



Memorandum

Date: November 21, 2012

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

From: Mr. Matt Dunn, Principal Engineer, URS Corporation
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Subject: **Criteria Pollutant Emissions from the Proposed Agincourt Solar Project, CUP Application (P201200011), San Bernardino County, California**

1.0 INTRODUCTION

Agincourt Solar, LLC (Applicant) proposes to construct a 10-megawatt (MW) solar energy generation facility (Project) on approximately 79 acres of land in San Bernardino County, approximately 24 miles east of Apple Valley. The project area is within the jurisdiction of the Mojave Desert Air Quality Management District (MDAQMD). Construction is estimated to start in 2013 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 project Applicant's engineer, Lincoln Renewable Energy, LLC (LRE). 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. LRE estimated project construction activities would occur over an eight month period, while the operational project life is estimated at 30 years.

2.0 METHODOLOGY AND ASSUMPTIONS FOR CONSTRUCTION

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 by LRE. 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. LRE 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 (SO₂), carbon monoxide (CO), and particulate matter under 10 microns (PM₁₀) 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 (O₃),

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 (CO₂) 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 2013 selected as the construction and first operational year. Subsequent operational emissions were assumed the same as the first year, this is conservative since 2013 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 offsite 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.

$$Emission_{DieselEx} = \sum_i (EF_i * x Pop_i * x AvgHp_i * x Load_i * x Activity_i)$$

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:

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

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 Avg HP and LF were obtained from input files to the model.

The model was run for calendar year 2013 in the Mojave Desert area of San Bernardino County. The construction activity is assumed to start in January, 2013.

2.2 ON-SITE CONSTRUCTION ACTIVITY

Calculations of emissions due to on-site construction activity were based on information provided by LRE regarding the type and quantity of construction equipment anticipated to operate on-site each month. The onsite equipment utilization list is presented in Table 2 of the Greenhouse Gas Emissions from the Proposed Agincourt Solar Project technical memorandum (URS 2012). 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 engineering judgment and contractor estimates. During construction all electricity will be provided onsite by portable diesel fueled generators. Therefore, there will be no electrical demand from the grid.

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 of the Greenhouse Gas Emissions (GHG) from the Proposed Agincourt Solar Project technical memorandum (URS 2012) presents the distribution for construction labor force and material deliveries. Some labor may come from Lucerne Valley but 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 of technical memorandum (URS 2012).

Delivery trucks for material hauling reflect the transport of construction materials within MDAQMD and portions of San Bernardino County within the South Coast Air Quality Management District (SCAQMD). This memo only addresses transportation 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 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 of technical memorandum (URS 2012) on GHG Emissions.

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) 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 calculations used inputs of the material moisture content and material silt content from the *Report of Geotechnical Investigation and Geologic Hazard Stud*, prepared by G2 Consulting Group 2012. Truck loading material moisture content was determined by CalEEMod default values.

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. These emissions were found to be less than one percent of all onsite particulate matter dust emissions. CalEEMod similarly does not account for fugitive dust emissions from periodic blasting for dirt and rock movement during construction. URS investigated the potential PM_{10} emissions from this potential activity at the site using a conservative estimated volume of earth moved for trenching and emission factors provided by MDAQMD for blasting. URS' review shows the PM_{10} emissions negligible, similar to trenching/conveying of excavated dirt.

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 312 round trips to the site per year for security and part-time workers from the nearest population centers. 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. (Note: the number of assumed truck loads used in this analysis is somewhat greater than estimated in the general project description and thus represents a conservative approach for estimating Project-related emissions.) Water used for panel washing would be purchased from a local purveyor at an assumed distance of 10 miles away from the project site. Fifty percent of the workforce for the operational phase was assumed to commute to the site from Apple Valley, and the remaining 50 percent from Victorville.

4.0 RESULTS

Results of the criteria pollutant emission calculations are presented in Tables 1 to 3. Table 1 presents the total construction phase (on-site and off-site) emissions within the MDAQMD. This table includes both the onsite 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 travelling from the Los Angeles County border). These estimated emissions are presented in Table 2. 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, SCAQMD. The SCAQMD CEQA thresholds are presented in Table 2 for completeness to demonstrate the mobile sources associated with the construction activities are not significant.

Table 3 presents the estimated operational emissions for the all mobile sources. It has been conservatively assumed that all operational emissions are generated in the MDAQMD, given there are no long distance deliveries required during the operational phase. 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>
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- G2 Consulting Group, 2012, Report of Geotechnical Investigation and Geologic Hazard Study, Marathon Solar Field Development, Prepared for Atwell, LLC, Denver Colorado G2 project No. 120700B, October 25, 2012
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- South Coast Air Quality Management District, 2011. South Coast Air Quality Significance Thresholds. <http://www.aqmd.gov/ceqa/handbook/signthres.pdf>. Accessed 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.
- URS 2012. Greenhouse Gas Emissions from the Proposed Agincourt Solar Project Technical Memorandum, San Bernardino County, California, July 19, 2012.

TABLES

**TABLE 1
CONSTRUCTION PHASE EMISSIONS
WITHIN MDAQMD FOR
AGINCOURT SOLAR 10 MW PV PROJECT**

Criteria Pollutant	Unmitigated Construction Sources (tons/yr)	MDAQMD Threshold (tons/yr)
Carbon Monoxide (CO)	9.24	100
Oxides of Nitrogen (NO _x)	17.59	25
Volatile Organic Compounds (VOC)	2.25	25
Oxides of Sulfur (SO _x)	0.02	25
Particulate Matter (PM ₁₀) ¹	5.28	15
Particulate Matter (PM _{2.5}) ¹	2.05	15

Note: ¹ Exhaust and Fugitive Dust.

**TABLE 2
MOBILE SOURCE EMISSIONS FROM CONSTRUCTION ACTIVITIES
IN SCAQMD PORTION OF SAN BERNARDINO COUNTY
FOR AGINCOURT SOLAR 10 MW PV PROJECT**

Criteria Pollutant	Unmitigated Mobile Sources (tons/yr)	Unmitigated Mobile Sources (lb/day)	SCAQMD Mass Daily Thresholds Construction (lbs/day)
Carbon Monoxide (CO)	0.28	2.73	550
Oxides of Nitrogen (NO _x)	0.84	8.20	100
Volatile Organic Compounds (VOC)	0.06	0.59	75
Oxides of Sulfur (SO _x)	0.00	0.00	150
Particulate Matter (PM ₁₀) ¹	1.03	10.05	150
Particulate Matter (PM _{2.5}) ¹	0.05	0.49	55

Note: ¹ Exhaust and Fugitive Dust.

**TABLE 3
OPERATIONAL EMISSIONS
FOR AGINCOURT SOLAR 10 MW PROJECT**

Criteria Pollutant	Operational Emissions (tons/yr)	MDAQMD Threshold (tons/yr)
Carbon Monoxide (CO)	0.11	100
Oxides of Nitrogen (NO _x)	0.06	25
Volatile Organic Compounds (VOC)	0.01	25
Oxides of Sulfur (SO _x)	0.00	25
Particulate Matter (PM ₁₀) ¹	2.24	15
Particulate Matter (PM _{2.5}) ¹	0.23	15

Note: ¹ Exhaust and Fugitive Dust.