South Texas Electric Cooperative, Inc. – Red Gate Power Plant
Prevention of Significant Deterioration Permit for Greenhouse Gas Emissions
PSD-TX-1322-GHG

Response to Public Comments

U.S. Environmental Protection Agency
February 2015

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I. Summary of the Formal Public Participation Process

The U.S. Environmental Protection Agency, Region 6 (EPA) proposed to issue a Prevention of Significant Deterioration (PSD) permit to South Texas Electric Cooperative, Inc. (STEC) for the proposed Red Gate Power Plant on September 17, 2014. The public comment period on the draft permit began September 17, 2014 and closed on October 17, 2014. EPA announced the public comment period through a public notice published in *The Monitor* on September 17, 2014 and on Region 6's website. In accordance with 40 CFR Part 124, EPA also notified agencies and municipalities on September 17, 2014.

The Administrative Record for the draft permit was made available at EPA Region 6's office. EPA also made the draft permit, Statement of Basis and other supporting documentation available on Region 6's website and at the Sekula Memorial Library in Edinburg, TX.

EPA's public notice for the draft permit also provided the public with notice of the public hearing. The public notice stated:

> Any request for a public hearing must be received by the EPA either by email or mail by October 7, 2014, and must state the nature of the issues proposed to be raised in the hearing…EPA maintains the right to cancel a public hearing if no request for a public hearing is received by October 7, 2014 or the EPA determines that there is not a significant interest. If the public hearing is cancelled, notification of the cancellation will be posted by October 10, 2014 on the EPA's Website http://yosemite.epa.gov/r6/Apermit.nsf/AirP. Individuals may also call the EPA at the contact number listed above to determine if the public hearing has been cancelled.

During the comment period, EPA did not receive any written requests for a public hearing. On October 10, 2014, EPA posted its announcement that there would not be a hearing. EPA received one comment letter from Sierra Club on October 3, 2014.

II. EPA's Response to Public Comments

This section summarizes the public comments received by EPA and provides our responses to the comments. EPA received one comment letter from Sierra Club on October 3, 2014. EPA did not receive any other comment letters.

Response to Sierra Club's Comments

Sierra Club submitted a letter commenting on the draft permit and statement of basis (hereinafter, "Comments") that we have summarized below (in their order of appearance in the comment letter) and to which we have provided responses.

Comment 1: Sierra Club argues that the Region must consider incorporating energy storage into the project as an alternative control option in Step 1 of the BACT analysis. The proposed reciprocating internal combustion engines (RICE) do not constitute the best available control technology (BACT) to meet the stated purpose of this project. The stated purpose of the Red Gate plant can be better achieved at much lower emissions if energy storage units are incorporated into the project. The Region must consider in Step 1 of the BACT analysis whether alternatives that incorporate energy storage could

provide functionally equivalent operation at a lower emission rate. Sierra Club recommends that the Region consider two additional alternatives that were not considered in the Application or the SOB: (1) replacing all of the 12 RICE units with an energy storage unit or units; and (2) replacing some of the 12 RICE units with an energy storage unit or unites (i.e. a hybrid energy storage-RICE configuration).

In support of these arguments, Sierra Club also claims that incorporating (1) energy storage and/or (2) hybrid energy storage-RICE as available control technology options does not constitute "redefining the source." A requirement to consider energy storage would not change the underlying business purpose of the facility, nor would it require a completely different fuel source. The Environmental Appeals Board recently reminded permitting agencies that they must carefully consider projects that include cleaner fuels or operating configurations. "The Board has cautioned that permitting authorities should not simply dismiss alternative control options, such as cleaner fuels, as constituting redesign, thereby creating an 'automatic BACT off-ramp' from further consideration of the option." *In re La Paloma Energy Center*, *LLC* ("La Paloma"), PSD Appeal No. 13-10, slip op. at 26, (EAB Mar. 14, 2014),16 E.A.D. ___. Sierra Club asserts that the permitting authority must make a case-specific assessment about the feasibility of incorporating energy storage into the design of the Red Gate plant.

Response: While the commenter states that RICE "are extremely inefficient and highly polluting compared to other sources of generation such as renewable energy or combined-cycle natural gas units[,]" the main focus of the comment is on the use of energy storage alone or in hybrid with the RICE. Comments at 2. As noted in EPA's statement of basis and consistent with STEC's application, the purpose of the project is to provide backup or support for renewable power, transmission grid support, and energy and ancillary services to meet its eight member distribution electric cooperatives energy and capacity needs as well as support the Energy Reliability Council of Texas (ERCOT) grid demands.

The influx of renewable energy into the ERCOT market and the variability associated with renewable technologies, such as wind and solar, put increased demands on grid stability. STEC represented that larger baseload units are unable to respond adequately to the large swings in generation caused by connection of large quantities of renewables to the grid. Fast ramping, quick starting, natural gas-fired RICE can help stabilize this volatility and enable the grid to handle the increased renewable profile. ERCOT has recognized this need and increased the amount of responsive reserve and regulation resources that are needed to support grid operations. As explained by the applicant, the project's rapid start capability, combined with the dispatchable unit size, minimizes part load operation and results in greater overall plant efficiency and reduced GHG emissions over a large operating load range and for extended periods of time, as required to support renewable energy and necessary ancillary services.

ERCOT load serving entities are required to procure their load ratio share of ancillary services to support reliable grid operation. These ancillary services include responsive reserve, regulation up, regulation down, and non-spinning reserve and may be purchased on the market or self-provided. Quick start capability along with fast ramp rates and good part-load efficiency are essential qualities for units providing ancillary services. Since these services are awarded and paid on a capacity basis even if the service is not dispatched in real-time, they may artificially lower the energy cost and increase the dispatch of flexible generation RICE units, such as those proposed for Red Gate. STEC is forecasting that the engines' efficiency and flexibility, combined with dispatch from ERCOT for ancillary services and transmission support, will lead to dispatch levels that are considerably higher than comparably sized simple cycle turbine facilities.

The commenter argues that STEC and EPA Region 6 failed to consider modern energy storage options such as batteries, compressed air energy storage (CAES), pumped hydro, and flywheels, and argues that the use of such technologies would provide "functionally equivalent operation at a lower emission rate" while fitting the general business purpose and technical requirements of the project. Comments at 2. The options proposed by the Sierra Club are vague and do not provide specific technical details or other specificity in defining the design alternative. For example, the commenter does not provide specific configurations that it believes EPA and the applicant should have considered. The commenter does not assert or provide information showing that each technology, either alone or as part of a hybrid energy storage-RICE configuration, could meet each of the specific technical requirements. *See generally* Comments at 4-6 (listing the technical requirements for the facility, and then giving an example of how one or two specific technologies could meet that objective and/or noting that energy storage generally could be used in that manner). Due to the broad nature of the comments and the lack of specific technical information supporting the commenter's proposed options, EPA has determined that not enough technical information has been provided by the commenter to warrant a highly detailed response that considers the myriad of permutations of storage options that might be considered, either alone or in hybrid. *See In re City of Palmdale*, PSD Appeal No. 11-07, slip op. at 47-48, 59 (EAB Sept. 17, 2012)[1] (finding a lack of specificity in public comments "effectively calls upon the Region to analyze a myriad of potential […] configurations for the proposed plant" that "goes well beyond the permitting authority's obligations").

Therefore, we have performed a general analysis of the options proposed in Sierra Club's comments, examining each technology as a full replacement for the proposed RICE project and as part of a hybrid energy storage-RICE project. As explained below, based on the general information available regarding the options and the specific information regarding the proposed facility, we have determined that all options proposed by Sierra Club can be eliminated as BACT for this proposed facility.

At the outset, we note that PSD permitting authorities are not required to consider in Step 1 of the BACT analysis alternative controls that would fundamentally redefine the nature of the source proposed by the permit applicant. *In re Prairie State*, 13 E.A.D. 1, 23 (EAB 2006).[2] In determining whether an alternative would redefine the source, the permitting authority should look at "how the applicant defined its goal, objectives, purpose or basic design for the proposed facility in its application [… and] then take a 'hard look' at the applicant's proposed design in order to discern which design elements are inherent for the applicant's purpose and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility." U.S. EPA, *PSD and Title V Permitting Guidance for Greenhouse Gases* ("GHG Permitting Guidance") 26 (March 2011).[3] In determining the facility's basic design, the permitting authority should look at how the project is described in the application and supporting materials. *La Paloma*, slip op. at 26. Sierra Club's description of the purpose of the proposed facility focuses on a general statement in the applicant's cover letter to the application – that the project intended to "meet the generation needs of South Texas to limit exposure of STEC member load to temporary price spikes" – and a list of technical requirements STEC provided in June 2013. Comments at 4. There are, however, other fundamental aspects of the project described in the application and other supporting materials. As explained below, Region 6 has

[1] Available at http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/Case~Name/05F646C34C4F833385257A7C005E55A2/$File/City%20of%20Palmdale%20final%20decision.pdf.

[2] Available at http://yosemite.epa.gov/oa/eab_web_docket.nsf/78952121D2AEC6288525721F00683223/$File/Prairie%20State%20opinion%20(7th%20Cir)..49.pdf.

[3] Available at http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf.

reviewed the project's purpose and taken a "hard look" at the proposed design, as described throughout the application and other supporting materials, in assessing the various energy storage technologies presented in Sierra Club's comments and has determined that some of the suggestions in the letter should not be considered in Step 1 of the BACT analysis because they would fundamentally redefine the source, while others can be eliminated as BACT for other reasons.

Full Replacement: With regard to the suggested option of replacing all of the 12 RICE with an energy storage unit or units, we note that as a general matter there is no evidence in the record showing that such replacement would actually produce lower emissions overall, because Sierra Club does not explain where the energy stored would come from or how it would be produced. While Sierra Club argues that energy storage is a zero- or low-emitting option, the comments fail to recognize and discuss a key aspect of energy storage – it accepts electrical energy generated from some other source, converts it to another form and stores it for some period of time, and then converts it back to electricity when needed.[4] The commenter has not provided information about the initial production of the electrical energy that would be eventually be stored, so we have no way to evaluate how the overall emissions associated with the commenter's preferred full replacement options would compare with the proposed project. To the extent the commenter is arguing that Red Gate should build an energy storage project that would be supplied by available off-site energy that is otherwise going unused, we are unaware of and there is nothing in the record to suggest that such unused energy is available or that even if it were available, it could supply energy the proposed maximum power capacity of 225MW for extended periods of time, as may be required during peak summer and winter conditions for this facility or when providing ancillary services[5]. Thus, full replacement does not meet the fundamental business purpose or technical requirements of the source and can be eliminated at either Step 1 or Step 2 of the BACT analysis. We also note that such an option would require STEC to purchase power from third parties for onsite storage, which would amount to a fundamental change in the purpose of the project, effectively changing STEC's operation from power generation to power purchase and distribution, which further supports elimination of this option at Step 1.

To the extent that Sierra Club is suggesting that the proposed Red Gate RICE facility be entirely replaced by energy storage in which the energy stored is produced by on-site renewables or natural gas combined cycle turbine (NGCC), we find that such configurations can also be eliminated for consideration at this facility. We are not aware of, and the commenter did not provide any basis or explanation showing that there is, a configuration of a renewable energy source in tandem with energy storage that could supply a maximum power capacity of 225MW for multiple days at this location, as required for this project. With regard to NGCC, we are not aware of, and the commenter did not provide any basis or explanation showing that there is, a configuration of NGCC energy production and energy storage that could be located at this site and that would supply power at a lower emission rate than the proposed facility.

It is important to note that all energy transfer and conversion processes, including energy storage, have associated energy losses. Specifically, the technologies proposed in Sierra Club's comments have energy efficiencies that can range from 60-90% efficient.[6] Thus, it is difficult to know – without more precise

[4] R. Carnegie, D. Gotham, D. Nderitu, & P.V. Preckel, *Utility Scale Energy Storage Systems: Benefits, Applications, and Technologies* (State Utility Forecasting Group; June 2013) ("State Utility Study") at 1, *available at* http://www.purdue.edu/discoverypark/energy/assets/pdfs/SUFG/publications/SUFG%20Energy%20Storage%20Report.pdf.
[5] Email from STEC (John Packard) to EPA (Jeff Robinson); January 28, 2015.
[6] *See* J. Eyer & G. Corey, *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide* (DOE; Feb. 2010) at 14, *available at* http://www.sandia.gov/ess/publications/SAND2010-0815.pdf; State Utility Study at 3.

technical information regarding the storage technology use and the configuration needed to meet the capacity and time requirements of the project – the extent to which any potential GHG emissions advantage that might be gained by use of a smaller NGCC system with marginally higher efficiency at high loads would be offset by the loss in overall efficiency due to the energy storage. Given the likelihood that the gains in NGCC efficiencies would be negated by the efficiency losses related to energy storage, we expect these options would have overall GHG emissions equivalent to or higher than the proposed RICE project, and would thus be eliminated as BACT at Step 3.[7]

Thus, we believe there is sufficient information to eliminate the overall suggestion of full replacement with energy storage as a BACT. However, we also have additional reasons for eliminating the specific technologies as BACT for this project, as explained below.

A. Batteries – The commenter referenced a specific site's (AES's Laurel Mountain) utilization of 98 MW of wind energy with 64 MW of integrated battery-based storage. We acknowledge that there are power generation configurations in the U.S. that utilize battery storage as an option for storing and releasing power to the grid. The AES Laurel Mountain Wind Farm in West Virginia has been operational since 2011 and includes 32 MW/8 MWh grid storage. The batteries known as the Grid Battery System (GBS™) is the energy storage component of the Grid Storage Solution (GSS™). The GBS is based on modular rack-integrated energy storage units. These rack-integrated energy storage units come in two types, High Rate (HR), which have high output power capable of full discharging 15 minutes, or Long Duration (LD), which have high energy content optimized for runtimes upwards of 4 hours. In addition, there are other power generation projects using energy storage utilizing lead acid battery technology (e.g., Duke Energy, Notrees Wind Farm Project in Texas). While these are good examples of power generation configurations utilizing energy storage, STEC Red Gate has designed their project to respond to load patterns that are unpredictable and where uninterrupted electricity generation at maximum load may be required for long periods of time. EPA is not aware of, and Sierra Club has not presented information showing, an all-battery facility that can provide the proposed maximum power capacity of 225MW for multiple days. Thus, the option may be eliminated at Step 1 of the BACT analysis because it would not meet the business purpose of the project – to provide up 225MW of energy for necessary time periods – and it may also be eliminated at Step 2 of the BACT analysis because it does not meet the technical requirements of the project – to provide such power for multiple days.

B. Compressed Air Energy Storage (CAES): Since the commenter has suggested CAES could be considered a potential alternative to the RICE units for the proposed Red Gate facility, EPA performed an analysis of potential storage reservoirs in the Rio Grande Valley. At the outset, we note that the location of the proposed project at a Greenfield site approximately 10 miles north of Edinburg in southern Texas, in Hidalgo County, is a key feature of the basic project design. The location is on land already owned by STEC, with on-site access to transmission (which means the project does not have to go through the Public Utility Commission's Certificate of Convenience and Necessity (CCN) process and thus avoids additional delays to the project) near much of STEC's load (which minimizes transmission costs and increases reliability).[8] We did not find suitable storage reservoirs that were available for use at the Red Gate facility. Assuming

[7] *See* GHG Permitting Guidance at 29 (explaining that options having essentially equivalent emissions need not be examined in detail in subsequent Steps of the top-down BACT Process).
[8] Email from STEC (John Packard) to EPA (Jeff Robinson); February 10, 2015.

compressed air would be stored in a salt dome, we note that the nearest potential storage reservoirs are approximately 60 miles from the proposed project site. The nearest salt domes to project are located in Brooks, Duval, and Willacy Counties to the north of the project site approximately 60 miles;[9] however, there is no evidence that these sites could structurally serve as a storage reservoir for compressed air even they could be used in conjunction with the current location.[10] As there are no available storage sites at the proposed Red Gate location, and the location is a part of the basic project design, this option can be eliminated at Step 1. Also, as there is nothing in the record to suggest that long distance storage in salt domes is technically feasible for the Red Gate facility, this option can be eliminated at Step 2 of the BACT analysis.

C. Pumped Hydro: Pumped storage projects move water between two reservoirs located at different elevations (i.e., an upper and lower reservoir) to store energy and generate electricity. Generally, when electricity demand is low (e.g., at night), excess electric generation capacity is used to pump water from the lower reservoir to the upper reservoir. When electricity demand is high, the stored water is released from the upper reservoir to the lower reservoir through a turbine to generate electricity. Pumped storage projects are also capable of providing a range of ancillary services to support the integration of renewable resources and the reliable and efficient functioning of the electric grid. As noted above, the location for this project was chosen as part of its basic design. There are no existing reservoirs on this site, and the location is a part of the basic project design, this option can be eliminated at Step 1. Also, as there is nothing in the record to suggest that long distance storage at other reservoirs is technically feasible for the Red Gate facility, this option can be eliminated at Step 2 of the BACT analysis. To the extent Sierra Club is proposing that the applicant build and utilize artificial reservoirs at the current location, we note the proposed facility is located in an area that the National Weather Service has currently classified as "extreme" drought in their "Long Term Drought Indicator Blend Percentiles." Thus, pumped hydro could also excluded at Step 4 of the BACT analysis given negative environmental impacts on water resources for this technology option due to the substantial increase in use of available water resources in an area that is currently experiencing a prolonged extreme, especially in light of the evaporation and leakage that occur during pumped hydro energy storage and the relatively small water usage of the proposed RICE facility.[11] The proposed Wartsilla engines operate on an air cooled system that does not consume any process water.

D. Flywheels – Beacon Power currently operates three commercial flywheel plants ranging in capacity up to 20 MW in three U.S. markets. In addition, a 2 MW flywheel storage facility opened in Ontario, Canada in 2014. It is also being used or proposed for use to support more localized power demands at lower MW configurations such as metropolitan transit systems with

[9] Duval County is the site of the Palangana and Pedras Pintas salt domes – the Piedras Pintas dome is located in Noleda, 2 miles northest of Benavides, and the Palanga dome is located 9 miles north of Benevides. United States Department of the Interior, *Geology and Ground-Water Resources of Duval County*, Texas, Albert Nelson Sayre, 1937. Brooks County is the site of the Gyp Hill Dome and the Alta Verde salt domes – theGyp Hill Dome is located about 4 miles southeast of Falfurrias, and the Alta Verde salt dome is about 15 miles west-southwest of Falfurrias. U.S. Geological Survey and Texas Water Development Board, *Ground-Water Resources of Brooks County, Texas*, October 167, reprinted April 1987. Willacy County is the site of La Sal Vieja (The Old Salt) lake which sits atop a massive salt dome. *See* http://www.texasbeyondhistory.net/st-plains/images/he5.html.

[10] Evidence of faulting in the areas adjacent to the domes in Brooks County would suggest that these domes would not be suitable for use in CAES. *See* FN 7, *supra*, *Ground-Water Resources of Brooks County, Texas*.

[11] State Utility Study at 24; Red Gate BA at 13. *See* http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/stec-redgate-ba.pdf.

rail systems, airports, office buildings, and data centers. The technology can provide fast response times and the ability to store power at off-peak hours instead of utilizing traditional sources of energy for peaking power; however, flywheels are a short discharge duration technology, and EPA is not aware of any flywheel that has been utilized or configured to construct a larger scale power project at the significantly higher MW ranges and durations proposed by STEC Red Gate.[12] Accordingly, similar to the battery option above, the option may be eliminated at Step 1 of the BACT analysis because it would not meet the business purpose of the project – to provide up 225MW of energy for necessary time periods – and it may also be eliminated at Step 2 of the BACT analysis because it does not meet the technical requirements of the project – to provide such power for multiple days.

The hybrid energy storage-RICE configuration suggested in Sierra Club's comments, in which some of the 12 RICE units are replaced with an energy storage unit or units, can also be eliminated as BACT for this project for the reasons discussed below.

A. Battery: If Sierra Club is proposing that EPA consider an option in which some battery storage is added to the proposed facility to create hybrid RICE/battery facility, we note that such an option would be eliminated later in the BACT analysis as all indications are that it would have higher GHG emissions than the proposed facility since energy storage results in a loss of gross power output due to inefficiency in the storage system.[13] For example, battery storage results in a loss of the energy input that varies based on discharge/recharge and battery type.[14] Furthermore, since RICE are generally able to maintain a high thermal efficiency at varying operational loading, there is no advantage to proceeding with a hybrid RICE-energy storage configuration whereby the RICE run at a constant low load to generate power for storage. In fact, it appears that using battery storage in tandem with a RICE turbine configuration would produce higher GHG emissions when compared with directly utilizing the RICE alone. Therefore, a hybrid RICE/battery facility can be eliminated as BACT since it would be ranked lower than the proposed facility at Step 3 of the BACT analysis, and there is no evidence in the record to suggest (and the commenter failed to explain or quantify) any environmental or other impacts arising from a hybrid configuration that would lead to its selection as BACT for this facility.

B. Compressed Air Energy Storage (CAES): For the same reasons as proved above in examining full replacement with CAES, there are no available storage sites at the proposed Red Gate location, and there is nothing in the record to suggest that long distance storage in salt domes is an available control option for the Red Gate location. Therefore, CAES used in hybrid with existing RICE can be eliminated at either Step 1 or Step 2 of the BACT analysis.

[12] *See* State Utility Study at 30 (explaining that the largest known flywheel can provide 340 MW for only 30 seconds and noting that flywheel systems are only able to provide up to an hour of stored energy).

[13] It appears that Sierra Club has assumed that fewer RICE engines would be required in the project scope if energy storage were utilized without the benefit of a source specific scaling analysis. It is currently unknown whether additional or fewer RICE engines would be needed to insert energy storage into the project scope, and STEC Red Gate has indicated to EPA that they believe they would need to add additional RICE engines if energy storage was required at the project. To consider adding hybrid energy storage to this project would require STEC Red Gate to perform a source specific scaling analysis to determine the optimal number of RICE engines in conjunction with optimal amount of energy storage (in MW) to determine if the project could functionally meet the demands of its customers and the grid operator (ERCOT). We have not required Red Gate to perform a project-specific scaling analysis as we have sufficient information to consider Sierra Club's comments.

[14] *See* the studies cited in FN 6, *supra.*

C. Pumped Hydro: For the same reasons as proved above in examining full replacement with pumped hydro, based on the lack of existing reservoirs on the project site and the environmental consequences water use in this drought area, pumped hydro used in hybrid with existing RICE can be eliminated at Steps 1, 2, or 4 of the BACT analysis.

D. Flywheels: As noted above, we are aware of small flywheel configurations, and it might be possible to use such configurations in hybrid with existing RICE. However, as discussed in the analysis of the hybrid battery-RICE configuration above, given the generally high efficiency of RICE engines at all loads and the efficiency losses inherent to energy storage, it appears that using flywheel storage in tandem with a RICE turbine configuration would produce higher GHG emissions when compared with directly utilizing the RICE alone. Therefore, a hybrid RICE/flywheel facility can be eliminated as BACT for this facility since it would be ranked lower than the proposed facility at Step 3 of the BACT analysis, and there is no evidence in the record to suggest (and the commenter failed to explain or quantify) any environmental or other impacts arising from a hybrid configuration that would lead to its selection as BACT for this facility.

Comment 2: The proposed operating hours are too high. The Draft Permit Section III.A.2.c provides that each RICE unit may operate up to 8,760 hours, including periods of startup and shutdown. The Draft Permit Section III.A.4.c further provides that each engine can startup and shutdown up to 730 times per year (twice a day, every day). These operating limits are inconsistent with the stated purpose of the project and would allow excessive emissions. The comments assert that operating a baseload plant is clearly not the purpose of the Red Gate plant. The application repeatedly states that the plant is intended to provide peaking capacity to avoid market price spikes. The operating limit in the permit must have the same rational basis in the business purpose of the facility as the technical requirements put forward by the Applicant. The Region should require STEC to provide data and information to support the number of hours that it anticipates such "temporary" price spikes will occur. The commenter argues that operating limit of the Red Gate plant should then be set at that limit, with an appropriate cushion to provide headroom. The Region should set the operating limit at 250 hours for each RICE unit.

Response: In response to public comments on the proposed permit, STEC has re-reviewed the Red Gate operational plan and has determined that it will operate the plant similarly to other permitted facilities (i.e., Guadalupe Power and Golden Spread Elk-Antelope). STEC has proposed to reduce their potential to emit in annual emissions from the proposed 8,760 hours of operation per engine (1,036,304 tpy for the 12 engines) to a potential to emit annual emissions which equate to around 5,648 hours of operation per engine (728,510 tpy for the 12 engines). The engines will maintain the same BACT limit of 1,145 lb CO_2/MWh on a 12-month rolling average and the resultant potential to emit GHGs will be reduced by approximately 35%. The engines selected can provide energy at an efficiency of 48.6% on a lower heat value (LHV) basis, while operating from 8% to 100% of plant's rated load output. They can provide full load in seven minutes and achieve full emissions control in less than 30 minutes, and the engines can shut down in less than five minutes. This rapid start and shut down capability, combined with the small dispatchable unit size, minimizes part load operation and results in greater overall plant efficiency and reduced emissions.

Further, STEC has provided some cost analysis based on the commenter's recommendation to cap the RICE units at 250 hours of operation each per year.[15] The estimated capital cost to procure the

[15] Email from STEC (John Packard) to EPA (Kyndall Cox); January 30, 2015.

equipment and construct the Red Gate facility is approximately $200 million, which will be amortized over the 30-year anticipated economic life of the facility. STEC further stated that:

> Running only 250 hours per year (max 2.85% capacity factor) our estimated cost of electricity coming out of the facility of would be over $520/MWh or $0.50/kWh not including transmission and distribution costs. This is the direct result of spreading the fixed costs for the facility over so few MWh's. For comparison, prices in the ERCOT market (South Hub) for energy during 2014 averaged $39.82/MWh ($0.03982/kWh). With energy produced by the facility costing over 12.5x the market price of power, the plant would be uneconomical to build and run, not to mention nearly impossible to finance.

In EPA Region 6's BACT analysis, we determined that the RICE proposed are more energy efficient and lower GHG-emitting than simple cycle turbines, and less efficient than combined cycle turbines when operated at full load. We also determined that the proposed RICE can achieve an output based BACT limit of 1,145 lb of CO_2/MWh (gross) during all hours of operation including startups and shutdowns. The sole purpose of this facility is to meet shortfalls of the electric grid while operating at 40% to 100% load. STEC plans to operate at times with an operating range load as low as 40% of the total plant, but has also indicated they may be required to turndown generation to as little as 10MW to the grid (a little less than 5% of full load capability of the proposed plant). For the RICE model (Wartsila 18V50SG) proposed for this project, the units are approximately 48.6% efficient on a lower heating value basis. While the RICE efficiency is less than a combined-cycle combustion turbine configuration operating a full load, the proposed RICE can generate as little as 10% of power load to the grid in 2 minutes and deliver total load to the grid within 7 minutes while remaining relatively stable with respect to its operating efficiency (approximately 45% efficient) from a load of 10MW up to 225 MW.[16,17] While combined-cycle power plants may achieve higher efficiencies than the proposed RICE when operated at full load, they generally cannot maintain high thermal efficiency over the load curve range that is required for the STEC facility.[18] Thus, from an efficiency perspective, the proposed RICE have the highest efficiency over the proposed operating load range and also meet the turndown requirements for the plant. In light the fact that the purpose of this facility is to provide power at a range of loads and for durations of different periods to meet the expected electrical demands in the area – but is not intended to run all engines at all times – and based on the information from STEC, in the final permit, the facility will be permitted to operate a total of 67,771 engine hours per year. The multi-unit configuration proposed by STEC creates a part-load profile that enables STEC to optimize performance and efficiency over the entire output range of the proposed plant. STEC will operate as many individual generating sets as required at their optimal efficiency to meet the expected variable demand by the grid. In addition, all maintenance and repairs on the engines can be performed on-site, one unit at a time, leaving the remaining units available for duty. The multiple genset concept proposed by STEC ensures high reliability and availability.

[16] http://www.wartsila.com/file/Wartsila/en/1278532913298a1267106724867-Gas-and-multi-fuel-power-plants-2014.pdf
http://www.wartsila.com/file/Wartsila/en/1278532913298a1267106724867-Gas-and-multi-fuel-power-plants-2014.pdf
[17] http://pennwell.websds.net/2014/kl/pga/papers/T2S2O2-paper.pdf
[18] Wartsila Gas and Multi-Fuel Power Plants at 9. *See*
http://www.wartsila.com/file/Wartsila/en/1278532913298a1267106724867-Gas-and-multi-fuel-power-plants-2014.pdf

III. Revisions in Final Permit

The following is a list of changes for the *STEC Red Gate (PSD-TX-1322-GHG) Prevention of Significant Deterioration Permit, Final Permit Conditions.*

1. Section II Annual Facility Emission Limits[1]

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[1,2]	BACT Requirements
				TPY[1]		
ENG01 ENG02 ENG03 ENG04 ENG05 ENG06 ENG07 ENG08 ENG09 ENG10 ENG11 ENG12	ENG01 ENG02 ENG03 ENG04 ENG05 ENG06 ENG07 ENG08 ENG09 ENG10 ENG11 ENG12	4 Stroke Lean Burn SI RICE	CO_2	~~86,271~~ 727,830[3]	728,510	- BACT limit of 1,145 lb CO_2/MW-hr (gross) on a 12-month rolling average basis. - Not to exceed a total 67,771 hours on a 12-month rolling basis for the engines. -See permit conditions III.A.
			CH_4	~~1.59~~ 1230[3]		
			N_2O	~~0.161~~ 1.254[3]		
GEN01	GEN01	Diesel Black Start Emergency Generator	CO_2	13.94	13.98	- Not to exceed 100 hours of non-emergency operation on a 12-month rolling basis. - Use of Good Combustion Practices. See permit conditions III.B.
			CH_4	No Numerical Limit Established[4]		
			N_2O	No Numerical Limit Established[4]		
FP01	FP01	Firewater Pump Engine	CO_2	3.10	3.11	-Not to exceed 100 hours of operation on a 12-month rolling basis. - Use of Good Combustion Practices. See permit conditions III.C.
			CH_4	No Numerical Limit Established[4]		
			N_2O	No Numerical Limit Established[4]		
CB-FUG01 CB-FUG02	CB-FUG01 CB-FUG02	Fugitive SF_6 Circuit Breaker Emissions	SF_6	No Numerical Limit Established[5]	No Numerical Limit Established[5]	Work Practices. See permit conditions III.D.

NGFUG	NGFUG	Components Fugitive Leak Emissions	CO_2	No Numerical Limit Established[6]	No Numerical Limit Established[6]	Implementation of AVO LDAR Program. See permit conditions III.E.
			CH_4	No Numerical Limit Established[6]		
Totals[7]			**CO_2**	**~~1,035,269.36~~ 727,847.07**	**~~1,036,615~~ 728,820**	
			CH_4	**~~29.9~~ 23.1**		
			N_2O	**~~1.93~~ 1.25**		
			SF_6	**0.001**		

1. The TPY emission limits specified in this table are not to be exceeded for this facility and include emissions from the facility during all operations and include MSS activities.
2. Global Warming Potentials (GWP): CO_2=1, CH_4 = 25, N_2O = 298, SF_6=22,800
3. The GHG Mass Basis TPY limit and the CO_2e TPY limit is a combined limit for the aggregate of the twelve (12) natural gas fired SI RICE ~~applies to each engine and is not a combined limit~~.
4. These values indicated as "No Numerical Limit Established" are less than 0.01 TPY with appropriate rounding. The emission limit will be a design/work practice standard as specified in the permit.
5. SF_6 fugitive emissions from EPNs CB-FUG01 and CB-FUG02 are estimated to be 0.001 TPY of SF_6 and 22.8 TPY CO_2e. In lieu of an emission limit, the emissions will be limited by implementing a design/work practice standard as specified in the permit.
6. Fugitive Leak Emissions from EPN NGFUG are estimated to be 0.319 TPY CO_2, 10.824 TPY CH_4, and 270.9 TPY CO_2e. In lieu of an emission limit, the emissions will be limited by implementing a design/work practice standard as specified in the permit.
7. Total emissions include the PTE for fugitive emissions. Totals are given for informational purposes only and do not constitute emission limits.

The emissions for the twelve RICE engines have been changed to reflect the new operational limits STEC has proposed for Red Gate. EPA Region 6 is granting the Applicant's request to lower the hours of operation from 8,670 hours per year per engine to 67,771 hours total for all twelve engines. The BACT limit originally proposed in the Draft Permit remains unaltered for EPNs ENG01-ENG12.

2. Special Condition III.A.2 SI RICE BACT Requirements:

a. The Permittee shall install twelve (12) 18.76-MW Wartsila (Model 18V50SG) lean burn natural gas-fired spark ignition reciprocating internal combustion engines or their equivalent.
b. The BACT limit of 1,145 lbs CO_2/MW-hr gross output applies to each engine.
c. ~~Each~~ The engines (EPNs ENG01-ENG12) may operate up to a combined total 67,771 ~~8,760~~ hours on a 12-month rolling basis, which shall include periods of startup and shutdown.
d. The engines shall have fuel metering for each fuel, and Permittee shall:
    i. Measure and record the fuel flow rate using an operational non-resettable elapsed flow meter or by recording the flow rate data in an electronic format with individual flow measurements being taken no less frequently than once every 15 minutes. Electronic data may be reduced to hourly averages for recordkeeping purposes.
    ii. Record the total fuel combusted for each fuel monthly.
    iii. The fuel flow of the fuel fired in the combustion engines shall be continuously monitored and recorded.
    iv. The gross energy output [MWh (gross)] for each engine shall be measured and recorded on an hourly basis.
d. Permittee shall calibrate and perform preventative maintenance check of the fuel gas flow meters and document annually.
e. All analyzers identified in this section III.A.2.d. shall achieve 95% on-stream time or greater.

EPA Region 6 is granting the Applicant's request to lower the hours of operation from 8,760 hours per year per engine to 67,771 hours total for all twelve engines. The BACT emissions limit originally proposed in the Draft Permit remains unaltered for EPNs ENG01-ENG12.