URS

Memorandum

Date: April 16, 2013

To: Mr. Nelson Miller, Senior Planner, San Bernardino County
385 North Arrowhead Avenue, San Bernardino, CA 92415-0182

From: Mr. Matt Dunn, Principal Engineer, URS Corporation
130 Robin Hill Road, Suite 100, Santa Barbara, CA 93117

Subject: **Criteria Pollutant Emissions from the Proposed Alamo Solar Project, San Bernardino County, California**

1.0 INTRODUCTION

E.ON Climate & Renewables North America (Applicant) proposes to construct a approximately 20-megawatt (MW) solar energy generation facility (Project) on approximately 175 acres of land in San Bernardino County, approximately 12 miles north of Victorville. The Project area is within the jurisdiction of the Mojave Desert Air Quality Management District (MDAQMD). Construction is estimated to start in 2014 and would take approximately eight months to complete. URS quantified criteria pollutant emissions resulting from the construction and operation of the Project using construction and operational data provided by the Project Applicant. Emission factors and other data are from the CalEEMod California Emissions Estimator Model™ version 2011.1.1 (successor to planning level emissions estimating software, URBEMIS). This software was used as the criteria pollutant quantification tool for this Project. The Applicant estimated the Project construction activities would occur over an eight month period, while the operational project life is estimated at 30 years.

2.0 METHODOLOGY

2.1 EMISSION FACTORS FOR FUEL COMBUSTION

URS quantified criteria pollutant emissions resulting from the construction and operation of the Project using construction and operational data provided Applicant. Emission factors and other data are from the CalEEMod California Emissions Estimator Model. This software was used as the air emissions quantification tool for this project. The Applicant estimated the project construction activities would occur over an eight month period. The operational project life is estimated at 30 years, based on the application expectation of equipment life.

The emissions factors of the criteria air pollutants include: oxides of nitrogen (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter under 10 microns (PM_{10}) and under 2.5

microns ($PM_{2.5}$). The emissions of reactive organic gases (ROGs), also known as volatile organic compounds (VOCs) were also quantified. This class of compound is a precursor to the criteria air pollutant ozone (O_3).

Emission factors for off-site emissions from on-road travel (via public highways to the site access) were calculated CalEEMod. This software program calculates on-road vehicle emissions based on emission factors from California specific highway emissions database, the latest version of the California EMission FACtor model (EMFAC2007). Emissions from personal vehicles for worker and vendor commuting, and trucks for material hauling are based on the number of trips and vehicle miles traveled (VMT) along with emission factors from EMFAC2007. The emissions from mobile sources were calculated by CalEEMod as follows:

$$Emissions_{pollutant} = VMT * EF_{running,pollutant}$$

Where:

$Emissions_{pollutant}$ = emissions (CO_2) from vehicle running for each pollutant
VMT = vehicle miles traveled
$EF_{running,pollutant}$ = emission factor for running emissions

The model was run with the calendar year 2014 selected as the construction and first operational year. Subsequent operational emissions were assumed the same as the first year. This is conservative since 2014 would be less efficient for highway vehicles (more emissions) than subsequent years. The vehicle class selected for worker personal vehicles was a mix of the following categories: Light Duty Auto (LDA), Light Duty Truck 1 (LDT1), and Light Duty Truck 2 (LDT2). The vehicle class for vendors and construction material hauling were selected as Heavy Heavy Duty Diesel Truck (HHDDT) to represent off-site travel.

Emission factors for on-site diesel construction equipment were calculated in CalEEMod; the software program calculates the exhaust emissions based on California Air Resources Board (CARB) OFFROAD2007 methodology using the equation presented below.

$$Emission_{DieselEx} = \Sigma_i (EFi = x\ Pop_i\ x\ AvgHp_i\ x\ Load_i\ x\ Activity_i)$$

Where:

EF = Emission factor in grams per horsepower-hour (g/bhp-hr) as processed from OFFROAD2007
Pop = Population, or the number of pieces of equipment
AvgHp = Maximum rated average horsepower
Load = Load factor
Activity = Hours of operation
i = equipment type

The software calculates the exhaust emission factors for each piece of equipment at each horsepower range by back calculating from total daily emissions reported in the model output files using the following formula:

$$Emission\ Factor\ \left[\frac{g}{hphr}\right] = \frac{Total\ Daily\ Exhaust}{Activity\ x\ AvgHP\ x\ LF\ x\ 907184.74}$$

Where:

Total Daily Exhaust = Total pollutant emissions [tons/day]
Activity = Total daily statewide usage of equipment [hours/day]
AvgHP = Average HP of equipment within the horsepower range [HP]
LF = Load Factor of equipment [unitless]
907,184.74 = Conversion factor from tons to grams

Total Daily Exhaust and Activity were obtained from OFFROAD2007 model output, while Average HP and LF were obtained from input files to the model.

The model is made to be region specific. Each calendar year, the model assigns emission characteristics to regionally-specific equipment populations. For the present analysis, the model used emissions of 2014 equipment populations in the Mojave Desert area of San Bernardino County as the basis. The construction activity is assumed to start in February, 2014.

2.2 ON-SITE AND OFF-SITE CONSTRUCTION ACTIVITY

Calculations of emissions due to on-site construction activity were based on information provided by the Applicant regarding the type and quantity of construction equipment anticipated to operate on-site each month. The equipment utilization list is presented in Table 1. All onsite construction equipment was assumed to be fueled on diesel. Engine load factors of equipment were preselected by default levels of CalEEMod; this information is based on historical data from CARB and MDAQMD. The utilization of the equipment (operating hours per day) was based on contractor estimates. During construction it is assumed all electricity will be provided onsite by small portable diesel fueled generators (estimated at 10kW). Therefore, there will be no electrical demand from the grid.

Table 1 includes the equipment necessary for the proper upgrades for its distribution lines and gen-tie equipment for power delivery from the site to Southern California Edison's existing transmission system. This equipment will operate off site from project site for the last four months of the construction schedule. The Alamo project site and the areas of the existing distribution line that would be upgraded are presented in Figure 1a-b.

2.3 OFF-SITE TRAVEL DISTANCE

Travel distance assumed a distribution of passenger vehicles for workers commuting between greater Victorville area and the site. Table 2 presents the distribution for construction labor force and material deliveries. The calculations conservatively assume larger population centers for the craft labor. It was assumed that passenger vehicles for the construction work force transported an average of one passenger. This is conservative considering some workers may carpool. Emissions from passenger vehicles traveling to and from the site were based on estimated construction labor force per month as shown in Table 3.

Delivery trucks for material hauling reflect the transport of construction materials within MDAQMD and other portions of San Bernardino County within the South Coast Air Quality Management District (SCAQMD). This memo only addresses transport emissions within San Bernardino County. Emissions from concrete trucks were included in offsite delivery trips based on having a ready mix plant within ten miles for supply. Water supplied for construction will be purchased from a local purveyor located at an assumed distance of 10 miles away from the Project site. Emissions from water truck delivery to site were based on average off-site delivery trips shown in Table 4.

2.4 FUGITIVE DUST EMISSIONS

Fugitive emissions of particulates (PM_{10} and $PM_{2.5}$) were quantified using CalEEMod. The program calculates fugitive dust associated with the site preparation and grading phases from three major activities: haul road grading, earth bulldozing, and truck loading. As recommended by MDAQMD, the fugitive dust emissions from the grading phase are calculated using the methodology described in United States Environmental Protection Agency (USEPA) PA AP-42, Compilation of Air Pollutant Emission Factors. The CalEEMod uses these emission quantification methodologies within its algorithm to develop fugitive dust estimates. Fugitive emissions from material movement dust calculations were determined by CalEEMod default values for material moisture content and material silt content.

The ratio of PM_{10} to $PM_{2.5}$ for emissions quantification is based on EPA and CARB factors from historical studies.

CalEEMod uses AP-42 methodology to calculate fugitive emissions from vehicles that drive on both paved and unpaved roads generating fugitive dust by dispersing the silt from the roads. CalEEMod default values were used for road silt and moisture content of the dirt roads. Due to the amount of trenching for direct current and alternating current cables on site, URS made estimates of the fugitive dust generated by the trenching and conveyance the soil from the trenching machine based on available emissions factors for this type of actiivty. These emissions associated with the underground cable installation onsite were found to be *de minimis* (less than one percent of all onsite particulate matter dust emissions.)

3.0 METHODOLOGY AND ASSUMPTIONS FOR OPERATIONS BASED EMISSIONS

Operational phase emission calculations assumed the solar facility would be unmanned and several part-time employees and security personnel would visit the site periodically. To provide a conservative analysis, the calculations assumed there would be 96 round trips to the site per year for security and part-time workers from the San Bernardino County line. Several times a year, the employees or a contractor would also visit the site to wash the photo voltaic (PV) panels. It was conservatively assumed panel washing would require approximately two acre-feet of water per year. Based on an assumed use of 4,000 gallon water tankers (diesel fueled), panel washing would require approximately 163 truckloads (326 truck trips) for delivery of this water. Water used for panel washing would be purchased from a local purveyor at an assumed distance of 10 miles away from the Project site. The workforce for the operational phase was assumed to commute from outside of San Bernardino County.

4.0 RESULTS

Results of the criteria pollutant emission calculations are presented in Tables 5 to 7. Table 5 presents the total construction phase (on-site and off-site) emissions within the MDAQMD. This table includes both the on-site activity of off-road equipment and the on-road mobile sources making deliveries to the site during the construction phase. These data indicate that all emissions are below MDAQMD's annual thresholds of significance for California Environmental Quality Act (CEQA) review. The remainder of the construction phase emissions are from on-road mobile sources delivering construction materials within San Bernardino County (assumed traveling from the Los Angeles County border). These estimated emissions are presented in Table 6. The MDAQMD thresholds are not applicable to these totals because the emissions are emitted into a different air basin (South Coast Air Basin) and addressed by the governing jurisdiction, South Coast Air Quality Management District (SCAQMD). The CEQA thresholds of the SCAQMD are presented in Table 6 for completeness to demonstrate the mobile sources associated with the construction activities are not significant.

Table 7 presents the estimated operational emissions for the all mobile sources. These emissions are all below the annual thresholds of the MDAQMD.

5.0 REFERENCES

CalEEMod. 2011. (version 2011.1.1) California Emissions Estimator Model. Available online at: http://www.caleemod.com

2007a. EMFAC2007 (version 2.3) Motor Vehicle Emission Inventory Model. Available online at: http://www.arb.ca.gov/msei/onroad/latest_version.htm.

2006. OFFROAD2007 (version 2.0.1.2) Emissions Model. Available online at: http://www.arb.ca.gov/msei/offroad/offroad.htm.

Mojave Desert Air Quality Management District. 2009. California Environmental Quality Act and Federal Conformity Guidelines. February 2009.

Mojave Desert Air Quality Management District Antelope Valley Air Pollution Control District Emissions Inventory Guidance Mineral Handling and Processing Industries. 2000. www.mdaqmd.ca.gov/Modules/ShowDocument.aspx?documentid=401

South Coast Air Quality Management District, 2011. South Coast Air Quality Significance Thresholds. http://www.aqmd.gov/ceqa/handbook/signthres.pdf. Accessed by Matt Dunn of URS on November 20, 2012.

United States Environmental Protection Agency. AP-42, Compilation of Air Pollutant Emission Factors USEPA. http://www.epa.gov/ttnchie1/ap42/. Accessed By Beth Anna Cornett of URS on November 21, 2012.

TABLES

TABLE 1
ONSITE AND OFFSITE CONSTRUCTION EQUIPMENT (PIECES PER MONTH) FOR ALAMO SOLAR

Equipment Type	Horsepower	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Total
Grader	175	3	3	1	–	–	–	–	–	**7**
Excavator	175	2	2	–	–	–	–	–	–	**4**
Dozer	250	2	2	–	–	–	–	–	–	**4**
Compactor	120	–	2	2	–	–	–	–	–	**4**
Backhoe/Front End Loader	120	2	2	1	–	–	–	–	–	**5**
Rough Terrain Forklift	120	–	2	4	4	2	2	2	2	**18**
Crawler Trencher	175	–	–	2	2	–	–	–		**4**
Pick Up Truck	150	2	2	6	6	6	4	4	2	**32**
Water Truck, 4000 gal	220	1	1	1	1	1	1	1	1	**8**
Concrete Truck	250	–	–	6	6	–	–	–	–	**12**
ATV with material body	18	1	2	3	4	4	4	2	2	**22**
Auger	30	–	–	3	3	3	–	–	–	**9**
Pile Driver	50	–	–	3	3	3	–	–	–	**9**
Light Tower	14	–	–	–	–	2	2	–	–	**4**
Generator	7	5	5	5	5	5	5	5	5	**40**
Back Hoe, w/ Bucket	85	–	–	–	–	1	1	–	1	**3**
Digger, Truck Mount	190	–	–	–	–	1	1	–	–	**2**
Flatbed	180	–	–	–	–	1		–	–	**1**
Forklift	75	–	–	–	–	1	1	–	–	**2**
Line Truck	310	–	–	–	–	3	3	3	3	**12**
Motor, Auxiliary Power	5	–	–	–	–	2	2	–	–	**4**
Trailer, Flatbed	220	–	–	–	–	1	–	–	–	**1**
Truck, Semi, Tractor	310	–	–	–	–	1	–	–	–	**1**
Truck Flatbed w bucket	235	–	–	–	–		–	–	1	**1**
Truck, Dump	235	–	–	–	–	1	1	–	1	**3**
Truck, Flatbed w/ boom	235	–	–	–	–		–	–	1	**1**
Truck, Flatbed	210	–	–	–	–	3	3	–	1	**7**
Truck, Mechanics, 1-2 Ton	260	–	–	–	–	1	1	–	–	**2**
Truck, Pickup	180	–	–	–	–	4	4	3	3	**14**
Truck, Pickup	180	–	–	–	–	1	–	–	–	**1**

Truck, Pickup	210	–	–	–	–	2	2	2	3	**9**
Truck, Water, 2,000-5,000 Gal	175	–	–	–	–	1	1	1	1	**4**
Total	–	**18**	**23**	**37**	**34**	**50**	**38**	**23**	**27**	**250**

[1] Offiste Equipment needed for offsite transmission and gen tie improvements to utility connections 12 miles away..

TABLE 2
DISTRIBUTION OF TRAVEL FOR ALAMO SOLAR

	Victorville	Apple Valley	Los Angeles County
Commuters	50%	50%	0%
Construction Deliveries	0%	0%	100%

TABLE 3
CONSTRUCTION LABOR FORCE
(LABORERS PER MONTH WITH SUPERVISION)
FOR ALAMO SOLAR

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8
Working Hours Per Day	10	10	10	10	10	10	10	8
Working Days per Week	6	6	6	6	6	6	6	5
Workforce Estimates (No. of workers)	10	20	50	60	176	176	66	39

TABLE 4
OFF SITE CONSTRUCTION DELIVERY ACTIVITY
(TRIPS PER MONTH)
FOR ALAMO SOLAR PROJECT

Vehicle Type	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Total
Material Delivery Trucks[1]		80	160	80	22				342
Water Truck (average)[2]	1,536	1,690	1,664	1,728	3,200	3,456	1,664	1,408	16,346

1 Heavy Heavy Duty Diesel (80,000 lbs gross vehicle weight).

2 Assumed 4,000 gallon water trucks. Water used for dust control.

TABLE 5
CONSTRUCTION PHASE EMISSIONS
WITHIN MDAQMD FOR
ALAMO SOLAR PROJECT

Criteria Pollutant	Unmitigated Construction Sources (tons/yr)	MDAQMD Threshold (tons/yr)
Carbon Monoxide (CO)	13.05	100
Oxides of Nitrogen (NO_x)	18.67	25
Volatile Organic Compounds (VOC)	2.57	25
Oxides of Sulfur (SO_x)	0.03	25
Particulate Matter (PM_{10}) [1]	1.81	15
Particulate Matter ($PM_{2.5}$) [1]	1.03	15

Note: [1] Exhaust and Fugitive Dust.

TABLE 6
MOBILE SOURCE EMISSIONS FROM CONSTRUCTION ACTIVITIES IN SCAQMD PORTION OF SAN BENARDINO COUNTY FOR ALAMO SOLAR PROJECT

Criteria Pollutant	Unmitigated Mobile Sources (tons/yr)	Unmitigated Mobile Sources (lb/day)	SCAQMD Mass Daily Thresholds Construction (lb/day)
Carbon Monoxide (CO)	0.07	0.68	550
Oxides of Nitrogen (NO_x)	0.20	1.95	100
Volatile Organic Compounds (VOC)	0.02	0.20	75
Oxides of Sulfur (SO_x)	0	0	150
Particulate Matter (PM_{10}) [1]	0.28	2.73	150
Particulate Matter ($PM_{2.5}$) [1]	0.01	0.10	55

Note: [1] Exhaust and Fugitive Dust.

TABLE 7
OPERATIONAL EMISSIONS FOR ALAMO SOLAR PROJECT

Criteria Pollutant	Operational Emissions (tons/yr)	MDAQMD Threshold (tons/yr)
Carbon Monoxide (CO)	0.03	100
Oxides of Nitrogen (NO_x)	0.02	25
Volatile Organic Compounds (VOC)	0.00	25
Oxides of Sulfur (SO_x)	0.00	25
Particulate Matter (PM_{10}) [1]	0.11	15
Particulate Matter ($PM_{2.5}$) [1]	0.01	15

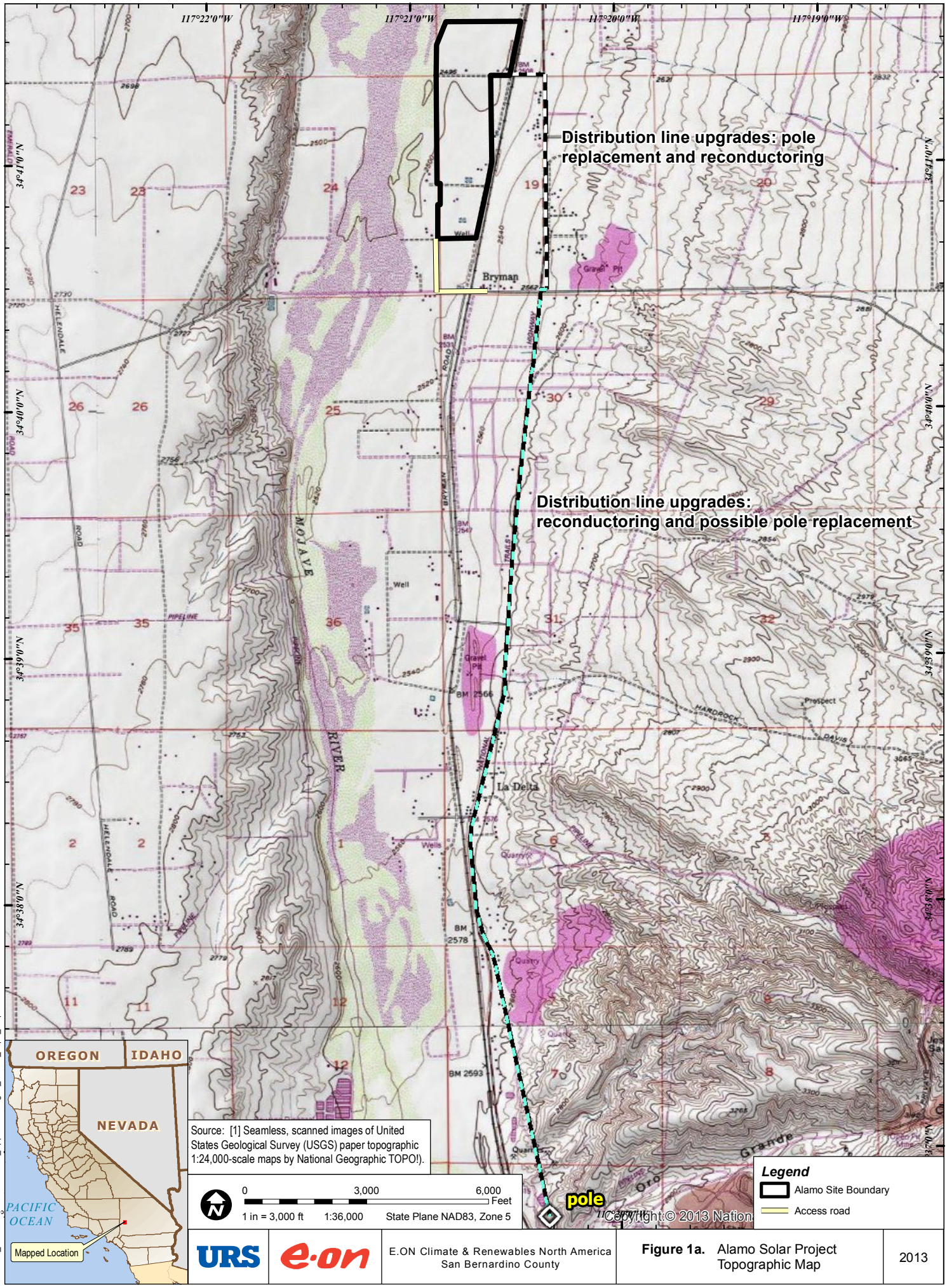
Note: [1] Exhaust and Fugitive Dust.

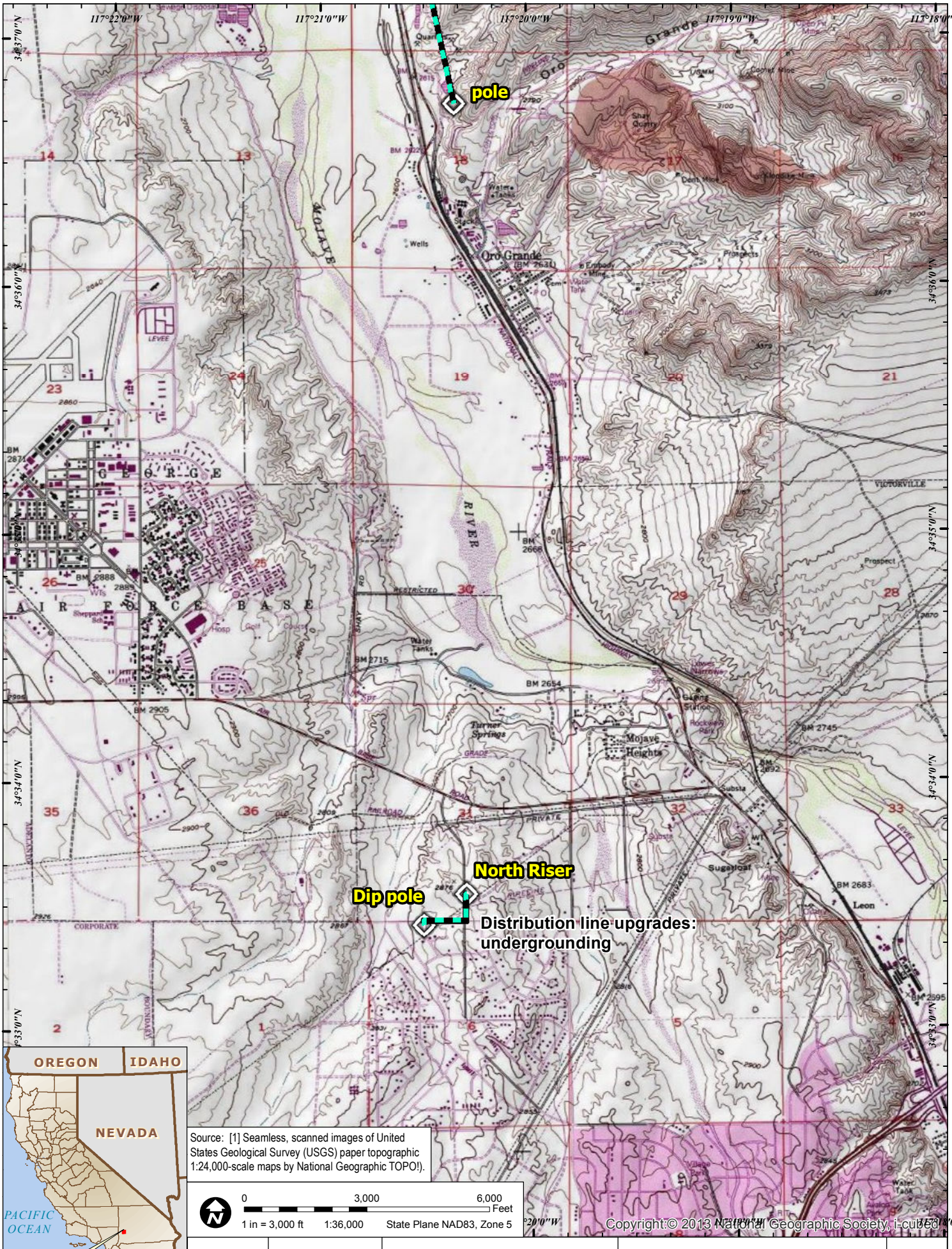
TABLE 8
OPERATIONAL EMISSIONS
IN SCAQMD PORTION OF SAN BENARDINO COUNTY
FOR ALAMO SOLAR PROJECT

Criteria Pollutant	Operational Emissions (tons/yr)	MDAQMD Threshold (tons/yr)
Carbon Monoxide (CO)	0.02	100
Oxides of Nitrogen (NO_x)	0.01	25
Volatile Organic Compounds (VOC)	0.00	25
Oxides of Sulfur (SO_x)	0.00	25
Particulate Matter (PM_{10}) [1]	0.06	15
Particulate Matter ($PM_{2.5}$) [1]	0.01	15

Note: [1] Exhaust and Fugitive Dust.

FIGURES




pole
North Riser
Dip pole
Distribution line upgrades: undergrounding
117°22'0"W
117°21'0"W
117°20'0"W
117°19'0"W
117°18'0"W
34°37'0"N
34°36'0"N
34°35'0"N
34°34'0"N
34°33'0"N
Oro Grande
GEORGE AIR FORCE BASE
MOJAVE RIVER
Mojave Heights
Sugarloaf
Leon
Turner Springs
VICTORVILLE
OREGON
IDAHO
NEVADA
PACIFIC OCEAN
Mapped Location
Source: [1] Seamless, scanned images of United States Geological Survey (USGS) paper topographic 1:24,000-scale maps by National Geographic TOPO!).
0
3,000
6,000
Feet
1 in = 3,000 ft
1:36,000
State Plane NAD83, Zone 5
Copyright © 2013 National Geographic Society, i-cubed
URS
e·on
E.ON Climate & Renewables North America
San Bernardino County
Figure 1b. Alamo Solar Project
Topographic Map
2013
T:\E.ON_Alamo\deliverables\CUP_Application\Fig1b_Alamo_Topo_Map.mxd