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February 15, 2024

Ms. Rebecca Matichuk
Air Dispersion Modeler
U.S. Environmental Protection Agency (EPA), Region 8
Matichuk.Rebecca@epa.gov

RE: Revised - Red Cedar Gathering CO_2 Capture Plant Minor NSR Application – AERSCREEN Modeling Analysis

Dear Ms. Matichuk:

Trinity Consultants, Inc. (Trinity) is submitting this letter on behalf of Red Cedar Gathering Company (RCG) to provide an air dispersion modeling analysis for the CO_2 Plant (the Facility) located on the Southern Ute Indian Reservation in Colorado. This modeling analysis is being submitted in response to the EPA Region 8 request dated June 7, 2022 to perform AERSCREEN modeling to evaluate impacts from the following regulated pollutants: nitrogen dioxide (NO_2), particulate matter with a diameter less than 10 micrometers (PM_{10}), particulate matter with a diameter less than 2.5 micrometers ($PM_{2.5}$), and carbon monoxide (CO) and reflects proposed changes associated with the revised application. Additionally, Trinity is providing a Modeled Emission Rates for Precursors (MERPs) analysis for ozone and secondary $PM_{2.5}$ per EPA Region 8's June 7, 2022 request. The modeling analyses described in this report incorporate the requested updates identified by EPA via email dated December 7, 2023. Updated information in the report is included in yellow highlighted text.

Background

RCG is proposing to construct a CO_2 capture facility to process CO_2 currently vented to the atmosphere from the Arkansas Loop and Simpson Treating Plants, located on the Southern Ute Indian Reservation in Colorado. RCG is proposing to install one (1) natural gas-fired 9331 kW SOLAR MARS 100-16000S turbine and one (1) natural gas-fired 701 bhp Cummins GTA 28E engine. There will also be three electric driven compressors, a TEG dehydrator, and ancillary equipment. The turbine will be utilized throughout the year for primary electricity generation. The engine will only operate for approximately ten minutes to start up the turbine and then four hours after each turbine shut down, and as needed for backup/emergency power. A conservative assumption of 500 hours of annual engine operation was used to estimate emissions and to accommodate annual turbine startup/shutdown events. Also, the engine power has not been derated and is thus a further conservative estimate of emissions.

AERSCREEN Modeling Analysis

The AERSCREEN analysis was performed in accordance with the request from EPA region 8 dated June 7, 2022 and subsequent information provided on February 9, 2023. A Significant Impact Level (SIL) analysis was performed for CO averaging periods, a National Ambient Air Quality Standards (NAAQS) analysis was performed for NO_2, PM_{10}, $PM_{2.5}$ averaging periods.

Dispersion Model Selection

The latest executable of EPA AERSREEN program, version 22112, was used to perform the air dispersion analysis for the Project. AERSCREEN is EPA's recommended screening-level air quality model, limited to a single-source, and based on the American Meteorological Society / Environmental Protection Agency Regulatory Model (AERMOD). The modeling was performed using the regulatory default option. Additionally, the area around the Facility is categorized as rural, so the rural boundary layer option was selected in AERSREEN for dispersion characteristics.

Modeled Sources and Structures

The turbine and generator engine are the only NO_x, CO, PM_{10}, and $PM_{2.5}$ emission sources associated with the Project which did not qualify as insignificant pursuant to 40 C.F.R. § 71.5(c)(11). The AERSCREEN algorithm only allows a single stack to be modeled per input file, therefore the two (2) stacks were modeled in individual AERSCREEN runs. Stack parameters for each source are summarized in Table 1.

Table 1. Modeled Stack Parameters

Stack Description	Exhaust Configuration	Location (m)		Stack Height (ft)	Stack Temperature (F)	Stack Velocity (ft/s)	Stack Diameter (ft)
		X	Y				
Turbine	Vertical point source	252,356.6	4,104,619.3	45.6	849	61.5	8.46 (equivalent diameter)
Engine	Vertical point source	252,345.4	4,104,610.2	9.85	1,147	155.12	0.67

The proposed engine and turbine each have a housing enclosure. Additionally, the CO_2 capture facility will include a compressor building that will be located close to both equipment. These structures were included in the model to account for downwash impacts on plume rise.

Building Wake Effects (Downwash)

The emission sources modeled in this analysis were evaluated in terms of their proximity to the nearby structures. The purpose of this evaluation was to determine if stack discharge might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the building was absent. Plumes entrained in the zones of turbulence experience enhanced plume growth and restricted plume rise. Downwash parameters for each stack were included in the AERSCREEN model using the input (.inp) file from the U.S. EPA's Building Profile Input Program (BPIP), version 04274. Graphics of the facility ambient air boundary as well as modeled sources and structures are contained in Attachment 2.

Terrain and Meteorology

The ambient air boundary (AAB) was determined as the location where the Facility's physical fence will be located, which is depicted in the figure contained in Attachment 2. A receptor grid with a distance of 5,000 meters (m) from the AAB and 25 m spacing was defined. The terrain elevation base height values for buildings and the point source were obtained from RCG documents. Receptor heights were calculated using AERMAP based on 1 arcsecond National Elevation Dataset (NED) data from the United States Geological Survey (USGS) for the terrain surrounding the facility as specified by EPA Region 8. The model used the default AERSCREEN meteorological settings for wind speed (0.5 m/s), minimum temperature (250 K), maximum temperature (310 K), and anemometer height (10 m). Additionally surface characteristics were determined via AERMET seasonal table inputs. The surface profile was defined as "Desert Shrubland" and the climate profile as "Dry". AERSCREEN interfaces with the MAKEMET processor, which generates meteorological data based on these inputs. The generated meteorological data was then used by the model to evaluate ambient impacts.

Steady-state and Start Up/Shutdown Emissions

This section describes the emission rates associated with the modeled sources, which are consistent with the RCG Potential-to-Emit (PTE) summary. The natural gas-fired generator engine has very quick startup and shutdown characteristics. Steady-state emissions for this engine are very quickly achieved upon startup, and the unit very quickly achieves zero emissions upon shutdown. Therefore startup/shutdown emissions (SUSD) for the generator engines are not required. Furthermore, NSPS JJJJ certification emissions were utilized for the NOx and CO modeling analyses. Because these emission standards are more conservative than the worst-case emission factors associated with the modeled pollutants at different loads, the model is conservative provided by the vendor.

The SUSD emission profiles for the turbine differs from the engine. While steady-state emissions are achieved within an hour of startup, a conservative estimate of startup emissions assumes a 10-minute period of startup emissions for NO_x, CO and VOC. Similarly, shutdown emissions from a turbine can encompass a minimum period of four-hours.

The corresponding emission rates utilized for each modeled pollutant are included in Attachment 3 of this application. For the NO_2 and CO 1-hr averaging period, the worst-case hourly emissions for each scenario were modeled (steady-state operations, startup, and shutdown). For the CO 8-hr averaging period, the worst-case emissions based on an eight-hour period for each scenario were modeled (steady-state operations, startup, and shutdown). Finally, for the NO_2 annual standard, annualized emissions including SUSD and steady-state emissions were used to estimate modeled impacts.

Results

Two types of model runs were carried out for each stack. The first scenario utilized a nominal emission rate of 1 g/s to represent CO, PM_{10}, and $PM_{2.5}$. The second scenario utilized a Tier 3 NO_2 modeling analysis to incorporate limited chemistry assumptions for NO_X to NO_2 conversion. The model used the ozone (O_3) limiting method (OLM), which was based on an in-stack NO_X /NO_2 ratio (provided in Attachment 1 for each stack) and an ambient background ozone concentration of 66.5 ppb. The latter was specified by EPA Region 8 to RCG on 12/7/2023 and corresponded to the 2020-2022 data for Ute 1 (Ignacio) and Ute 3 (Bondad) monitors, which are the monitors located closest to the facility. Radius of Impact (ROI) tables are also provided in Attachment 2 which depict the distance from the source to the maximum concentration for each modeled scenario.

A SIL analysis was conducted to determine model impacts for the 1-hr CO averaging period. First, the modeled concentration from the nominal model run for each source stack was multiplied times the source's corresponding pollutant emission rate (see Attachment 3) for each emission rate scenario (steady-state operations, startup, and shutdown) to obtain the modeled concentration. The total modeled impacts from the Project were determined as the sum of maximum modeled concentrations from each stack. For the turbine, this corresponded to the startup scenario. As depicted in Table 2, the CO modeled concentration for this averaging period is below the associated SIL threshold, and therefore the ambient air impacts demonstration is satisfied.

Table 2. SIL Analysis

Pollutant	Averaging Period	Turbine Modeled Concentration (µg/m³)	Engine Modeled Concentration (µg/m³)	Modeled Concentration (Engine +Turbine) (µg/m³)	Significant Impact Level (SIL) (µg/m³)	Exceed SIL? (Y/N)
CO	1-Hour	249.49	939.34	1,188.83	2,000	**No**

A NAAQS analysis was performed for the 8-hr CO averaging period, and all applicable averaging periods for NO_2, $PM_{2.5}$, and PM_{10} as these pollutant impacts exceed respective SIL thresholds. The NAAQS analysis utilized background concentrations to account for other sources in the area. The sum of the background concentration and the total maximum modeled concentration for each averaging period was compared to the NAAQS. EPA Region 8 provided all background concentrations from monitoring data collected at the Southern Ute Indian Tribe (SUIT) Ute 1 and Ute 3 monitoring sites for the 2020-2022 period. The maximum modeled concentration from the nominal model run for each source stack was scaled by the source's corresponding pollutant emission rate (see Attachment 3) to obtain the modeled concentration. For the 8-hr CO averaging period, this included the steady-state operations, startup, and shutdown scenarios. The total modeled impacts from the Project were determined as the sum of modeled concentrations from each stack, calculated by multiplying the maximum concentration from the nominal model run for each source stack multiplied the source's corresponding pollutant emission rate (see Attachment 3).

As explained in the background, the engine operates as an intermittent source. Following recent US EPA guidance, the short-term (hourly) emission rates for NO_x and $PM_{2.5}$ from the engine were adjusted per the "Treatment of Intermittent Sources" guidance.[1]. Specifically, the short-term emissions for each of these pollutants were multiplied by the ratio of the requested allowable hours of operation for the engine (500 hours/year) by the total available hours (8,760 hours/year) as shown in the equation below.

$$Average\ hourly\ rate\ \left(\frac{lb}{hr}\right) = Maximum\ short-term\ emissions\ \left(\frac{lb}{hr}\right) \times \frac{500\ hrs/yr}{8{,}760\ hrs/yr}$$

As shown in Table 3, the total concentrations for all pollutant averaging periods modeled are less than the applicable NAAQS thresholds, and therefore the ambient air impacts demonstration is satisfied. AERSCREEN model output files are provided in Attachment 4. For $PM_{2.5}$, additional analysis to consider secondary formation is considered in the MERPs Analysis.

Table 4 summarizes the distance and modeled concentration for the maximum impact receptor for each source and pollutant averaging period.

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[1] Email communication from Rebecca Matichuk, US EPA Region 8, to A. Jones, Trinity Consultants, 9/19/2023.

Table 3. NAAQS Analysis

Pollutant	Averaging Period	Maximum Modeled Concentration			Background Concentration [1]	Total Concentration	NAAQS [2]	Exceed NAAQS? (Y/N)
		Turbine	Engine	Total				
		(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	
CO	8-hour	57.34	845.48	902.82	1,755.54	2,658.36	10,350	**No**
NO_2 - OLM	1-Hour	29.56	24.10	53.66	33.41	87.07	188	**No**
	Annual	2.95	2.41	5.36	11.04	16.40	100	**No**
$PM_{2.5}$	24-Hour	2.15	1.18	3.33	17.30	20.63	35	**No**
	Annual	0.36	0.20	0.55	5.73	6.28	12	**No**
PM_{10}	24-Hour	2.15	20.67	22.81	118.17	140.98	150	**No**

[1] Background concentrations were provided by EPA Region 8 to Red Cedar Gathering (Ethan Hinkley) via email on 12/7/2023 and correspond to the most recent average design values (2020-2022) based on data from the UTE 1 (08-067-7001) and/or UTE 3 (08-067-7003) monitors, which are considered to be the closest and most representative monitor for the project area.
[2] The primary CO 8-hr NAAQS is 9 ppm. The CO NAAQS in units of ppm was converted to units of µg/m³ with a conversion factor of 1 ppb = 1.15 µg/m3. Per https://www.breeze-technologies.de/blog/air-pollution-how-to-convert-between-mgm3-%C2%B5gm3-ppm-ppb/

Table 4. Maximum Concentration Receptor Distance – Engine

Pollutant	Averaging Period	Operation Description	Distance	Maximum Concentration
			(m)	(µg/m³)
CO	1-Hour	Steady-state	25.09	939.34
	8-Hour	Steady-state	25.09	845.48
NO_2 - OLM	1-Hour	Steady-state	25.09	24.10
	Annual	Steady-state	25.09	2.41
PM2.5	24-Hour	Steady-state	25.09	1.18
	Annual	Steady-state	25.09	0.20
PM10	24-Hour	Steady-state	25.09	20.67

Table 5. Maximum Concentration Receptor Distance – Turbine

Pollutant	Averaging Period	Operation Description	Distance	Maximum Concentration
			(m)	(µg/m³)
CO	1-Hour	Startup	78.00	249.49
	8-Hour	Startup	78.00	57.34

Pollutant	Averaging Period	Operation Description	Distance (m)	Maximum Concentration ($\mu g/m^3$)
NO_2 - OLM	1-Hour	Startup	78.00	29.56
	Annual	Steady-state	78.00	2.95
PM2.5	24-Hour	Steady-state	78.00	2.15
	Annual	Steady-state	78.00	0.36
PM10	24-Hour	Steady-state	78.00	2.15

MERPs Analysis

A Modeled Emission Rates for Precursors (MERPs) analysis was performed for precursors of pollutants ozone and secondary $PM_{2.5}$. This is a type of Tier 1 demonstration tool that provides a simple way to relate maximum downwind impacts with a critical air quality threshold, such as the SIL or NAAQS thresholds. Tier 1 demonstrations involve use of technically credible relationships between emissions and ambient impacts based on existing modeling studies deemed sufficient for evaluating a project source's impacts. The proposed sources associated with the Project will be located on the Southern Ute Indian Reservation, in La Plata County, Colorado. The MERPS analysis conservatively utilized worst case annual PTE increases associated with the project, inclusive of insignificant emissions, as summarized in the table below.

Table 6 Facility PTE - MERPS Analysis

PTE increases	tpy
PM/ PM_{10}/ $PM_{2.5}$	2.87
SO_2	0
VOC [2]	6.24
CO	28.05
NO_x	26.50

Ozone

The MERP framework may be used to describe an emission rate of an individual precursor that is expected to result in a change in the level of ambient ozone that would be less than a specific air quality threshold for ozone that a permitting authority adopts and chooses to use in determining whether a projected impact causes or contributes to a violation of the ozone NAAQS. Increases NO_x or VOC, the regulated precursors for ozone, were used for the ozone MERPs analysis. Per EPA, Scenario A was used for Ozone calculations. However, although consideration of a single pollutant is recommended with this approach, both ozone precursors (NO_x and VOCs) were conservatively used for the ozone MERPs analysis.

[2] The facility wide PTE is inclusive of uncontrolled glycol dehydrator VOC emissions (i.e., 2.8 tpy).

The worst-case MERPs were obtained from a hypothetical source located in Bent, Colorado found in EPA's MERPs View Qlik website. NO_x and VOC Project emissions increases are summarized in Table 6 (inclusive of all emissions at the CO_2 capture plant), while criteria associated with the selected MERPs hypothetical source are summarized in Table 7. Table 8 depicts the calculated MERP, and the Tier 1 MERP Modeled Air Quality Impact as percent of the SIL.

Table 6. Ozone Precursor Emission Increases

Pollutant	Project Increase (tpy)
NO_x	26.50
VOC	6.24

Table 7. Representative Impacts for Ozone

Secondary Pollutant	Precursor	Stack Height	MERP Source *	Emission Rate	MERP **	SIL
		(m)		(tpy)		(ppb)
Ozone	NO_x	10	Bent, Colorado	500	235	1
	VOC	10	Bent, Colorado	500	8,655	1

* Based on 500 tons emissions and 10 m stack height
** The listed MERPs were obtained from EPA's Air Qlik Website August 19, 2022 as the worst-case MERPs for Colorado sources.

Table 8. Calculated Ozone MERP

Precursor	Tier 1 MERP Modeled Air Quality Impact as % of SIL	Tier 1 MERP Modeled Air Quality Impact as % of SIL *	MERP Ozone
NO_x	11.28%	11.35%	0.1135
VOC	0.072%		

* A value less than 100% indicates that the EPA recommended ozone SIL would not be exceeded when considering the combined impacts on 8-hr ozone.

Secondary $PM_{2.5}$

$PM_{2.5}$ precursor pollutants (e.g., NO_X, SO_2) can undergo photochemical reactions with ambient gases such resulting in the formation of secondary $PM_{2.5}$ downwind.

For the daily $PM_{2.5}$ MERPs analysis, worst-case MERPs were obtained from a hypothetical source located in Weld, Colorado found in EPA's MERPs View Qlik website. NO_x and SO_2 Project emissions increases are summarized in Table 9 while criteria associated with the selected MERPs hypothetical source are summarized in Table 10 for the daily $PM_{2.5}$. Table 11 depicts the calculated MERP for the daily $PM_{2.5}$ standard, and the Tier 1 MERP Modeled Air Quality Impact as percent of the SIL.

Table 9. Precursor Emission Increases

Pollutant	Project Increase (tpy)
NO_x	26.50
SO_2	0

Table 10. Representative Impacts for Daily $PM_{2.5}$

Secondary Pollutant	Precursor	Stack Height (m)	MERP Source *	Emission Rate * (tpy)	MERP **	SIL (µg/m^3)
$PM_{2.5}$	NO_x	10	Weld, Colorado	500	6,514	1.2
	SO_2	10	Weld, Colorado	500	1,508	1.2

* Based on 500 tons emissions and 10 m stack height
** The listed MERPs were obtained from EPA's Air Qlik Website August 19, 2022 as the worst-case MERPs for Colorado sources.

Table 117. Daily $PM_{2.5}$ Calculated MERP

Precursor	Tier 1 MERP Modeled Air Quality Impact as % of SIL	Tier 1 MERP Modeled Air Quality Impact as % of SIL *	MERP Secondary $PM_{2.5}$
NO_x	0.41%	0.41%	0.0049
SO_2	0%		

* A value less than 100% indicates that the EPA recommended PM2.5 SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual $PM_{2.5}$.

Since the primary $PM_{2.5}$ impacts were over the SIL, Table 12 shows the sum of Primary and Secondary $PM_{2.5}$ plus background concentration compared to the NAAQS. NAAQS compliance is demonstrated with this analysis.

Table 12. Cumulative Daily $PM_{2.5}$ Impacts

Precursor	Modeled Primary $PM_{2.5}$ Impact + Calculated Secondary $PM_{2.5}$ MERP + Primary $PM_{2.5}$ Background Concentration	NAAQS Threshold	Exceed NAAQS?
	(µg/m³)	(µg/m³)	
NO_x	20.63	35	No
SO_2			

For the annual $PM_{2.5}$ MERPs analysis, worst-case MERPs were obtained from the same hypothetical source located in Weld, Colorado. Criteria associated with the selected MERPs hypothetical source are summarized in Table 13. Table 14 depicts the calculated MERP, and the Tier 1 MERP Modeled Air Quality Impact as percent of the SIL.

Table 138. Representative Impacts for Annual $PM_{2.5}$

Secondary Pollutant	Precursor	Stack Height	MERP Source *	Emission Rate **	MERP **	SIL
		(m)		(tpy)		(µg/m³)
$PM_{2.5}$	NO_x	10	Weld, Colorado	500	11,960	0.2
	SO_2	10	Weld, Colorado	500	10,884	0.2

* Based on 500 tons emissions and 10 m stack height
** The listed MERPs were obtained from EPA's Air Qlik Website August 19, 2022 as the worst-case MERPs for Colorado sources.

Table 14. Annual $PM_{2.5}$ - Calculated MERP

Precursor	Tier 1 MERP Modeled Air Quality Impact as % of SIL	Tier 1 MERP Modeled Air Quality Impact as % of SIL *	MERP Secondary PM2.5
NO_x	0.22%	0.22%	0.0004
SO_2	0%		

* A value less than 100% indicates that the EPA recommended PM2.5 SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual PM2.5.

Since the primary $PM_{2.5}$ impacts were over the SIL, Table 15 shows the sum of Primary and Secondary $PM_{2.5}$ plus background concentration compared to the NAAQS. NAAQS compliance is demonstrated with this analysis.

Table 15. Cumulative Annual $PM_{2.5}$ Impacts

Precursor	Modeled Primary $PM_{2.5}$ Impact + Calculated Secondary $PM_{2.5}$ MERP + Primary $PM_{2.5}$ Background Concentration	NAAQS Threshold - MERP Secondary $PM_{2.5}$	Exceed NAAQS?
	($\mu g/m^3$)	($\mu g/m^3$)	
NO_x	6.28	12	No
SO_2			

If you have any questions about the information or the analysis presented, please contact Ashley Jones at 720.638.7647 ext. 5601 or via email at avjones@trinityconsultants.com.

Ashley Jones
Managing Consultant, Trinity Consultants

cc: Mr. Ethan Hinkley, Red Cedar Gathering
Ms. Camille Maradiaga Ponce, Trinity Consultants

ATTACHMENT 1

Modeled Parameters

Red Cedar Gathering
AERSCREEN Modeling

Mars 100-16000S Turbine - Stack Parameters

Parameter	Units	Value
Stack ID	-	SOLAR100
Stack Location X: UTM Easting	m	252,356.6
Stack Location Y: UTM Northing	m	4,104,619.3
Type of Source	N/A	point source
Stack Height	ft	45.63
	m	13.91
Rectangular Stack length	ft	7.50
Rectangular stack width	ft	7.50
Stack Equivalent Diameter	ft	8.46
	m	2.58
Exhaust flowrate	acfm	207,571
	m^3/s	98
Exit velocity	m/s	18.75
Distance to Fenceline	m	17.90
Elevation	m	2,237.23
Stack Temperature	F	849
	K	727

Meteorological and Downwash Parameters

Parameter	Units	Value
Anemometer Height	m	10.00
Urban/Rural	-	Rural
Maximum Distance to Probe	m	5,000
Minimum Temperature	K	250.00
Maximum Temperature	K	310.00
Minimum Wind Speed	m/s	0.50
BPIP		
Genset Enclosure		
Elevation	ft	7,331
Building Height	ft	10
Building Length (X Length)	ft	8.00
Building Width (Y Length)	ft	20.00
Turbine Enclosure		
Elevation	ft	7,331
Building Height	ft	13
Building Length (X Length)	ft	46.58
Building Width (Y Length)	ft	9.83
Compressor Building		
Elevation	ft	7,331
Building Height	ft	41
Building Length (X Length)	ft	107
Building Width (Y Length)	ft	75

NO_2 Ozone-Limiting Method (OLM) Model Inputs

Value	Units	Value
NO_2/NO_X In-stack ratio (ISR)[1]	-	0.3
Background Ozone	ppb	64.8

[1] Per manufacturer specification data.

Red Cedar Gathering
AERSCREEN Modeling

Cummins GTA 28E - Stack Parameters

Parameter	Units	Value
Stack ID	-	GEN1
Stack Location X: UTM Easting	m	252,345.4
Stack Location Y: UTM Northing	m	4,104,610.2
Type of Source	N/A	vertical point source
Stack Height	ft	9.85
	m	3.002
Stack Equivalent Diameter	ft	0.67
	m	0.20
Exhaust flowrate (maximum site rating 100%)	acfm	3,249
	m^3/s	1.53
Velocity (maximum site rating 100%)	m/s	47.28
	ft/s	155.13
Distance to Fenceline	m	25.09
Elevation	m	2,234.49
Stack Temperature (maximum site rating 100%)	F	1147
	K	893

Meteorological and Downwash Parameters

Parameter	Units	Value
Anemometer Height	m	10.00
Urban/Rural	-	Rural
Maximum Distance to Probe	m	5,000
Minimum Temperature	K	250.00
Maximum Temperature	K	310.00
Minimum Wind Speed	m/s	0.50
BPIP		
Genset Enclosure		
Elevation	ft	7,331
Building Height	ft	9.67
Building Length (X Length)	ft	18.26
Building Width (Y Length)	ft	7.50
Turbine Enclosure		
Elevation	ft	7,331
Building Height	ft	12.64
Building Length (X Length)	ft	46.58
Building Width (Y Length)	ft	9.83
Compressor Building		
Elevation	ft	7,331.00
Building Height	ft	41
Building Length (X Length)	ft	107
Building Width (Y Length)	ft	75

NO_2 Ozone-Limiting Method (OLM) Model Inputs

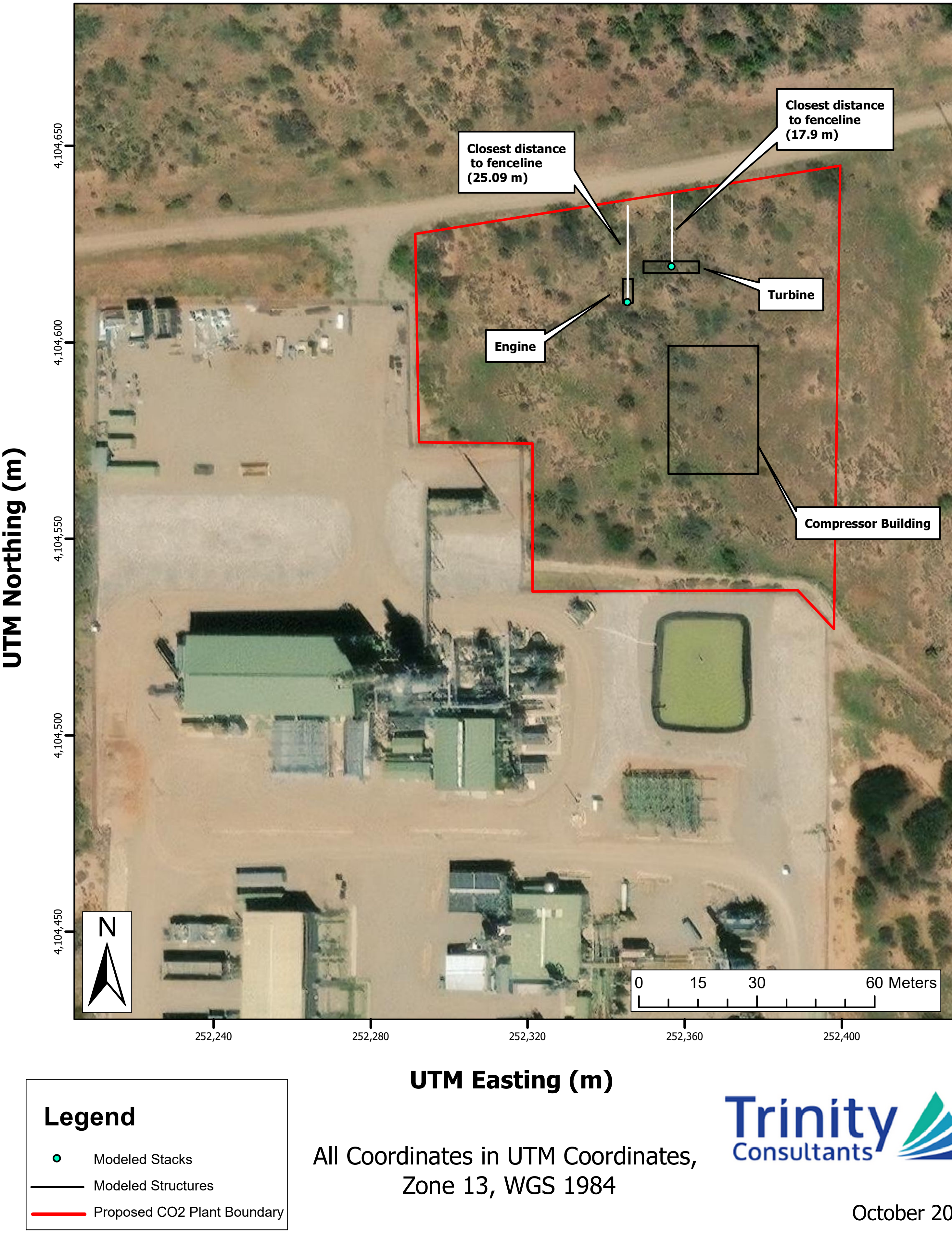
Value	Units	Value
NO_2/NO_X In-stack ratio (ISR) [1]	-	0.4
Background Ozone	ppb	64.8

[1] Average ISR for natural gas lean-burn engines of similar rated horsepower from the EPA, Nitrogen Dioxide/Nitrogen Oxide In-Stack Ratio (ISR) Database, https://www.epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-

ATTACHMENT 2

Facility Graphics

Red Cedar Gathering
Arkansas Loop/Simpson Treating Plant - CO2 Capture Plant
AERSCREEN Model Layout



All Coordinates in UTM Coordinates, Zone 13, WGS 1984

Trinity Consultants

October 2023

ATTACHMENT 3

Emission Calculations

Red Cedar Gathering
AERSCREEN Modeling - Emission Calculations

Natural Gas-Fired Turbine - Inputs

Emission Unit ID	Description	Fuel Used	Capacity [1]		Hours of Operation [2]	Heat Input Capacity [3]
			kW	(hp)	(hrs/yr)	(MMBtu/hr)
SOLAR100	Mars 100-16000S Turbine	Natural gas	9,284	12,450	8,760	98

[1] Per vendor specification sheet.
[2] Conservative assumption.
[3] Based on a conversion of 10,528 Btu/kW-hr per manufacturer specification sheet

Natural Gas-Fired Turbine - Steady-state Emissions

Pollutant	Emission Factors		Footnote	Emissions			
	Value	Units		Hourly (lb/hr)	Hourly (g/s)	Annual (tpy)	Annual (g/s)
PM/ PM_{10}/ $PM_{2.5}$	6.60E-03	lb/MMBtu	1,2	0.65	0.08	2.83	0.08
VOC (UHC)	0.07	lb/Mwh	3	0.65	8.19E-02	3.01	8.65E-02
CO	5.99	lb/hr	3	5.99	0.75	26.25	0.76
NO_x	5.91	lb/hr	3	5.91	0.7446	25.87	0.7442
SO_2	0.0	lb/MMBtu	4	0.00	0.00	0.00	0.00

[1] Emission factor for PM were obtained from U.S. AP-42, Section 3.1 (Natural Gas-fired Gas Turbines) Table 3.1-2a.
[2] It is conservatively assumed that $PM=PM_{10}=PM_{2.5}$.
[3] Worst-case emission factors for unburned hydrocarbons (UHC), CO, and NO_x were obtained from the manufacturer specification sheet. The VOC emission factor is 20% of manufacturer provided UHC emissions per vendor.
[4] Based on engineering assessment sulfur content in gas is negligible.

Natural Gas-Fired Turbine - Startup and Shutdown Emissions

Pollutant	Emission Factors		Estimated Max Startups/yr	Maximum hourly emissions		(ton/yr) [1]
				(lb/hr)	(g/s)	
Startup Emissions						
NO_x	1	lbs/event	20	5.93	0.7465	0.01
CO	40	lbs/event	20	44.99	5.67	0.4
VOC	7	lbs/event	20	7.54	0.95	0.07
Shutdown Emissions						
NO_x	1	lbs/event	20	0.25	0.031	0.01
CO	44	lbs/event	20	11.00	1.39	0.44
VOC	7	lbs/event	20	1.75	0.22	0.07

[1] Emissions obtained from the CO_2 Plant PTE summary per RCG application.
[2] It is conservatively assumed a startup period will last ten (10) minutes while a shutdown could last four (4) hours.

Natural Gas-Fired Turbine - Total Annual Emissions

Annual PTE increases	tpy	Annual (g/s)
PM/ PM_{10}/ $PM_{2.5}$	2.83	0.08
SO_2	-	-
VOC	3.15	0.09
CO	27.09	0.78
NO_x	25.89	0.7448

Natural Gas Fired Generator Engine - Inputs

Parameter	Value	Units
	100% Load	
Emission Unit ID	GEN1	-
Description	Cummins GTA 28E	-
Fuel Used	Natural Gas	
Hours of Operation	500	(hrs/yr)
Rated Power (sea level)	701	bhp
Rated Power (sea level)	523.0	bkW
Fuel Heating Value	854	(Btu/scf)
Brake Specific Fuel Consumption	8,331	(Btu/hp-hr)
Maximum Heat Input	5.84	(MMBtu/hr)

Pollutant	Emission Factors		Footnote	Emissions at 500 hrs/yr			
	100% Standby rating						
	Value	Units		Hourly (lb/hr)[4]	Hourly (g/s)	Annual (tpy)	Annual (g/s)
$PM_{2.5}$	1.94E-02	lb/MMBtu	1,2,4	6.47E-03	8.15E-04	0.028	8.15E-04
PM/ PM_{10}				1.13E-01	1.43E-02	0.028	8.15E-04
SO_2	0.00E+00	lb/MMBtu	5	0.00E+00	0.00E+00	0.000	0.00E+00
VOC	0.70	g/hp-hr	3	1.08	0.14	0.27	7.78E-03
CO	2.00	g/hp-hr	3	3.09	0.39	0.77	2.22E-02
NO_x	1.00	g/hp-hr	3,4	8.82E-02	1.11E-02	0.39	1.11E-02

[1] Emission factors for condensable and filterable PM were obtained from U.S. AP-42, Section 3.2 (Natural Gas Engines) Table 3.2-3 for rich-burn engines.
[2] It is conservatively assumed that PM=PM_{10}=$PM_{2.5}$. The average hourly emission rate for PM2.5 is annualized per guidance from the US EPA. See email from Rebecca Matichuk, US EPA Region 8, 19-September 2023, to A. Jones, Trinity Consultants.
[3] EPA certified emission factors for VOCs, CO, and NOx for engine family PCEXB28.0ARB.
[4] Hourly NO_x and $PM_{2.5}$ emissions adjusted per "Treatment of Intermittent Sources" in *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*, March 1, 2011; pgs 8 -11.

[5] Based on engineering assessment sulfur content in gas is negligible.

Annual PTE increases	tpy
PM/ PM_{10}/ $PM_{2.5}$	0.03
SO_2	-
VOC	0.27
CO	0.77
NO_x	0.39

ATTACHMENT 4
AERSCREEN Model Output Files

See external attachments