APPENDIX F: AIR QUALITY CALCULATIONS

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Appendix F: Air Quality Calculations

1.0 Introduction

The following analyses were performed to evaluate the potential for impacts to air quality and greenhouse gas (GHG) emissions from the construction and operation of the Eldorado-Lugo-Mohave Series Capacitor Project (Proposed Project):

- Total annual emissions for the construction phase for the following criteria air pollutants were calculated and compared to the Mojave Desert Air Quality Management District's (MDAQMD's) significance thresholds and Federal Conformity Guidelines for regional air quality impacts:

  - Volatile organic compounds (VOCs)
  - Carbon monoxide (CO)
  - Nitrogen oxides (NO_x)
  - Sulfur oxides (SO_x)
  - Particulate matter (PM) less than 10 microns in diameter (PM_{10})
  - PM less than 2.5 microns in diameter ($PM_{2.5}$)

- Total emissions for the construction and operation phases were calculated for the following GHGs and compared to applicable thresholds of significance from the MDAQMD[1] to evaluate the potential for cumulative impacts:

  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Sulfur hexafluoride (SF_6)

The emission sources considered and the calculation methodology for each of these sources are described in the sections that follow.

1.1 Emission Sources

Construction emissions were divided into two categories—on site and off site—for preparation of the analyses described in Section 1.0, Introduction. On-site construction emissions consist of tailpipe emissions from construction equipment and vehicles used at active construction areas, fugitive dust emissions from earthwork activities, and entrained PM emissions from vehicle and equipment travel on paved and unpaved roads. Off-site emissions consist of tailpipe emissions and entrained PM emissions from roadways during travel to and from active construction areas.

[1] The Clark County Department of Air Quality (DAQ) does not have published GHG thresholds, so the MDAQMD thresholds were used.

In addition to the aforementioned sources, fugitive SF_6 emissions from the circuit breakers installed as part of the Proposed Project were also calculated.

1.1.1 Off-Road Equipment Exhaust Emissions

Exhaust emissions from off-road equipment use were calculated using the following equation:

$$E_{i,j} = EF_{i,j} \times H_j \times N_j$$

Where:

$E_{i,j}$ = Emissions of pollutant *i* from equipment type *j* (pounds/day)

$EF_{i,j}$ = Emission factor for pollutant *i* from equipment type *j* (pounds/operating hour)

H_j = Daily operating time for equipment type *j* (hours/day)

N_j = Number of pieces of equipment of type *j*

The emission factors used for this calculation were obtained from Appendix D: Default Data Tables of the California Emissions Estimator Model (CalEEMod) version 2013.2.2 User Guide. The lookup tables provided in the User Guide were used to identify emission factors for each piece of equipment that would be used for the Proposed Project.[2] This simulation also included mitigation requiring all pieces of equipment to utilize engines that comply with the U.S. EPA's Tier 4 final specifications.[3]

1.1.2 On-Road Vehicle Exhaust Emissions

Exhaust emissions from on-road vehicle use were calculated using the following equation:

$$E_{i,j} = EF_{i,j} \times VMT_j \times N_j$$

Where:

$E_{i,j}$ = Emissions of pollutant *i* from motor vehicle type *j* (pounds/day)

$EF_{i,j}$ = Emission factor for pollutant *i* from motor vehicle type *j* (pounds/mile)

VMT_j = Daily vehicle-miles-traveled (VMT) for motor vehicle type *j* (miles/day)

N_j = Number of motor vehicles of type *j*

The emission factors used for this calculation were obtained from the output of a CalEEMod version 2013.2.2 simulation. Separate construction phases for each vehicle type (i.e., passenger,

[2] The controlled off-road emissions assumed that all equipment would be fitted with engines that comply with the United States (U.S.) Environmental Protection Agency's (EPA's) Tier 4 Final standards.

[3] In instances where Tier 4 final emission factors were not available for certain pollutants, the emission factors from CalEEMod's Appendix D were used.

delivery, and heavy duty) on paved and unpaved roads were entered into the model. Each construction phase had a duration of one day with 1,000 vehicle miles traveled. The resulting output emissions were divided by 1,000 to achieve the tailpipe emission rates for each vehicle class. These emission factors are provided in Table 1: On-Road Vehicle Emission Factors.

Entrained road dust emissions were calculated using the following equation:

$$E_{i,j} = EF_{i,j} \times VMT_j \times N_j$$

Where:

$E_{i,j}$ = Emissions of pollutant *i* from motor vehicle type *j* (pounds/day)

$EF_{i,j}$ = Emission factor for pollutant *i* from motor vehicle type *j* (pounds/mile)

VMT_j = Daily vehicle-miles-traveled (VMT) for motor vehicle type *j* (miles/day)

N_j = Number of motor vehicles of type *j*

The emission factors used for this calculation were obtained from the output of a CalEEMod version 2013.2.2 simulation. Separate construction phases for each vehicle type (i.e., passenger, delivery, and heavy duty) on paved and unpaved roads were entered into the model. Each construction phase had a duration of one day with 1,000 vehicle miles traveled. The resulting output emissions were divided by 1,000 to achieve the fugitive emission rates, by road type, for each vehicle class. These emission factors are provided in Table 2: Entrained Road Dust Emission Factors. Additional emission factors for unpaved roads with the application of a chemical stabilizer/suppressant were generated by assuming an efficiency of 84-percent when compared to uncontrolled, unpaved roads.

1.1.3 Earthwork PM Emissions

Soil disturbance during excavation and grading activities generates fugitive PM emissions from soil dropping during transfers and bulldozing, scraping, and grading. The following equation was used to calculate daily emissions from soil dropping during construction:

$$E_i = EF_i \times V_s$$

Where:

E_i = Emissions of pollutant *i* (PM_{10} or $PM_{2.5}$) from soil dropping (pounds/day)

EF_i = Emission factor for pollutant *i* from soil dropping (pounds/cubic yard)

V_s = Volume of soil dropped (cubic yards/day)

The following equation was used to calculate the emission factor for PM emissions during soil dropping:

$$EF_i = f_i \times 0.011 \times \frac{\left(\frac{WS}{5}\right)^{1/3}}{\left(\frac{M}{2}\right)^{1.4}} \times N_s \times D_s$$

Where:[4]

EF_i = Emission factor for fugitive PM emissions from soil dropping

f_i = Mass fraction of pollutant *i* (PM_{10} or $PM_{2.5}$) in PM emissions from soil dropping

WS = Mean wind speed (miles/hour)

M = Soil moisture content (percent by weight)

N_s = Number of times each cubic yard is dropped (number/day)

D_s = Soil density (tons/cubic yard)

The following equation was used to calculate daily emissions from bulldozing, scraping, and grading:

$$E_i = EF_i \times H_G$$

Where:

E_i = Emissions of pollutant *i* (PM_{10} or $PM_{2.5}$) from bulldozing, scraping, and grading (pounds/day)

EF_i = Emission factor for pollutant *i* from bulldozing, scraping, and grading (pounds/hour)

H_G = Daily bulldozing, scraping, and grading (hours/day)

The following equation was used to calculate the emission factor for PM emissions during bulldozing, scraping, and grading:

$$EF_i = f_i \times 0.75 \times \frac{s^{1.5}}{M^{1.4}} \times \left(1 - \frac{CE}{100}\right)$$

[4] Soil Handling Constants: fi= 0.0011, WS = 12 miles per hour, M = 10.6, Ns = 4, Ds = 1.215

Where:[5]

EF_i = Emission factor for fugitive PM emissions from bulldozing, scraping, and grading

f_i = Mass fraction of pollutant i (PM_{10} or $PM_{2.5}$) in PM emissions from bulldozing, scraping, and grading

s = Material silt content (weight percent)

M = Soil moisture content (percent by weight)

CE = Control efficiency

A control efficiency of 55 percent was used for both earthwork calculations to account for the planned dust control measures.

1.1.4 Fugitive SF_6 Emissions

The new circuit breakers that would be installed at the existing substations would be insulated with SF_6. The following equation was used to calculate the annual emissions due to the leaking of SF_6 gas during operation:

$$E = \frac{L}{100} \times M_{SF_6}$$

Where:

E = SF_6 emission from leakage (pounds of SF_6/year)

L = SF_6 leak rate (percent/year)

1.2 Annual Emissions Calculations

Daily emissions during construction of the Proposed Project were calculated for each piece of equipment, then multiplied by the maximum number of potential days of operation for each piece of equipment in 2019 and 2020. These values were then summed to generate the total annual emissions for each year of construction. The following emission sources were used for this calculation:

- Daily emissions for each piece of off-road construction equipment
- Daily emissions for on-road vehicle travel
- Fugitive PM emissions for earthwork
- Entrained PM emissions for vehicle travel

[5] Grading Constants: fi= 0.85, s = 26.7, M = 100 percent, CE = 55 percent

The emissions from each construction activity were also applied to each state where they would occur (e.g., California and Nevada).

1.3 Total GHG Emissions

GHG emissions during the construction and operation phases of the Proposed Project were calculated using the procedures described in Section 1.1.1, Off-Road Equipment Exhaust Emissions; Section 1.1.2, On-Road Vehicle; and Section 1.1.4, Fugitive SF_6 Emissions. To prepare the CO_2 equivalent emissions, CH_4 and SF_6 emissions were multiplied by their respective global warming potentials and summed with the CO_2 emissions. For comparison with the operational significance thresholds, emissions from the construction phase were amortized over 30 years and then added to the annual operational emissions.

1.4 References

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Table 1: On-Road Vehicle Emission Factors

Equipment Type	On Road Type	Emission Factor (pounds per mile)							
		VOCs	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4
10 C.Y. Dump Truck	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
1-Ton Crew Cab, 4x4	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05
2-Ton Truck	delivery	3.31E-04	3.80E-03	5.98E-03	2.07E-05	1.88E-04	1.73E-04	2.04E+00	9.57E-06
3/4-Ton Truck, 4x4	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05
4000 Water Truck	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
8,000 Gal. Water Pull	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Concrete Mixer Truck	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Flat Bed Truck/Trailer	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Foreman's Truck	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05
Fuel Truck	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Helicopter Support Truck	delivery	3.31E-04	3.80E-03	5.98E-03	2.07E-05	1.88E-04	1.73E-04	2.04E+00	9.57E-06
Job Site Utility Cart	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05
Low Bed Equipment Hauler (5 axle)	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Low Bed Equipment Hauler (7 axle)	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Low Bed Hauler	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05

Equipment Type	On Road Type	Emission Factor (pounds per mile)							
		VOCs	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4
Low Side End Dump	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Lowboy Truck/Trailer	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Medium duty splicing lab Truck	delivery	3.31E-04	3.80E-03	5.98E-03	2.07E-05	1.88E-04	1.73E-04	2.04E+00	9.57E-06
Splicing Lab	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05
Test Truck	delivery	3.31E-04	3.80E-03	5.98E-03	2.07E-05	1.88E-04	1.73E-04	2.04E+00	9.57E-06
Tool Truck	delivery	3.31E-04	3.80E-03	5.98E-03	2.07E-05	1.88E-04	1.73E-04	2.04E+00	9.57E-06
Truck, Semi Tractor	hhdt	3.85E-04	3.40E-03	7.48E-03	3.46E-05	2.44E-04	2.24E-04	3.45E+00	1.68E-05
Worker Commute	passenger	1.35E-04	5.16E-03	4.34E-04	9.48E-06	4.75E-06	4.36E-06	7.51E-01	4.06E-05

Table 2: Entrained Road Dust Emission Factors

Vehicle Category	Emission Factor (pounds per mile)									
	Paved Roads				Unpaved Roads					
	Uncontrolled		Controlled		Uncontrolled		Controlled (watered)		Controlled (chemical stabilizer)	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Passenger	0.0008	0.0002	0.0008	0.0002	1.4719	0.1469	0.4056	0.0404	0.2355	0.0235
Delivery	0.0009	0.0003	0.0009	0.0003	1.4720	0.470	0.4058	0.0405	0.2355	0.0235
hhdt	0.0009	0.0002	0.0009	0.0002	1.4720	0.2469	0.4057	0.0405	0.2355	0.0395

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