BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS FOR GREENHOUSE GASES FROM AUXILIARY BOILER AND FIRE-WATER PUMP

In March 2011, a best available control technology (BACT) analysis for greenhouse gas (GHG) emissions from the Effingham expansion project was submitted to the Georgia Environmental Protection Division (GEPD). The BACT analysis, which included GHG emissions from the proposed combustion turbines (CTs), auxiliary boiler, and fuel gas heater followed the U.S. Environmental Protection Agency (EPA)-recommended 5-step procedure for the CTs and included a brief discussion on BACT for the other equipment. The detailed 5-step procedure was conducted only for the CTs because more than 99 percent of the GHG emissions for the expansion project are emitted by the CTs. In response to the United States Environmental Protection Agency (EPA) Region IV's comments, the 5-step BACT analysis process is discussed in this document for GHG emissions from both the auxiliary boiler and the gas heater. The cooling tower and the fuel oil storage tank do not emit any GHG emissions.

For prevention of significant deterioration (PSD) purposes, GHGs are a single air pollutant defined as the aggregate group of the following six gases: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Based on EPA's definition, the 5-step "top-down" BACT process has the following five 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
- Step 5: Select the BACT

The GHG BACT analysis for the CTs presented in the March 2011 submittal discussed energy efficiency and concluded that the proposed project will be one of the most efficient electric generating facilities in Georgia and will result in GHG emissions that are lowest in the SERC Reliability Corporation's (SERC's) sub-region and Georgia.

In Table A-1 of the March 2011 submittal, GHG emissions were presented as a function of power output [pounds per megawatt hour (lb/MWh)] for different operating scenarios of the CTs. Using the worst-case emission factors in lb/MWh for each type of fuel, total GHG emissions for the 2-on-1 combined-cycle system was estimated as CO_2 equivalent (CO_2e) in Table A-2 (attached). Total GHG emissions for the auxiliary boiler and gas heater were also estimated and presented in Table A-2. As shown, GHG emissions potential for the auxiliary boiler and the gas heater was estimated to be only 0.1 percent and

0.2 percent of the combined-cycle system, respectively. Due to the negligible amount of GHG emissions from the auxiliary boiler and the gas heater compared to the combined-cycle system, even 100-percent control of GHG emissions from these units will not make any meaningful reduction in total GHG emissions potential of the expansion project. A detailed BACT analysis for GHG emissions from these units will therefore not be very productive.

A brief discussion of the BACT steps with respect to GHG emissions from the auxiliary boiler and gas heater is presented below:

Step 1 – Identify All Available Control Technologies

The first step in the top-down BACT process is to identify all "available" control options. Available control options are those air pollution control technologies or techniques (including lower-emitting processes and practices) that have the potential for practical application to the emissions unit and the regulated pollutant under evaluation.

The definition of BACT in 40 Code of Federal Regulations (CFR) 52.21(b)(12) includes use of clean fuels as a pollution control technique. The proposed auxiliary boiler and gas heater will be fired with only natural gas, which is the cleanest fuel compared to other fossil fuels such as oil or coal due to its low GHG emissions potential when combusted.

In the BACT analysis, GHGs are considered as a single air pollutant, which is the aggregate group of the six principal gases, CO_2, N_2O, CH_4, HFCs, PFCs, and SF_6. CO_2 emissions result from the oxidation of carbon in the fuel. CH_4 emissions result from incomplete combustion, and N_2O emissions result primarily from low temperature combustion. CO_2, N_2O, and CH_4 are the principal GHGs that will be emitted from the auxiliary boiler and the gas heater. Emissions of CH_4 and N_2O are negligible compared to CO_2 and specific control options for these pollutants are not discussed.

EPA recommends that permit applicants and permitting authorities should identify all "available" GHG control options that have the potential for practical application to the source under consideration. In the PSD and Title V Permitting Guidance for GHGs, EPA emphasizes on two mitigation approaches for CO_2 – energy efficiency and carbon capture and storage (CCS). CCS is not practical for CO_2 emissions from the proposed 17 million British thermal units per hour (MMBtu/hr) auxiliary boiler or the 8.75 MMBtu/hr gas heater due to the small amount of CO_2 emissions potential from this equipment compared to the combined-cycle system.

Energy Efficiency

In the GHG BACT guidance, EPA has stressed importance of energy efficiency for combustion sources. The proposed 17 MMBtu/hr auxiliary boiler will be used to provide steam to the steam cycle during the startup sequences, and the 8.75 MMBtu/hr gas heater will be used to warm up the natural gas flowing through the pipeline before feeding into the CTs.

A boiler's efficiency is measured by its annual fuel utilization efficiency (AFUE). AFUE is the ratio of heat output of the boiler compared to the total energy consumed by the boiler. An AFUE of 90 percent means that 90 percent of the energy in the fuel becomes heat and the other 10 percent is lost in the system. In general fossil fuel-fired boilers have high AFUE rating around 90 percent. For example, based on data from Cleaver Brooks for 100 to 800 HP firetube boilers, the fuel-to-steam efficiencies for a 400 HP (heat input 16.3 MMBtu/hr) boiler are 84.7 and 87.5 percent for natural gas and No. 2 fuel oil-firing, respectively.

Higher efficiency means, less fuel will be required to produce the same amount of steam (auxiliary boiler) or heating (gas heater). Recent BACT determinations for GHG emissions from auxiliary boiler and gas heater are based on the proposed efficiency of this equipment.

Step 2 – Identification of Technically Feasible Control Alternatives

Under the second step of the top-down BACT analysis, a potentially applicable control technique listed in Step 1 may be eliminated from further consideration if it is not technically feasible for the specific source under review. EPA considers a technology to be potentially applicable if it has been demonstrated in practice or is available. The boiler efficiency is considered to be the only technically feasible CO_2 control option for the proposed auxiliary boiler and the gas heater.

Step 3 – Rank Remaining Control Technologies

After the list of all available controls is narrowed down to a list of the technically feasible control technologies in Step 2, Step 3 of the top-down BACT process calls for the remaining control technologies to be listed in order of overall control effectiveness for the regulated New Source Review (NSR) pollutant under review. Based on the discussion in Steps 1 and 2, the only technically feasible control option for CO_2 from the proposed auxiliary boiler and the gas heater is energy efficiency.

Step 4 – Economic, Energy, and Environmental Impacts

Under Step 4 of the top-down BACT analysis, economic, energy, and environmental impacts must be evaluated for each option remaining under consideration.

In the top-down BACT analysis, the "top" control option should be established as BACT unless the applicant demonstrates, and the permitting authority agrees, that the energy, environmental, or economic impacts justify a conclusion that the most stringent technology is not "achievable" in that case. If the most stringent technology is eliminated in this fashion, then the next most stringent alternative is considered.

Energy efficiency improvements results in collateral reductions in emissions of all pollutants resulting from combustion processes. Based on emissions factors for distillate oil-firing boilers available in EPA's AP-42, nitrogen oxide (NO_X), sulfur dioxide (SO_2) and particulate matter (PM)/particulate matter less than 10 microns (PM_{10}) emissions are lower for natural gas-firing than oil-firing. Carbon monoxide (CO) and