Statement of Basis
Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for Chamisa CAES at Tulia, LLC

Permit Number: PSD-TX-108130-GHG

February 2014

This document serves as the Statement of Basis (SOB) for the above-referenced draft permit, as required by 40 CFR 124.7. This document sets forth the legal and factual basis for the draft permit conditions and provides references to the statutory or regulatory provisions, including provisions under 40 CFR 52.21, that would apply if the permit is finalized. This document is intended for use by all parties interested in the permit.

I. Executive Summary

On November 6, 2012, Chamisa CAES at Tulia, LLC (Chamisa) submitted to EPA Region 6 a Prevention of Significant Deterioration (PSD) permit application for Greenhouse Gas (GHG) emissions for a proposed construction project. On February 28, 2013, Chamisa submitted additional information for inclusion into the application. In connection with the same proposed construction project, Chamisa submitted an application for a Standard Permit for Electric Generating Facilities for non-GHG pollutants to the Texas Commission on Environmental Quality (TCEQ) on February 5, 2013. The project proposes to construct a bulk energy storage system that will use compressed air energy storage (CAES) to produce up to 270 megawatts (MW) of electrical power. The Chamisa facility will be located near Tulia in Swisher County, Texas. The Chamisa facility will consist of two 135 MW trains. Each train will use CAES technology developed by Dresser-Rand and will be equipped with selective catalytic reduction (SCR) and catalytic oxidation units. Exhaust emissions from the turbine trains comprise the majority of air emissions from the plant site, with smaller emissions from an associated emergency generator engine, the natural gas and ammonia supply equipment, electrical equipment, and two cooling towers. After reviewing the application, EPA Region 6 has prepared the following SOB and draft air permit to authorize construction of air emission sources at the Chamisa facility.

This SOB documents the information and analysis EPA used to support the decisions EPA made in drafting the air permit. It includes a description of the proposed facility, the applicable air permit requirements, and an analysis showing how the applicant plans to comply with the requirements.

EPA Region 6 concludes that Chamisa’s application is complete and provides the necessary information to demonstrate that the proposed project meets the applicable air permit regulations. EPA's conclusions rely upon information provided in the permit application, supplemental information requested by EPA and provided by Chamisa, and EPA's own technical analysis. EPA is making all this information available as part of the public record.

II. Applicant

Chamisa CAES at Tulia, LLC
2300 North Ridgetop Road
Santa Fe, New Mexico 87506

Facility Physical Address:
1,000 meters west of I-27 intersection with SH 86.
Tulia, Texas 79088

Contact:
Alissa Oppenheimer
Managing Director
Chamisa Energy
2300 North Ridgetop Road
Santa Fe, New Mexico 87506
(505) 467-7800

III. Permitting Authority

On May 3, 2011, EPA published a federal implementation plan that makes EPA Region 6 the PSD permitting authority for the pollutant GHGs. 75 FR 25178 (promulgating 40 CFR § 52.2305). The State of Texas still retains approval of its plan and PSD program for pollutants that were subject to regulation before January 2, 2011, i.e., regulated NSR pollutants other than GHGs.

The GHG PSD Permitting Authority for the State of Texas is:

EPA, Region 6
1445 Ross Avenue
Dallas, TX 75202

The EPA, Region 6 Permit Writer is:
Aimee Wilson
Air Permitting Section (6PD-R)
(214) 665-7596

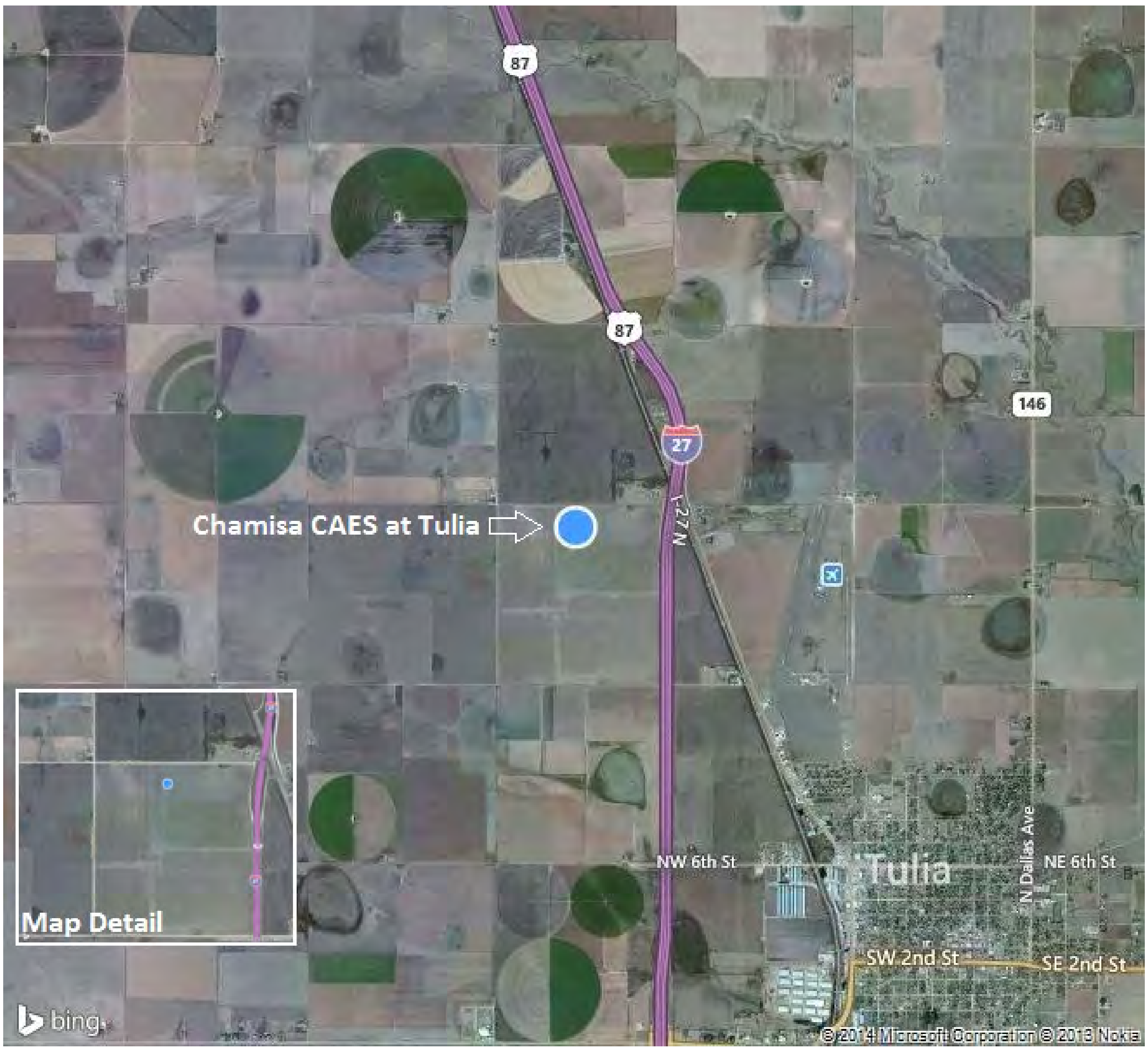
Facility Location

The Chamisa CAES at Tulia facility is located in Tulia, Swisher County, Texas, and this area is currently designated "attainment" for all criteria pollutants. The nearest Class 1 area is the Wichita Mountains Wildlife Refuge, which is located well over 100 miles from the site. The geographic coordinates for this proposed facility site are as follows

Latitude: 34º 31' 14.46" North
Longitude: -101º 48' 17.77" West

Below, Figure 1 illustrates the proposed facility location for this draft permit.

Figure 1. Chamisa CAES at Tulia Location (Blue Circle)



IV. Applicability of Prevention of Significant Deterioration (PSD) Regulations

EPA concludes that Chamisa's application is subject to PSD review for the pollutant GHGs as described at 40 CFR § 52.21(b)(23) and (49)(iv). Under the project, the potential GHG emissions are calculated to exceed the major source threshold of 250 TPY on a mass basis, as provided at 40 CFR § 52.21(b)(1), and the applicability threshold of 100,000 tpy "CO_2-equivalent" (CO_2e) potential to emit (Chamisa calculates CO_2e emissions of 401,326 tpy). EPA Region 6 implements a GHG PSD FIP for Texas under the provisions of 40 CFR § 52.21 (except paragraph (a)(1)). See 40 CFR § 52.2305.

The applicant represents that the proposed project is not a major stationary source for non-GHG pollutants. The applicant also represents that the increases in non-GHG pollutants will not be authorized (and/or have the potential) to exceed the "significant" emissions rates at 40 CFR § 52.21(b)(23). At this time, TCEQ, as the permitting authority for regulated NSR pollutants other than GHGs, has issued the standard permit for electric generating facilities for non-GHG pollutants.[1]

EPA Region 6 takes into account the policies and practices reflected in the EPA document "PSD and Title V Permitting Guidance for Greenhouse Gases" (March 2011). Consistent with recommendations in that guidance, we have not required the applicant to model or conduct ambient monitoring for GHGs, and we have not required any assessment of impacts of GHGs in the context of the additional impacts analysis or Class I area provisions of 40 CFR 52.21(o) and (p), respectively. Instead, EPA has determined that compliance with the selected Best Available Control Technology (BACT) is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules, with respect to emissions of GHGs. The applicant has, however, submitted an analysis to evaluate the additional impacts of the non-GHG pollutants to meet the requirements of 40 CFR § 52.21(o), as it may otherwise apply to the project.

V. Project Description

The proposed GHG PSD permit, if finalized, would authorize Chamisa to construct a new compressed air energy storage (CAES) power plant near Tulia in Swisher County, Texas to produce up to 270 MW of electrical power. The facility will be known as Chamisa CAES at Tulia, LLC, referred to within this document as "Chamisa". The Chamisa facility will comprise two nominally rated 135 MW trains. Each train will use CAES technology developed by Dresser-Rand and will be equipped with selective catalytic reduction (SCR) and catalytic oxidation units. CAES technology can use electrical power from the utility grid (produced by

[1] *See* EPA, Question and Answer Document: Issuing Permits for Sources with Dual PSD Permitting Authorities, April 19, 2011, http://www.epa.gov/nsr/ghgdocs/ghgissuedualpermitting.pdf

renewable and conventional power generation facilities) to operate multi-stage electric compressors to compress ambient air to pressures as high as 1,838 psia in underground storage caverns. Once stored, the compressed air is released as needed, heated by mixing and combusting it with natural gas, and exhausting it through an expansion turbine which drives an electrical generator to produce electricity. Bulk storage facilities such as Chamisa can hold weeks of megawatt-scale energy production capacity and provide an array of grid support services. Unlike traditional natural gas fired power plants, Chamisa will consume little water in its every day operations and use less fuel and produce fewer emissions than typical natural gas fired generators.

Exhaust emissions from the turbine trains comprise the majority of air emissions from the plant site, with smaller emissions from an associated emergency generator engine, the natural gas and ammonia supply equipment, electrical equipment, and two cooling towers. The compressed air for the project will be stored in caverns developed at the site.

<u>Gas Expansion Turbine Trains (EPNs: TURB1 and TURB2)</u>

Compressed air withdrawn from the storage caverns will first be preheated in a recuperator with hot exhaust gases from the process. Natural gas will be combusted with the pre-heated air in high-pressure combustors before entering a high-pressure expanding turbine stage. Water will be injected into the turbine stages at higher production capacities to maximize power production and help reduce the formation of nitrogen oxides. After expansion in the turbine, the turbine gases will be cooler and at a lower pressure. The exhaust gases will enter low-pressure combustors where additional natural gas will be combusted. The gases will then enter a low-pressure expanding turbine stage. Exhaust gases from that turbine will exchange heat with the incoming cavern air in a recuperator, and pass through a catalytic oxidation unit (for reduction of carbon monoxide and volatile organic compounds) and a selective catalytic reduction (SCR) unit (for reduction of nitrogen oxides) before exhausting to the atmosphere through two stacks. The electrical generators driven by the expansion turbines are rated to produce nominally 135 MW per turbine train, with a peak gross production of 140 MW.

<u>Emergency Generator</u>

A natural gas-fired generator with a capacity of 1,400 kW will provide emergency power when necessary. This generator will be equivalent to a Caterpillar SR4B-DM5498 generator set equipped with a G3516B LE (low emission) engine. The generator set will operate in non-emergency mode less than 100 hours per year for purposes of maintenance checks and readiness testing.

Cooling Towers

Heated cooling water from each compressor train and the generator set will be cooled in mechanical draft cooling towers equipped with high-efficiency mist eliminators to minimize drift emissions. The cooling towers do not have any GHG emissions.

Piping Equipment Fugitives

Fugitive methane emissions occur from piping equipment carrying natural gas at the site. Chamisa will use a Leak Detection and Repair (LDAR) program to help control the fugitive methane emissions.

Electrical Equipment Insulated with Sulfur Hexafluoride (SF_6)

The circuit breakers associated with the proposed units will be insulated with sulfur hexafluoride (SF_6). SF_6 is a colorless, odorless, non-flammable, and non-toxic synthetic gas. It is a fluorinated compound that has an extremely stable molecular structure. The unique chemical properties of SF_6 make it an efficient electrical insulator. The gas is used for electrical insulation, arc quenching, and current interruption in high-voltage electrical equipment. SF_6 is only used in sealed and safe systems which under normal circumstances do not leak gas. The capacity of the circuit breakers associated with the proposed plant is currently estimated to be 2,920 lbs of SF_6. Instrumentation and an LDAR program will be utilized to identify and/or prevent leaks from the circuit breakers.

VI. General Format of the BACT Analysis

The BACT analyses for this draft permit were conducted by following the "top-down" BACT approach recommended in EPA's *PSD and Title V Permitting Guidance for Greenhouse Gases* (March 2011) and earlier EPA guidance. The five steps in the top-down BACT process are listed below.

(1) Identify all available control options;
(2) Eliminate technically infeasible control options;
(3) Rank remaining control options;
(4) Evaluate the most effective controls (taking into account the energy, environmental, and economic impacts) and document the results; and
(5) Select BACT.

VII. Applicable Emission Units for BACT Analysis

The majority of the GHGs associated with the project are from emissions at combustion sources (i.e., gas expansion turbines and emergency engines). The project will have fugitive emissions from piping components which will account for 100 TPY of CO_2e, or less than 0.01% of the project's total CO_2e emissions. Stationary combustion sources primarily emit CO_2, and small amounts of N_2O and CH_4. The following equipment is included in this proposed GHG PSD permit:

- Gas Expansion Turbine Trains (EPNs: TURB1 and TURB2)
- Emergency Generator (EPNs: EMERGEN)
- Natural Gas Fugitives (EPN: NG-FUG)
- Natural Gas Maintenance Purges (EPN: NG-PURGE)
- SF_6 Insulated Equipment (EPN: SF6-FUG)

VIII. Gas Expansion Turbine Trains (EPNs: TURB1 and TURB2)

There will be two expansion turbine trains (TURB1 and TURB2). The electrical generators driven by the expansion turbines are rated to produce nominally 135 MW per turbine train, with a peak gross production of 140 MW.

As part of the PSD review, Chamisa provided in the GHG permit application a 5-step top-down BACT analysis for the combustion turbines. EPA has reviewed Chamisa's BACT analysis for the gas expansion turbine trains, which is part of the record for this permit (including this Statement of Basis), and we also provide our own analysis in setting forth BACT for this proposed permit, as summarized below.

Step 1 – Identify All Available Control Options

<u>Energy Efficiency Processes, Practices, and Design</u>

<u>Gas Expansion Turbine:</u>

- *Turbine Design* – The turbine models selected by Chamisa are highly efficient turbines, in terms of their heat rate (expressed as number of BTUs of heat energy required to produce a kilowatt-hour of electricity), which is a measure that reflects how efficiently a generator uses heat energy.

- *Reduction in Heat Loss* – Insulation is applied to the combustion turbine casing. This insulation minimizes the heat loss through the combustion turbine shell and helps improve the overall efficiency of the machine.
- *Instrumentation and Controls* – The control system is a digital type "model based control" supplied with the combustion turbine. The control system monitors the operation of the unit and modulates the fuel flow and turbine operation to achieve optimal high-efficiency low-emission performance for full load and part-load conditions on a real time basis by ensuring good combustion.
- *Cooling Water* – Cooling water will be used to cool the electric generator sets.
- *Carbon Capture and Storage (CCS)*

Auxiliary Energy Efficiency Processes

Chamisa has proposed other measures that help improve overall energy efficiency of the facility (and thereby reducing GHG emissions from the emission units), including:

- *Continuous Emission Monitoring System (CEMS)* – The CEMS unit monitors and records data on effluents from the gas expansion turbine trains. Employing CEMS to monitor performance of the turbines provides data to optimize operations of the turbines and to keep track of the emissions from the turbines.
- *Operating Procedures and Practices* – Vendor specified operating procedures and practices will be used to ensure efficient operation of the equipment. Implementing Standard Operating Procedures (SOPs) formulated with guidance from vendor specified operating manuals and maintenance standards will be used to ensure proper maintenance of equipment and promote efficient operation.

Step 2 – Elimination of Technically Infeasible Alternatives

All options identified in Step 1 are considered technically feasible for this project, except for CCS.

Carbon Capture and Storage (CCS)

Chamisa estimated the CO_2 concentration at maximum production in the turbine exhaust stacks would be approximately 3.25%, based on fuel consumption and stack flow of 328,320 scfm (at standard temperature of 60 ^oF) and a discharge temperature of 210 ^oF. At lower production levels, the CO_2 concentration declines to a low of 1.80% at 25% capacity, and the discharge temperature is slightly higher at 232 ^oF. The exhaust flow rates at lower capacities are nearly proportional to the production level. CCS has not been demonstrated in practice on low CO_2 concentration emission streams such as this. EPA expects that the technical challenges of capturing a 3.25% CO2 stream are exacerbated when a combustion turbines unit is operated intermittently and therefore the CO_2 stream is more cyclic in nature rather than steady state. CCS has not been demonstrated in practice on streams derived from combustion turbines operating in a peaking capacity mode with a limited number of operable hours in a given year. Although CCS technology is generally available from commercial vendors, we do not have information indicating that this technology can be applied to dilute emissions streams generated from combustion sources with limited operable hours such as a CAES facility which will operate in a peaking capacity mode with as many as 700 startup and shutdowns throughout the year for each turbine. Fluor has built a new demonstration project in Germany to capture CO_2 in a flue stream from a coal-fired power station where the key feature of the pilot plant is a "one button start/stop" concept that allows the plant to automatically come on line when the power plant operator wants to capture CO_2. Since this type of "start/stop" operational process has not yet been demonstrated for combustion turbine power plants that operate intermittently when dispatched for peak demand electricity, we do not believe CCS is technically feasible for the proposed Chamisa project.

Step 3 – Ranking of Remaining Technologies Based on Effectiveness

The energy efficiency (and therefore emission control effectiveness) of many of the control options that remain in Step 2 cannot be directly quantified. Since these options are not mutually exclusive, and Chamisa proposes to implement them all for this project, this analysis does not rank and compare their effectiveness. We will proceed to consider the impacts of these control options in BACT Step 4.

Step 4 – Evaluation of Control Options in Order of Most Effective to Least Effective, with Consideration of Economic, Energy, and Environmental Impacts

<u>Energy Efficiency Measures</u>

None of the Energy Efficiency Measures have been eliminated from the BACT review based on adverse economic, environmental, or energy impacts. The Chamisa facility has a low heat rate (conversely, a high energy efficiency) due to the use of a recuperator to recover heat from the turbine exhaust gas and use it to heat incoming air, and the use of modern gas turbine technology. By minimizing fuel usage, these techniques also minimize the release of GHGs. The Chamisa facility will achieve heat rates over a range of operating rates of 50-100% of capacity of 4,502-4,581 Btu (HHV basis) per net kWh produced. Furthermore, the other energy efficiency measures proposed by Chamisa make the suite of Energy Efficiency options the preferred option for BACT.

Worldwide there are two operating CAES plants. One of which is the Huntorf CAES Plant in Germany, and the other being PowerSouth's McIntosh CAES Plant located in McIntosh, Alabama. Huntorf, completed in 1978, is a 290 MW facility designed and built by Brown Boveri Corporation (now a component of Asea Brown Boveri (ABB)). Huntorf was originally built to provide peaking power service, as well as black start capability for nuclear power units in the region. Today the plant has increasingly seen use to help balance wind generation in North Germany. The Huntorf CAES Plant in Germany is not equipped with a recuperator leaving only the McIntosh CAES Plant for comparison. McIntosh was placed in commercial operation in 1991 as a single train CAES facility, rated at 110-MW output. McIntosh used a novel "motor/generator", whereby a single electrical machine fulfilled dual roles as a motor for compressing, and as a generator when operating in the expansion mode. The McIntosh recuperator incorporates features to improve tolerance to high-sulfur fuels. The Chamisa recuperator will perform at a higher level of heat recovery due to the plant's use of only low-sulfur fuel gas. The McIntosh recuperator was designed for a nominal effectiveness of 70%, the Chamisa recuperator is designed for a nominal effectiveness of 90%. In addition, Region 6 has proposed a GHG PSD permit for the APEX Bethel Energy Center in Tennessee Colony, TX. Data for the proposed Chamisa facility, the two existing CAES facilities, and the proposed APEX CAES facility are summarized in the table below.

	Chamisa CAES	**APEX[1]**	**McIntosh[2]**	**Huntorf[2]**
Power Production Capacity, MW	280 (total of 2 trains)	317 (total of 2 trains)	110	290
Heat Rate at Maximum Production, BTU (HHV)/kWh	4,389 (gross)-4,502 (net)	4,262 (gross)-4,390 (net)	4,555	6,175
Design Recuperator Efficiency,%	90	90	70	N/A (no recuperator)
No. of Expanders	2	3	2	2
Cavern Pressure, psig	940-1,800	1,900-2,830	1,100	600-1,000
Hours of Storage	36 - 48	100	26	3-4

[1]APEX Bethel Energy Center is a current Region 6 permit application that is being processed for a permit.
[2]Both of these plants are operating.

As with Chamisa and APEX Bethel, the compressors are electrically driven with no GHG emissions and the expanders are natural gas combustors. It should also be noted that the cavern air storage pressures are considerably higher for APEX which also provides for additional storage for extended power generation.

The expander train's design features, the high pressure (HP) and low pressure (LP) expanders, and the associated combustors at Chamisa and APEX are very similar to the McIntosh equipment with one exception, that the APEX design has an additional HP topping turbine to accommodate the higher cavern well head pressure. Additionally, the Chamisa and APEX combustors will use water injection for NO_X control, whereas McIntosh does not use water injection.

The most important contributor to optimizing the energy efficiency for Chamisa is the improved recuperator efficiency at CAES at Tulia (90% for Chamisa versus 70% for McIntosh). The APEX Bethel Energy Center also proposes a recuperator efficiency of 90%. Other design changes, such as cooling water use and periodic tuning, have a meaningful impact on output (and hence capital cost on a $/kW basis) and specific air consumption, but they do not affect heat rate materially. The heat rate advantage of Chamisa shown in the table above is that Chamisa will have an energy conversion efficiency higher than CAES units currently in existence. The Chamisa CAES will be slightly less efficient than the proposed APEX Bethel facility. APEX is proposed to have a BACT limit of 558 lb CO_2e/MWh (gross) on a 365-day rolling average. Chamisa's proposed BACT limit is 575 lb CO_2/MWh (gross) on a 12-month rolling average. This Chamisa limit is slightly higher than APEX, due to the use of a third expander at APEX which allows a higher cavern well-head pressure, making the APEX facility slightly more efficient with a corresponding lower BACT limit than Chamisa.

Separating the compressor from the combustion expander and generator, in a CAES system, has additional advantages such as utilizing an electric compressor with no GHG emissions during non- peak hours for the compression of air, and when necessary, for additional power generation by having both compression and generation operations at the same time.

Additional BACT considerations are for the operations to use good combustion practices, good operating and maintenance practices to ensure complete combustion of the natural gas fuel, maximize heat recovery by monitoring the exit flue gas temperature and optimizing the air/fuel ratio in the combustors. The design will take into consideration insulation materials to minimize heat loss from the expanders, combustors, ducts, and the recuperator. Heat loss from the expanders and combustors will be further mitigated by the fact that these components will be housed within a building – i.e. not exposed to the elements.

Step 5 – Selection of BACT

The following specific BACT practices are proposed for the gas expansion turbine trains:

- Combustion Turbine Energy Efficiency Processes, Practices, and Design
    - Highly Efficient Turbine, Compressor, and Combustor Design
    - Use of Recuperator with 90% Efficiency
    - Periodic Turbine Burner Tuning
    - Reduction in Heat Loss
    - High Thermal Efficiency

    - Instrumentation and Model Based Controls
    - Cooling Water
- Auxiliary Energy Efficiency Processes, Practices, and Design
    - Use of CEMS
    - Efficient Operating Procedures
    - Personnel Training

BACT Limits and Compliance:

Chamisa requested the BACT limit for the gas expansion turbine trains to be an output-based efficiency limit expressed in pounds of CO_2 per megawatt hour (lbs CO_2/MWh). The GHG BACT limit for the Chamisa facility is 575 lbs CO_2/MWh on a gross electrical output basis on a 12-operating month rolling average basis. The limit proposed takes into account the range of loads from the lowest sustainable load of 25% to 100% load which reflects the highest production rate of CO_2 over the full operational range. These values reflect a maximum 3% deterioration in turbine performance between overhauls. Over the operating range of 50% to 100% load, the vendor performance data indicates a heat rate of 4,389 to 4,667 Btu (HHV)/kWh (gross). At lower loads, the heat rate would gradually increase to a maximum of 4,925 Btu (HHV)/kWh (gross) at the lowest sustainable load. The proposed BACT limit of 575 lbs CO_2/MWh (gross) includes a 2% contingency factor and directly measures and reflects the overall process efficiency of the gas expansion turbine trains.

The heat recovery performance of the Chamisa recuperator will be monitored continuously during plant operation. Pressure and temperature measurements of the air at the recuperator inlet and recuperator outlet, and of the combustion gas at the turbine exhaust will be monitored and compared to expected values based on the gas expansion train's air mass flow and gas fuel input.

On January 8, 2014, the EPA proposed New Source Performance Standard (NSPS), 40 CFR Part 60 Subpart TTTT, that would control CO_2 emissions from new electric generating units (EGUs).[2] The proposed rule would apply to fossil-fuel fired EGUs that generate electricity for sale and are larger than 25 MW. The EPA proposed that new EGUs greater than 73 MW and equal to or less than 250 MW meet an annual average output based standard of 1,100 lb CO_2/MWh, on a gross basis. The proposed CO_2 emission rates from the Chamisa turbine trains are well within the emission limit of the proposed NSPS at 40 CFR Part 60 Subpart TTTT.

Chamisa will demonstrate compliance with the CO_2 BACT limit by the use of a CO_2 continuous emission monitoring system (CEMS) and also by recording the heat input to and the gross power output from the turbine. Chamisa shall install, calibrate, and operate the CO_2 CEMS and

---

[2] Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 79 Fed Reg 1430, January 8, 2014. Available at http://www.gpo.gov/fdsys/pkg/FR-2014-01-08/pdf/2013-28668.pdf

volumetric stack gas flow monitoring system with an automated data acquisition and handling system for measuring and recording CO_2 emissions. To demonstrate compliance with the CO_2 BACT limit using CO_2 CEMS, the measured hourly CO_2 emissions are divided by the net hourly energy output and averaged daily.

Chamisa proposes to determine a site-specific Fc factor using the ultimate analysis and GCV in equation F-7b of 40 CFR 75, Appendix F. The site-specific Fc factor will be re-determined annually in accordance with 40 CFR 75, Appendix F, §3.3.6

The equation for estimating CO_2 emissions as specified in 40 CFR 75.10(3)(ii) is as follows:

$$W_{CO_2} = (Fc \times H \times Uf \times MW_{CO_2})/2000$$

Where:

W_{CO2} = CO_2 emitted from combustion, tons/hour
MW_{CO2} = molecular weight of CO_2, 44.0 lbs/mole
Fc = Carbon-based Fc-Factor, 1040 scf/MMBtu for natural gas or site-specific Fc factor
H = hourly heat input in MMBtu, as calculated using the procedure in 40 CFR 75, Appendix F, §5
Uf = 1/385 scf CO_2/lb-mole at 14.7 psia and 68°F

Chamisa is subject to all applicable requirements for fuel flow monitoring and quality assurance pursuant to 40 CFR 75, Appendix D, which include:

- Fuel flow meter- meets an accuracy of 2.0%, required to be tested once each calendar quarter pursuant to 40 CFR 75, Appendix D, §2.1.5 and §2.1.6(a))
- Gross Calorific Value (GCV) - determine the GCV of pipeline natural gas at least once per calendar month pursuant to 40 CFR Part 75, Appendix D, §2.3.4.1

Additionally, this approach is consistent with the CO_2 reporting requirements of 40 CFR Part 98, Subpart D- GHG Mandatory Reporting Rule for Electricity Generation. Furthermore, Chamisa proposed CO_2 monitoring method is consistent with the recently proposed New Source Performance Standards, Subpart TTTT- Standards of Performance for Greenhouse Gas Emissions for Electric Utility Generating Units (40 CFR 60.5535(c)) which allows for electric generating units firing gaseous fuel to determine CO_2 mass emissions by monitoring fuel combusted in the affected electric generating unit and using a site specific Fc factor determined in accordance to 40 CFR Part 75, Appendix F.

The emission limits associated with CH_4 and N_2O are calculated based on emission factors provided in 40 CFR Part 98, Table C-2 and the actual heat input (HHV). Comparatively, the emissions from CO_2 contribute the most (greater than 99%) to the overall emissions from the combustion turbines and; therefore, additional analysis is not required for CH_4 and N_2O. To calculate the CO_2e emissions, the draft permit requires calculation of the emissions based on the procedures and Global Warming Potentials (GWP) contained in the Greenhouse Gas Regulations, 40 CFR Part 98, Subpart A, Table A-1. Records of the calculations would be required to be kept to demonstrate compliance with the emission limits on a 12-month, rolling average.

An initial stack test demonstration will be required for CO_2 emissions from TURB1 and TURB2. An initial stack test demonstration for CH_4 and N_2O emissions are not required because the CH_4 and N_2O emission are approximately 0.01% of the total CO_2e emissions from the combustion turbines. Repeat testing shall be performed every 5 years, plus or minus 6 months, of when the pervious performance test was performed, or within 180 days after the issuance of a permit renewal, whichever comes later to verify continued performance at permitted emission limits.

IX. Emergency Engine (EMERGEN)

The Chamisa facility will be equipped with one 1,400 kW natural gas-fired emergency generator to provide electricity to the facility in the case of power failure.

Step 1 – Identification of Potential Control Technologies

- *Low Carbon Fuels* – Engine options includes engines powered by natural gas, or liquid fuel, such as gasoline or fuel oil.
- *Good Combustion Practices and Maintenance* – Good combustion practices include appropriate maintenance of equipment, such as periodic readiness testing, and operating within the recommended air to fuel ratio recommended by the manufacturer.
- *Low Annual Capacity Factor* – Limiting the hours of non-emergency operation reduces the emissions produced. The emergency engine will be limited to 100 hours of operation per year for purposes of maintenance checks and readiness testing.

Step 2 – Elimination of Technically Infeasible Alternatives

- *Low Carbon Fuels* – The purpose of the engine is to provide a power source during emergencies, which includes outages of the combustion turbines. Natural gas is the lowest carbon fuel available and will be used as fuel in the emergency generator.
- *Good Combustion Practices and Maintenance* – Is considered technically feasible.
- *Low Annual Capacity Factor* – Is considered technically feasible since the engine will only be operated either for readiness testing or for actual emergencies.

Step 3 – Ranking of Remaining Technologies Based on Effectiveness

Since the remaining technically feasible processes, practices, and designs in Step 1 are being proposed for the engine, a ranking of the control technologies is not necessary.

Step 4 – Evaluation of Control Technologies in Order of Most Effective to Least Effective, with Consideration of Economic, Energy, and Environmental Impacts

Since the remaining technically feasible processes, practices, and designs in Step 1 are being proposed for the engine, an evaluation of the most effective controls is not necessary.

Step 5 – Selection of BACT

The following specific BACT practices are proposed for the natural gas-fired emergency generator:

- *Low Carbon Fuel* – The emergency engine will be natural gas-fired.
- *Good Combustion Practices and Maintenance* – Good combustion practices for compression ignition engines include appropriate maintenance of equipment, periodic testing conducted weekly, and operating within the recommended air to fuel ratio, as specified by its design.
- *Low Annual Capacity Factor* – The emergency engine will not be operated more than 100 hours per year for non-emergency use. It will only be operated for maintenance and readiness testing, and in actual emergency operation.

Using the BACT practices identified above results in an emission limit of 107 tpy CO_2e for the Emergency Generator. Chamisa will demonstrate compliance with the CO_2 emission limit using the default emission factor and default high heating value for natural gas from 40 CFR Part 98 Subpart C, Table C-1. The equation for estimating CO_2 emissions as specified in 40 CFR 98.33(a)(1)(i) is as follows:

$$CO_2 = 1 \times 10^{-3} * Fuel * HHV * EF * 1.102311$$

Where:
CO_2 = Annual CO_2 mass emissions from combustion of natural gas (short tons)
Fuel = Mass or volume of fuel combusted per year, from company records.
HHV = Default high heat value of the fuel, from Table C-1 of 40 CFR Part 98 Subpart C.
EF = Fuel specific default CO_2 emission factor, from Table C-1 of 40 CFR Part 98 Subpart C.
1×10^{-3} = Conversion of kg to metric tons.
1.102311 = Conversion of metric tons to short tons.

The emission limits associated with CH_4 and N_2O are calculated based on emission factors provided in 40 CFR Part 98, Table C-2 and the volume of fuel combusted.

X. Natural Gas Fugitive Emissions (NG-FUG)

The proposed project will include natural gas piping components. These components are potential sources of methane and CO_2 emissions due to emissions from rotary shaft seals, connection interfaces, valve stems, and similar points. The additional methane and CO_2 emissions from process fugitives have been conservatively estimated to be 85 tpy as CO_2e. Fugitive emissions are negligible, and account for less than 0.01% of the project's total CO_2e emissions.

Step 1 – Identification of Potential Control Technologies for GHGs

- *Use of leak-less and/or seal-less equipment;*
- *Implementing a leak detection and repair (LDAR) program using a handheld analyzer;*
- *Implement alternative monitoring using a remote sensing technology such as infrared camera monitoring; and*
- *Implementing an auditory/visual/olfactory (AVO) monitoring program.*

Step 2 – Elimination of Technically Infeasible Alternatives

Leakless/Sealless Technology – Leakless technology valves may be incorporated in situations where highly toxic or otherwise hazardous materials are present. Likewise, some technologies, such as bellows valves, cannot be repaired without a unit shutdown. Diaphragm valves are not available for the high pressures in the gas supply system. Complete elimination of flanges and threaded connections in the fuel system would significantly increase the cost of initial installation, as well as cause increased downtime for maintenance. Other components such as flanges and valves inherently cannot be leakless, and the facility cannot be constructed, operated, or maintained without the use of flanges and valves. Therefore, installing leakless technology is technically infeasible for controlling process fugitive GHG emissions from flanges and valves.

Instrument LDAR Programs – LDAR programs have traditionally been developed for control of VOC emissions. Instrumented monitoring is considered technically feasible for components in CH_4 service.

Remote Sensing – Remote sensing technologies have been proven effective in leak detection and repair. The use of sensitive infrared camera technology has become widely accepted as an effective means for identifying leaks of hydrocarbon.

AVO Monitoring – Leaking components can be identified through AVO methods. AVO programs are common and in place industry and are considered technically feasible.

Step 3 – Ranking of Remaining Technologies Based on Effectiveness

Instrumented monitoring can identify leaking CH_4, making identification of components requiring repair possible. This is the most effective of the controls.

Remote sensing using an infrared imaging has proven effective for identification of leaks. Instrument LDAR programs and the alternative work practice of remote sensing using an infrared camera have been determined by EPA to be equivalent methods of piping fugitive controls.[3]

As-observed AVO methods are generally somewhat less effective than instrument LDAR and remote sensing, since they are not conducted at specific intervals. This method cannot generally identify leaks at as low a leak rate as instrumented reading can identify. This method, due to frequency of observation, is effective for identification of larger leaks.

Step 4 – Evaluation of Control Technologies in Order of Most Effective to Least Effective, with Consideration of Economic, Energy, and Environmental Impacts

Although instrument LDAR and/or remote sensing of piping fugitive emissions in natural gas service may be somewhat more effective than as-observed AVO methods, the incremental GHG emissions controlled by implementation of the TCEQ 28LAER LDAR program or a comparable remote sensing program is less than 0.05% of the total project's proposed CO_2e emissions. Leak monitoring quarterly using instrument monitoring would cost approximately $6,000 annually. Leak monitoring using a camera (remote sensing) would cost approximately $16,000 annually. Leak repair costs are estimated to be approximately $5,000 per year. Leak monitoring using a camera could result in an overall reduction of 85% of the CO_2e emissions from equipment leaks. This would result in a cost effectiveness of $150 - $290 per ton of CO_2e. The 28LAER program credits a 97% control efficiency for valve leak reduction and a 75% control efficiency for flange/connector reduction. With an overall control efficiency of approximately 92%, costs for a 28LAER LDAR program would be $140 per ton CO_2e. Accordingly, given the costs of implementing 28LAER or a comparable remote sensing program when not otherwise required, these methods are not economically practicable for GHG control from components in natural gas service.

[3] 73 FR 78199-78219, December 22, 2008.

Step 5 – Selection of BACT

Based on the economic impracticability of instrument monitoring and remote sensing for fuel gas and natural gas piping components, Chamisa proposes to incorporate AVO as BACT for the piping components associated with this project in fuel gas and natural gas service. The proposed permit contains a condition to implement an AVO program on a weekly basis. As noted above, LDAR programs would not normally be considered for control of GHG emissions alone due to the negligible amount of GHG emissions from fugitives, and while the AVO program is being imposed in this instance, the imposition of a numerical limit for control of those negligible emissions is not feasible.

XI. Natural Gas Maintenance Purges (EPN: NG-PURGE)

During the first year of operation, the facility may have up to 8 maintenance purges from the natural gas supply which has been estimated at 1.7 tons/yr of methane, and 42.5 tons/yr of CO_2e. After the first year of operation, the facility will perform a quarterly maintenance purge from the natural gas supply which has been conservatively estimated at 0.85 tons/yr of methane, and 21 tons/yr of CO_2e.

Step 1 – Identification of Potential Control Technologies for GHGs

- *Use of a Flare or other Control Device*
- *Minimization of Purges*

Step 2 – Elimination of Technically Infeasible Alternatives

Both options are considered technically feasible.

Step 3 – Ranking of Remaining Technologies Based on Effectiveness

Flaring of maintenance purges would reduce CH_4 and other hydrocarbons by 98%, CO_2e emissions would be reduced by 81% since the combustion of the hydrocarbon emissions would result in the formation of CO_2.

Minimizing purges would cause fewer emissions.

Step 4 – Evaluation of Control Technologies in Order of Most Effective to Least Effective, with Consideration of Economic, Energy, and Environmental Impacts

Rental and operation of a portable flare once per quarter for the maintenance purge would cost approximately \$3,500 per quarter or \$14,000 annually. This results in a cost effectiveness of \$810 per ton CO_2e.

Neither option has any significant adverse energy or environmental impacts.

Step 5 – Selection of BACT

Due to the high cost of flaring, flaring is not considered BACT for the maintenance line purges. Gas volumes in the system will be minimized through use of the shortest and smallest diameter line sizes consistent with the turbine performance requirements, and components such as filters and valves will be selected to maximize intervals between scheduled service and to minimize entrapped volumes of gas. The system will be designed so that components that may require more frequent service can be isolated, minimizing the volume of gas that may be lost during maintenance operations. BACT is determined to be the minimization of the number of purges performed in a year. Chamisa will be limited to performing no more than 4 purges per year after the first year of operation. Chamisa may perform up to 8 purges during the first year of operation.

XII. SF_6 Insulated Electrical Equipment (EPN: SF6-FUG)

The circuit breakers will be insulated with sulfur hexafluoride (SF_6) gas. SF_6 is commonly used in circuit breakers associated with electricity generation equipment. The capacity of the circuit breakers associated with the proposed plant is currently estimated to be 2,920 lb of SF_6.

Step 1 – Identification of Potential Control Technologies for GHGs

- *Use of new and state-of-the-art circuit breakers that are gas-tight and require less amount of* SF_6
- *Evaluating alternate substances to* SF_6 *(e.g., oil or air blast circuit breakers)*
- *Implementing an LDAR program to identify and repair leaks and leaking equipment as quickly as possible*

Step 2 – Elimination of Technically Infeasible Alternatives

According to the report NIST Technical Note 1425, SF_6 is a superior dielectric gas for nearly all high voltage applications. It is easy to use, exhibits exceptional insulation and arc-interruption properties, and has proven its performance by many years of use and investigation. It is clearly superior in performance to the air and oil insulated equipment used prior to the development of SF_6 insulated equipment. The report concluded that although "…various gas mixtures show considerable promise for use in new equipment, particularly if the equipment is designed specifically for use with a gas mixture…it is clear that a significant amount of research must be performed for any new gas or gas mixture to be used in electrical equipment". Therefore, there are currently no technically feasible options besides the use of SF_6.

Of the control technologies identified, only substitution of SF_6 is determined as technically infeasible. All other control technologies are technically feasible. The traditional LDAR program using a flame ionization detector (FID) will not detect SF_6. An infrared camera can detect leaks of SF_6 if calibrated for SF_6. The alternate leak detection program of a low pressure alarm, lockout and inventory accounting program (40 CFR § 98.303(a), equation DD-1), is an alternate operation for the enclosed pressure circuit breakers. Chamisa proposed to implement these methods to reduce and control SF_6 emissions.

Step 3 – Ranking of Remaining Technologies Based on Effectiveness

Since Chamisa proposed to implement feasible control options, ranking these control options is not necessary.

Step 4 – Evaluation of Control Technologies in Order of Most Effective to Least Effective, with Consideration of Economic, Energy, and Environmental Impacts

No adverse energy, environmental, or economical impacts are associated with the technically feasible control options.

Step 5 – Selection of BACT

The following specific BACT practices are proposed for the SF_6 Insulated Electrical Equipment:

- The use of state-of-the-art enclosed-pressure SF_6 circuit breakers.
- The use of an LDAR program. The circuit breakers will be designed to meet the latest of the American National Standards Institute (ANSI) C37.013 standard for high voltage circuit breakers.[4]

Chamisa will monitor emissions annually in accordance with the requirements of the Mandatory Greenhouse Gas Reporting rules for Electrical Transmissions and Distribution Equipment Use.[5] Annual SF_6 emissions will be calculated according to the mass balance approach in Equation

[4] ANSI Standard C37.013, *Standard for AC High-Voltage Generator Circuit Breakers on a Symmetrical Current*.
[5] See 40 CFR Part 98 Subpart DD.

DD-1 of Subpart DD. Chamisa will implement a comprehensive leak detection and disposition program. This program will involve inventory-and-use tracking, leak detection by handheld halogen detectors, and low-gas density alarms. It will also include a recycling program so that SF_6 is evacuated into portable cylinders rather than vented to the atmosphere.

XIII. Endangered Species Act

Pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1536) and its implementing regulations at 50 CFR Part 402, EPA is required to insure that any action authorized, funded, or carried out by EPA is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species or result in the destruction or adverse modification of such species' designated critical habitat.

To meet the requirements of Section 7, EPA is relying on a Biological Assessment (BA) prepared by the applicant, Chamisa CAES, LLC ("Chamisa"), and its consultant, Blanton and Associates, Inc, ("Blanton"), and adopted by EPA.

A draft BA has identified three (3) species listed as federally endangered or threatened in Swisher and Castro counties, Texas:

Federally Listed Species for Swisher and Castro counties by the U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD)	**Scientific Name**
Birds	
Whooping Crane	*Grus americana*
Mammals	
Black-Footed Ferret	*Mustela nigripes*
Grey Wolf	*Canis lupus*

EPA has determined that issuance of the proposed permit will have no effect on any of the three listed species, as there are no records of occurrence, no designated critical habitat, nor potential suitable habitat for any of these species within the action area.

Because of EPA's "no effect" determination, no further consultation with the USFWS is needed.

Any interested party is welcome to bring particular concerns or information to our attention regarding this project's potential effect on listed species. The final draft biological assessment can be found at EPA's Region 6 Air Permits website at http://yosemite.epa.gov/r6/Apermit.nsf/AirP.

XIV. National Historic Preservation Act (NHPA)

Section 106 of the NHPA requires EPA to consider the effects of this permit action on properties eligible for inclusion in the National Register of Historic Places. To make this determination, EPA relied on a cultural resource report prepared by Blanton on behalf of Chamisa submitted on December 10, 2013.

For purposes of the NHPA review, the Area of Potential Effect (APE) was determined to be location of the proposed construction of the power generation facility on a 512-acre property and up to 19.5 miles of transmission lines. Blanton conducted a desktop review within a 1,000 meter radius area of potential effect (APE). The desktop review included an archaeological background and historical records review using the Texas Historical Commission's online Texas Archaeological Site Atlas (TASA) and the National Park Service's National Register of Historic Places (NRHP). Based on the desktop review within the APE, several cultural resources survey was previously performed within the general of the APE and two previously recorded archaeological and historical sites were identified within 1000 meters of the APE. Both sites are potentially eligible for listing on the National Register; however both are outside of the APE. Based on the results of the field survey, that includes shovel testing, no archaeological resources or historic structures were found within the APE.

EPA Region 6 determines that because no historic properties are located within the APE and that a potential for the location of archaeological resources within the construction footprint itself is low, issuance of the permit to Chamisa will not affect properties potentially eligible for listing on the National Register.

On January 8, 2014, EPA sent letters to Indian tribes identified by the Texas Historical Commission as having historical interests in Texas to inquire if any of the tribes have historical interest in the particular location of the project and to inquire whether any of the tribes wished to consult with EPA in the Section 106 process. EPA received no requests from any tribe to consult on this proposed permit. EPA will provide a copy of the report to the State Historic Preservation Officer for consultation and concurrence with its determination. Any interested party is welcome to bring particular concerns or information to our attention regarding this project's potential effect on historic properties. A copy of the report may be found at http://yosemite.epa.gov/r6/Apermit.nsf/AirP.

XV. Environmental Justice (EJ)

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive branch policy on environmental justice. Based on this Executive Order, the EPA's Environmental Appeals Board (EAB) has held that environmental justice issues must be considered in connection with the issuance of federal Prevention of Significant Deterioration (PSD) permits issued by EPA Regional Offices [See, e.g., *In re Prairie State Generating Company*, 13 E.A.D. 1, 123 (EAB 2006); *In re Knauf Fiber Glass*, Gmbh, 8 E.A.D. 121, 174-75 (EAB 1999)]. This permitting action, if finalized, authorizes emissions of GHG, controlled by what we have determined is the Best Available Control Technology for those emissions. It does not select environmental controls for any other pollutants. Unlike the criteria pollutants for which EPA has historically issued PSD permits, there is no National Ambient Air Quality Standard (NAAQS) for GHGs. The global climate-change inducing effects of GHG emissions, according to the "Endangerment and Cause or Contribute Finding", are far-reaching and multi-dimensional (75 FR 66497). Climate change modeling and evaluations of risks and impacts are typically conducted for changes in emissions that are orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible [PSD and Title V Permitting Guidance for GHGs at 48]. Thus, we conclude it would not be meaningful to evaluate impacts of GHG emissions on a local community in the context of a single permit. Accordingly, we have determined an environmental justice analysis is not necessary for the permitting record.

XVI. Conclusion and Proposed Action

Based on the information supplied by Chamisa, our review of the analyses contained the TCEQ PSD Permit Application and the GHG PSD Permit Application, and our independent evaluation of the information contained in our Administrative Record, it is our determination that the proposed facility would employ BACT for GHGs under the terms contained in the draft permit. Therefore, EPA is proposing to issue Chamisa a PSD permit for GHGs for the facility, subject to the PSD permit conditions specified therein. This permit is subject to review and comments. A final decision on issuance of the permit will be made by EPA after considering comments received during the public comment period.

APPENDIX

Annual Facility Emission Limits

Annual emissions, in tons per year (TPY) on a 12-month, rolling total, shall not exceed the following:

Table 1 Annual Emission Limits[1]

FIN	EPN	Description	GHG Mass Basis		TPY CO_2e[2,3]	BACT Requirements
				TPY[2]		
TURB1 TURB2	TURB1 TURB2	Gas Expansion Turbine Train 1 and Train 2	CO_2	397,144[4]	400,932[4]	575 lb CO_2/MWh (gross)[5] on a 12-operating month rolling average for each turbine. See Special Condition III.A.1.a.
			CH_4	28.5[4]		
			N_2O	9.96[4]		
EMERGEN	EMERGEN	Emergency Generator	CO_2	86	107[4]	Good Combustion and Operating Practices. Limit to 100 hours of operation per year. See Special Condition III.B.2.
			CH_4	0.84		
NG-FUG	NG-FUG	Natural Gas Fugitives	CO_2	No Numerical Limit Established[6]	No Numerical Limit Established[6]	Implementation of AVO program. See Special Condition III.C.
			CH_4	No Numerical Limit Established[6]		
NG-PURGE	NG-PURGE	Natural Gas Maintenance Purges	CO_2	No Numerical Limit Established[7]	No Numerical Limit Established[7]	Limit to 4 purges per year, after the first year of operation. See Special Condition III.D.1.
			CH_4	No Numerical Limit Established[7]		
SF6-FUG	SF6-FUG	SF_6 Insulated Equipment	SF_6	No Numerical Limit Established[8]	No Numerical Limit Established[8]	Instrumented monitoring and alarm/ LDAR. See Special Condition III.E.
Totals[9]			**CO_2**	**397,230**	**CO_2e 401,326**	
			CH_4	**34.2**		
			N_2O	**9.96**		

1. Compliance with the annual emission limits (tons per year) is based on a 12-month rolling total.
2. 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.
3. Global Warming Potentials (GWP): CH_4 = 25, N_2O = 298, SF_6 = 22,800
4. These values are for both turbine trains combined and is based on each turbine train operating for 5,000 hours per year at maximum production and includes MSS emissions. Each turbine train could operate at greater hours at lower production levels or at maximum production if the other train operated fewer hours.
5. The electrical output shall be measured at the generator terminals.
6. Natural gas fugitive emissions from EPN NG-FUG are estimated to be 0.04 TPY CO_2, 4 TPY of CH_4, and 100 TPY CO_2e. The emission limit will be a design/work practice standard as specified in the permit.
7. Natural gas maintenance purge emissions from EPN NG-PURGE are estimated to be 0.018 TPY CO_2, 1.7 TPY of CH_4, and 42.5 TPY CO_2e during the first 12 months of operation. After the first year, the emissions are estimated to be 0.009 TPY CO_2, 0.85 TPY CH_4, and 21 TPY CO_2e. The emission limit will be a design/work practice standard as specified in the permit.
8. SF_6 fugitive emissions from EPN SF6-FUG are estimated to be 0.0073 TPY of SF_6 and 166 TPY of CO_2e. The emission limit will be a design/work practice standard as specified in the permit.
9. Total emissions include the PTE for maintenance purges (first year) and fugitive emissions (including SF6). Totals are given for informational purposes only and do not constitute emission limits.