities, should be assessed at later steps of a top-down BACT analysis. However, for these types of facilities and particularly for new facilities, CCS is an option that merits initial consideration and, if the permitting authority eliminates this option at some later point in the top-down BACT process, the grounds for doing so should be reflected in the record with an appropriate level of detail.”

The EPA “Fact Sheet” released along with the guidance document includes the following statement: “Carbon Capture and Sequestration (CCS) is a promising technology in the early stage of demonstration and commercialization. While it should be identified as an available control measure in the first step of BACT, it is currently an expensive technology and unlikely to be selected as BACT in most cases.” A similar statement appeared in the EPA “Questions & Answers” paper: “The guidance notes that Carbon Capture and Sequestration (CCS) is a promising technology in the early stage of demonstration and commercialization. While it should be identified as an available control measure in the first step of BACT for the large combustion source in these high GHG emitting sectors (Fossil-Fuel Fired Power Plants, Cement Production, and Iron and Steel Manufacturing), it is currently an expensive technology and unlikely to be selected as BACT in most cases.” These statements imply that EPA believes that, if CCS survives Step 2 (feasibility), its current high cost would exceed thresholds for elimination under Step 4 (cost, energy, and environmental considerations). However, the word “unlikely” is not found in the guidance itself.

⁵ Readers may note apparent differences between the characterization of source redefinition in the current guidance (based on business purpose), versus source redefinition in the oft-cited Workshop Manual. The Workshop Manual states that source redefinition should consider “physical and chemical unit operations used to produce the desired product from a specified set of raw materials.”

With respect to Step 2 (feasibility), EPA states that “what vendors will guarantee should be considered in the BACT selection process,” but “a control technology should not be eliminated in Step 2 of the top-down BACT process based solely on the inability to obtain a commercial guarantee from a vendor on the application of technology to a source type. The willingness of vendors to guarantee a certain level of performance should be considered by the permitting authority later in the BACT process when proposing a specific emissions limit or level of performance in the PSD permit.” *This language appears to say that EPA would accept a less restrictive emission limit by a permitting authority if the vendor was unwilling to provide assurance that the enabling technology would work.* Guidance on feasibility states:

“CCS may be eliminated from a BACT analysis in Step 2 if it can be shown that there are significant differences pertinent to the successful operation for each of these three main components [capture, transport, storage] from what has already been applied to a differing source type. For example, the temperature, pressure, pollutant concentration, or volume of the gas stream to be controlled, may differ so significantly from previous applications that it is uncertain the control device will work in the situation currently undergoing review. Furthermore, CCS may be eliminated from a BACT analysis in Step 2 if the three components working together are deemed technically infeasible for the proposed source, taking into account the integration of the CCS components with the base facility and site-specific considerations (e.g., space for CO₂ capture equipment at an existing facility, right-of-ways to build a pipeline or access to an existing pipeline, access to suitable geologic reservoirs for sequestration, or other storage options).”

The guidance suggests that permitting authorities would have the discretion of evaluating logistical difficulties as part of feasibility. EPA cites the example of a small residential boiler as a situation where logistics would make CCS infeasible, although one would assume that such a source would have rejected CCS in Step 1, based on earlier guidance (the example facility is not a “large combustion source” in one of the high emitting sectors).

Under Step 4 of the BACT process the permitting authority evaluates the economic, energy, and environmental impacts of the technologies that remain under consideration (those which are “available” and “feasible.” In practical terms, the main consideration is likely to be cost, although the significant water consumption of some existing CCS capture technologies may be an issue in some locations. EPA also recognizes that CCS technologies have significant impacts on the efficiency of a power plant.

“To justify elimination of an option on economic grounds, the permit applicant should demonstrate that the costs of pollutant removal for that option are disproportionately high.” The guidance states that permitting authorities will have “a great deal of discretion” in making determinations under Step 4, and that “on the basis of the current costs of CCS, we expect that CCS will often be eliminated from consideration in Step 4 of the BACT analysis, even in some cases where underground storage of the captured CO₂ near the power plant is feasible.” EPA notes that revenues from sale of CO₂ for enhanced oil recovery (EOR) may impact the cost determination, for CCS projects which have the EOR option. The cost test is to be based on average and marginal cost-effectiveness (\$/ton of CO₂ removed), “rather than ... the general affordability of the control alternative...” As discussed in the next section, the guidance and associated documents describe the general approach for evaluating the consideration of cost in

determining BACT, but do not identify a cost threshold (or even a range) for considering a technology too expensive.

How is cost considered in determining BACT? What level of cost is considered an acceptable basis for rejecting a technology as BACT?

The preceding discussion on Step 4 considerations for CCS provides a general introduction to the cost issue. Appendix K of the guidance explains how to calculate cost-effectiveness (differential costs / differential emissions). *The guidance suggests that when marginal cost-effectiveness begins to increase rapidly (a significant increase in the slope of the curve of incremental cost plotted against incremental emission reductions for each option), that point may indicate a limit on acceptable cost-effectiveness. However, no general target for unacceptable cost-effectiveness is provided.* One interesting statement in Appendix K relates to the capacity factor used in making cost and performance calculations. It states, “Although permit conditions are normally used to make operating assumptions enforceable, the use of ‘standard industry practice’ parameters for cost effectiveness calculations (but **not** applicability determinations) can be acceptable without permit conditions.” It is unclear how this concept applies, for example, if a proposed NGCC power plant is expected to operate at a high capacity factor, and the typical commercial application of similar units operates at a low or medium capacity factor.

EPA also released White Papers on technology options for several source categories, including Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From Coal-Fired Electric Generating Units. The paper for coal-fired EGUs includes cost and performance data for certain efficiency measures and CCS, but does not provide guidance on how to use this information to quantify the amount of cost that justifies elimination of a technology under Step 4.

Taken as a whole, the guidance suggests that EPA will grant broad deference to permitting authorities in their execution of Step 4, as long as the assumptions, methodology for analysis, and the logic upon which conclusions are based are clearly stated in the permit record. However, because this process is so subjective, and without clear quantitative benchmarks, permit applicants that seek to eliminate CCS, or other technology options, as too costly can expect challenges by other stakeholders, and concomitant delays in obtaining final permits.