**DR-AIR-1**

**Information Required:**

> Please describe the types of activities that emit combustion and fugitive dust emissions on the site currently and the quantities of those emissions that occur from those activities.

**Response:**

The 5,200-acre Project site is composed of undeveloped desert with naturally-vegetated areas, and there are no existing structures. Currently, there are no anthropogenic activities on the site that would create combustion or fugitive dust emissions, with the possible exception of off-road recreational vehicle use. BLM does not currently monitor off-road recreational vehicle use, making it impossible to predict emissions from this activity. However, off-road vehicle use is believed to be relatively infrequent.

The site also would be subject to natural wind erosion effects which would cause fugitive dust emissions. Pre-project fugitive dust emissions from wind erosion are discussed and estimated in association with the response to DR-AIR-2.

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**DR-AIR-2**

**Information Required:**

> Please describe whether those activities will be permanently discontinued when the project is completed and estimate the reductions from the current onsite baseline emissions**.**

**Response:**

Off-road recreational vehicle use, however limited, will cease following construction of the Project, and any emissions associated with those activities would cease as well.

The Preliminary Geotechnical Investigational Report for the Project site was completed after PSPP AFC submittal in August 2009 and it was submitted to the CEC as part of the October 2009 Data Adequacy submittal. As described in Attachment C of the PSPP Geotechnical Report, this site has a high potential for wind erosion. The Wind Erosion Prediction System (WEPS) model is a process-based, continuous, daily time-step model that simulates weather, field conditions, management and erosion. The model results are highly dependent upon the input parameters, which are supplied in Attachment C.4.2 of the Report. The model was applied with climate data and surface elevations from the nearest climate and weather stations, representative soil profiles for the site, and a representative area for the Project. Since the WEPS model treats the field input as an idealized rectangle, the Project area was modeled as a larger area calculated with the widest site dimensions and does not match the area of the exact Project outline.

The WEPS model predicted that the fugitive PM10 emission rate for the entire undisturbed site is 32.836 tons/acre-year. The WEPS model PM10 emission rate was multiplied by the total Project area of 5,200 acres to calculate the annual wind erosion of the Project site according to Equation AQ-1. This calculation yields a baseline (i.e., pre-Project) mass emission rate of 170,747 tons per year (tpy) of fugitive PM10 due to wind erosion on the currently undisturbed Project site.

**Total PM** = $WEPS_u$ * $Area_P$ (Eq. AQ-1)

Where: Total PM = PM10 emissions from the entire undisturbed site (tpy)

$WEPS_u$ = undisturbed PM10 emission factor from the WEPS model
($WEPS_u$ = 32.836 tons/acre-year)

$Area_P$ = Total Project site area ($Area_P$ = 5,200 acres)

Wind erosion following Project construction will be lower than present levels on the undisturbed site. This will be because of site compaction, the use of soil stabilizers, and paving of some on-site areas.

Similar to the undisturbed site, the WEPS model was used to predict the wind erosion from the planned disturbed site. The total predicted facility footprint for the Project is 2,970 acres, which is approximately 57 percent of the total Project area. The closest approximation to the site management practices at the PSPP available in the WEPS input parameters are the management operations that describe the conditions expected in the aftermath of grazing with complete removal of crop residue. The decrease in wind erosion due to road paving and use of dust suppressants are not accounted for the in the WEPS model for the planned disturbed site, and no distinction was made between the total disturbance area and the controlled areas within the site. The WEPS model used an idealized rectangle with an area of 826 acres, which is the area of one solar field array, to calculate the wind erosion from the planned disturbed area. The WEPS model predicted that the uncontrolled fugitive PM10 emission rate for the planned disturbed site would be 31.801 tons/acre-year.

To predict post-Project controlled emissions, the total area of the solar field and power block for both units was taken as the controlled area. This is a total of 2,760 acres that is either paved, covered with gravel, or treated with soil stabilizers. Soil stabilizers (dust suppressants) are assumed to provide 80 percent control efficiency compared to untreated soil. Gravel and paving would have a higher control efficiency; however, the lower value of 80 percent is used in the calculations to ensure that emissions are not underestimated. With these assumptions, the controlled PM10 emissions from the Project site following construction can be calculated using Equation AQ-2.

**Project $PM_C$** = ($WEPS_u$ * ($Area_P$ - $Area_F$)) + ($WEPS_d$ * ($Area_F$ - $Area_C$)) +
($WEPS_d$ * $Area_C$ * (1-CE)) (Eq. AQ-2)

Where: Project $PM_C$ = Controlled, post-Project PM10 emissions from the PSPP site (tpy)

$WEPS_u$ = normalized undisturbed PM10 emission factor from the WEPS model
($WEPS_u$ = 32.836 tons/acre-year)

$WEPS_d$ = normalized disturbed site PM10 emission factor from the WEPS model
($WEPS_d$ = 31.801 tons/acre-year)

$Area_P$ = Total Project ROW ($Area_P$ = 5,200 acres)

$Area_F$ = Total disturbed facility footprint ($Area_d$ = 2,970 acres)

$Area_C$ = Total controlled area of the solar fields and power blocks ($Area_F$ = 2,760 acres)

CE = Control Efficiency of soil stabilizer (CE = 80 percent)

Controlled, post-Project PM10 emissions are calculated to be 97,457 tpy. The net change in fugitive dust emissions due strictly to wind erosion is calculated by subtracting the controlled, post-Project emissions from the pre-Project, undisturbed emissions using Equation AQ-3.

**Emission Change** = Total PM - Project $PM_C$ (Eq. AQ-3)

As shown in Table DR-AIR-2-1, there is a net reduction in fugitive PM10 emissions due to wind erosion following construction of the Project of 73,291 tpy. Note that this calculation does not include the emissions associated with operations of the solar facility (please see DR-AQ-4 for those emission estimates). The detailed emission calculations are provided in Table E.2-18b in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations.

**Table DR-AIR-2-1 Fugitive PM10 Emissions from Wind Erosion**

| Site Condition | Annual PM10 Emissions (tpy) |
|---|---|
| Pre-Project Undisturbed Site | 170,747 |
| Controlled Post-Project | 97,457 |
| Net Emission Change | (73,291) |

As noted, the wind erosion estimates for before and after construction of the PSPP were developed using WEPS, a sophisticated numerical model developed by the U.S. Department of Agriculture – Agricultural Research Service. The WEPS model was designed to simulate wind erosion potential in an agricultural setting. Because soil conditions would be different in an industrial setting such as a solar thermal power plant, the model was run making conservative assumptions to ensure that estimates of wind erosion were not underestimated. When used to estimate emissions during the operational phase of the Project, the model is expected to significantly overestimate the amount of particulate matter emissions from the solar field due to wind erosion. If the mass emission levels estimated by WEPS during operations were to actually occur, the blowing sand and dust would quickly pit the mirror surfaces, and would significantly degrade the efficiency of power production to unacceptable levels. However, the control measures to be implemented at the site including initial site compaction, application of dust suppressant as needed, and regular application of water during mirror washing, are sufficient to lower potential wind erosion to acceptable levels.

Several features of the PSPP compared to the scenario modeled point to a significant overestimate in estimated operational wind erosion. These attributes include:

1. The whole solar array field is compacted during construction to a significant depth that will significantly alter the native soil characteristics assumed in the model. A 40% increase in soil density was assumed in the model run but this is only an unsupported assumption not based on any empirical data.

2. Ongoing operations involving mirror washing, dust suppressant application, and water/dust suppressant trucks traffic through the solar array field will produce additional compaction and cementation of the soil, further altering the soil characteristics to become less erodible, compared to the soil simulated in the model.

3. The WEPS model run for post-construction assumes free airflow across the entire site. In actuality, the mirror arrays will act as wind breaks and will significantly affect the wind flow near the ground. The mirror structures will most likely reduce the effective surface friction velocity in the solar field. With a lower friction velocity, there will be less energy available to produce suspension of dust particles from the solar array, resulting in a significant reduction in the potential for generating windblown dust compared to that modeled.

Given the above differences between what was modeled and what is actually expected in the operation phase of the PSPP, the WEPS model estimates of wind erosion are expected to significantly overestimate the wind erosion during facility operation. However, the conservative (high) estimate of operational emissions results in a minimum estimate of the reduction in windblown dust emissions from the pre-construction baseline scenario to operational activities. In other words, the expected potential reduction in windblown dust by construction of the PSPP, estimated using the WEPS model, is a minimum value and the reduction in emissions from pre- to post-Project will likely be much larger than presented.

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**DR-AIR-3**

**Information Required:**

Please provide data to enable an estimate of the actual surface silt content at the site, which can be from the geotechnical report not submitted as part of the AFC.

**Response:**

The silt content used to estimate construction, operation and wind erosion emissions for this Data Response submittal are based on the average silt content for all samples that were analyzed for grain size distribution in association with the geotechnical investigation that was conducted in support of the AFC. The data was provided in Appendix B of the Preliminary Geotechnical Investigation Report that is dated September 16, 2009 (this report was <u>not</u> submitted with the AFC), and the data is summarized in Table DR-AIR-3-1. As shown in Table DR-AIR-3-1, the silt content ranged from 4.5 percent to 24.4 percent, with an average of 15.83 percent. The average silt content was used in the emission calculations.

**Table DR-AIR-3-1**

| Sample Identification | Percent Fines used as "Silt Content" (%) | Sample Identification | Percent Fines used as "Silt Content" (%) |
|---|---|---|---|
| B-1 | 5.4 | B-12 | 7.5 |
| B-2 | 9.9 | B-13[1] | 17.3 |
| B-3 | 22.1 | B-13[1] | 16.0 |
| B-4 | 37.3 | TP-1 | 21.6 |
| B-5 | 4.5 | TP-3[1] | 13.8 |
| B-6 | 11.9 | TP-3[1] | 7.1 |
| B-7[1] | 15.3 | TP-4 | 14.9 |
| B-7[1] | 19.1 | TP-5 | 6.3 |
| B-8 | 15.0 | TP-7 | 19.6 |
| B-9 | 17.0 | TP-8[1] | 13.8 |
| B-10 | 24.4 | TP-8[1] | 23.3 |
| B-11 | 19.3 | **Average Silt Content** | **15.83** |

1. Where there are two samples with the same Sample Identification number, the silt analysis was conducted at two different depths from the same boring.

**DR-AIR-4**

**Information Required:**

Please update the construction and operations fugitive dust emissions calculations as appropriate based on the site specific surface silt content estimate.

**Response:**

The construction and operations fugitive dust emissions calculations were updated with a site-specific surface silt content of 15.83 percent as determined in response to DR-AIR-3. The updated construction emissions are presented in Tables DR-AIR-4-1 and DR-AIR-4-2, and the updated operating emissions are presented in Table DR-AIR-4-3. Detailed construction emission calculations are provided in the spreadsheet with filename *Palen DR Construction Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations. Detailed operating emission calculations are provided in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the same CD-ROM.

**Table DR-AIR-4-1 Maximum Daily Construction Emissions[1]**

| Phase of Construction | NOx (lb/day) | VOC (lb/day) | CO (lb/day) | SOx (lb/day) | PM10 (lb/day) | PM2.5 (lb/day) |
|---|---|---|---|---|---|---|
| Power Plant (onsite) | 801.04 | 85.09 | 459.03 | 1.75 | 616.76 | 148.84 |
| Roadway (offsite) | 73.42 | 6.76 | 35.86 | 0.14 | 25.95 | 7.22 |
| Transmission and Communication Line (offsite) | 19.30 | 2.91 | 30.21 | 0.06 | 12.01 | 3.08 |

1. The emissions presented in this table reflect the change in the silt content as explained in the response to DR-AIR-4, and include changes to the equipment (i.e., tailpipe) emission factors as explained in the responses to DR-AIR-7 and DR-AIR-8.

**Table DR-AIR-4-2 Maximum Annual Construction Emissions[1]**

| Phase of Construction | NOx (tpy) | VOC (tpy) | CO (tpy) | SOx (tpy) | PM10 (tpy) | PM2.5 (tpy) |
|---|---|---|---|---|---|---|
| Power Plant (onsite) | 98.86 | 10.50 | 55.49 | 0.21 | 75.72 | 18.33 |

1. The emissions presented in this table reflect the change in the silt content as explained in the response to DR-AIR-4, and include changes to the equipment (i.e., tailpipe) emission factors as explained in the responses to DR-AIR-7 and DR-AIR-8.

**Table DR-AIR-4-3 Summary of Project Criteria Pollutant Emissions[1]**

| Emissions | NOx | VOC | CO | SOx | PM10 | PM2.5 |
|---|---|---|---|---|---|---|
| Average Hourly Uncontrolled (AHU) (lb/hr) | 0.52 | 3.88 | 0.72 | 0.07 | 4.35 | 1.06 |
| Average Hourly Controlled (AHC) (lb/hr) | 0.52 | 0.52 | 0.72 | 0.07 | 4.35 | 1.06 |
| Maximum Hourly Uncontrolled (MHU) (lb/hr) | 63.39 | 79.02 | 39.61 | 0.86 | 41.74 | 11.13 |
| Maximum Hourly Controlled (MHC) (lb/hr) | 63.39 | 5.52 | 39.61 | 0.86 | 41.74 | 11.13 |
| Maximum Daily Uncontrolled (MDU) (lb/day) | 73.90 | 166.80 | 72.36 | 10.56 | 318.34 | 77.26 |
| Maximum Daily Controlled (MHC) (lb/day) | 73.90 | 19.80 | 72.36 | 10.56 | 318.34 | 77.26 |
| Annual Average (AA) (Controlled) (lb/yr) | 4,546 | 4,555 | 6,285 | 572 | 38,127 | 9,261 |
| 30-Day Average (30-DA) (Controlled) (lb/day) | 73.90 | 19.80 | 72.36 | 10.56 | 318.34 | 77.26 |

1. Operating emissions were updated (compared to the emissions presented in the AFC) to address five Project refinements and/or data requests:

a) Silt content of soils (impacts PM10 and PM2.5 emissions only) per DR-AIR-3,

b) Model year 2013 vehicle emission standards (all pollutants) per DR-AIR-13,

c) the increase in onsite maintenance vehicle mileage per DR-AIR-15 and -16,

d) a larger diesel-fired emergency generator (all pollutants) per DR-AIR-21, and

e) the removal of the HTF heater and increase in auxiliary boiler emissions as explained in DR-AIR-23 and -24.

The emissions shown in this table reflect all five of these changes to emissions.

**DR-AIR-5**

**Information Required:**

Please update the construction and operations particulate modeling analysis, as necessary, based on the revised fugitive dust emission calculations.

**Response:**

The particulate modeling analyses based on the revised construction and operational emissions are provided in Attachment DR-AIR-5, Air Quality Impacts Assessment.

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**DR-AIR-6**

**Information Required:**

Please provide the spreadsheet version of the Appendix E-2 Construction Emission Worksheets with the embedded calculations intact.

**Response:**

Updated construction emission calculations are provided in the spreadsheet with filename Palen DR Construction Emissions.xlsx on the CD-ROM in Attachment DR-AIR-2, Emission Calculations, as requested.

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**DR-AIR-7**

**Information Required:**

Please identify whether all of the off road equipment emission factors are based on Tier 3 engines, or if Tier 3 engines are only assumed for the engines listed with Tier 3 in the equipment name column.

**Response:**

All of the off road equipment emission factors are based on engines that meet Tier 3 emission standards. Please see DR-AIR-8 for a description of how the emission factors were derived.

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**DR-AIR-8**

**Information Required:**

Please provide the input assumptions to obtain the OFFROAD Model raw engine emission factors, the assumptions used to derive the equipment specific emission factors, and please provide the spreadsheets used to create the emission factors shown in Appendix E-2.

**Response:**

The OFFROAD2007 Model was run with the input options shown in Table DR-AIR-8-1.

**Table DR-AIR-8-1 OFFROAD Model Options**

| Variable | Selected Option |
|---|---|
| Episode Period | Calendar Year: 2010<br>Averaging Days: Monday – Sunday<br>Month or Season: Annual |
| Report Options | HC Emissions as ROG<br>Report by Model Year: Exhaust, Evaporative and Toxics |
| Filter Options: Area | State |
| Filter Options: Equipment Categories | All |
| Filter Options: Fuel and Horsepower | Fuel: Diesel<br>Horsepower Class: All horsepowers |

The model produced a tab-delimited text file that contains annual average daily diesel equipment exhaust emissions, in tons per day, and average daily operating time, in hours per day, for calendar year 2010, by equipment type (e.g., rubber-tired loaders, cranes, etc.), horsepower range (e.g., 0 to 25 horsepower, 26 to 50 horsepower, etc.) and model year for each combination of equipment type, horsepower range and model year. This information was listed for every combination of county, air district and air basin within the state. For example, one line of output listed average annual daily operating hours and daily exhaust emissions of ROG, CO, NOx, $CO_2$, $SO_2$, PM, $N_2O$ and $CH_4$ from model year 2008 air compressors with horsepower ratings from 26 to 50 horsepower in the portion of Riverside County located within the Mojave Desert Air Basin that is in the South Coast Air Quality Management District's jurisdiction. The model output file was imported into a Microsoft Access database, and a query was used to calculate total emissions and operating hours by equipment type, horsepower range and model year.

Emission factors, in pounds per operating hour, were calculated by dividing the annual average daily emissions, converted from tons per day to pounds per day, by the annual average daily operating hours. These emission factors were calculated for each combination of equipment type, horsepower range and model year. The emission factors used to calculate exhaust emissions presented in the AFC were based on the model outputs for the portion of Riverside County located within the Mojave Desert Air Basin that is in the Mojave Desert Air Quality Management District's jurisdiction. However, in preparing the response to this data request, it was concluded that it is more appropriate to use statewide totals because of the relatively small equipment populations within the local geographic area. Therefore, the emission factors and construction emission calculations have been revised.

The emission factors for the specific equipment shown in Appendix E.2, Table E.2-1 of the AFC, are the emission factors calculated from the OFFROAD2007 Model output for the corresponding OFFROAD2007 Model equipment category, horsepower range that encompasses the specific equipment, and the model year that is the earliest model year required to comply with Tier 3 emission standards, which depends on engine horsepower.

The tab-delimited output file from the OFFROAD2007 Model is provided in the zipped textfile with filename 2010 BMY State.BMyExh, and revised construction emission calculation spreadsheets, including tabs with

the emission factor calculations, are provided in the spreadsheet with filename Palen DR Construction Emissions.xlsx, both on the CD-ROM in Attachment DR-AIR-2, Emission Calculations. Revised maximum daily and annual construction emissions are provided in Data Response DR-AIR-4.

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**DR-AIR-9**

**Information Required:**

> Please provide a defensible rationale as to why the locations for the area source emission inputs did not change from short-term to annual modeling, or please provide annual construction modeling that matches the extent of annual construction activities.

**Response:**

The choice of location for the construction sources is discussed in the response to DR-AIR-10 below. The choices of source location were intended to demonstrate the worst-case scenario for construction-phase modeling. Keeping the construction emission sources in the worst-case location for the entire year for the annual period model runs is a more conservative (worst-case) approach compared to keeping the sources in the worst-case location for the shorter period of time. By increasing the size of the area sources to cover the entire area to be worked over the course of a year and thus distributing the annual construction emissions over a much wider area, the modeled impacts would decrease significantly. The annual impacts were assessed using the entire area to be worked over the course of a year; the revised model results are provided in Attachment DR-AIR-5, Air Quality Impacts Assessment.

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**DR-AIR-10**

**Information Required:**

> Please provide a defensible rationale why the modeling analysis focuses on Unit 2 construction and not Unit 1 construction.

**Response:**

The area sources used for modeling the short term construction activities were placed such that they would represent the worst-case construction modeling scenario. As was discussed in the AFC regarding the selection of source location:

> "...the northwestern power block (Solar Unit #2) was used as the worst-case scenario since it is the closest of the two power blocks to the location modeled for the solar field construction sources, which were located in the northwest quadrant of the site in order to be downwind of the predominant wind direction, which is from the south-southeast. Choosing the northwestern of the two power blocks thus maximized the interaction of construction sources impacts, resulting in a "worst case" conservative estimate of construction impacts."

The worst case modeling scenario for the solar field construction sources was to place them against the fenceline in the northwest part of the site (based on the wind rose for Blythe Airport, see Figure 5.2-8 of the AFC), which shows the predominant winds blowing from the south to southeast. For this reason, the power block that would yield the greatest overlap of impacts with the solar field construction sources, in

this case the western-most power block (i.e., Unit 2), was chosen for the modeling analysis. The sources used in the construction modeling analysis are shown in Figure 5.2-10 of the AFC. In the AERMOD modeling system, the worst impacts typically occur when sources are "lined up" with regard to the wind direction. Placing the construction sources for the solar array against the northwest fence line as described above, and also choosing the western-most power block to represent power block construction, maximizes the possibility of those sources being aligned with each other and the predominant wind direction.

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**DR-AIR-11**

**Information Required:**

> Please provide an analysis that indicates whether the meteorological data shows that this would be a conservative modeling assumption for predicting worst-case fence line impacts.

**Response:**

Low level area and volume sources in AERMOD tend to have their highest impacts just downwind of the edge of the sources, with the highest impacts occurring in low wind scenarios in a stable atmospheric condition. This has more to do with the way the model works than reality, since, in many cases, the low winds causing the model to generate the highest impacts would not be sufficiently strong to lift the material (i.e., silt or dust that becomes PM10) being modeled.

The three primary considerations when creating a worst-case modeling scenario using area sources are: 1) proximity of the source to the fenceline, 2) orientation of the source relative to the predominant wind direction, and 3) orientation of the sources relative to each other. These three factors were used in placing the construction sources, which were modeled against the fence line immediately upwind from the fence relative to the predominant wind direction, so as to maximize the overlap of their impacts with each other. Since the three solar array construction stages: surveying and grubbing, scraping and grading, and equipment installation, will typically occur on adjacent blocks of the construction site, the sources representing each of these activity stages were placed in a line that would be roughly parallel to the prevailing wind direction. The sources were also placed so as to maximize their interaction with both power block construction and the sources representing vehicular traffic to and from the equipment laydown area. Further, the modeling assumed that all five of these sources were emitting at their maximum potential for the entire modeling period, a conservative condition that will almost certainly not actually occur during construction.

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**DR-AIR-12**

**Information Required:**

> Please provide a revised construction emissions $NO_2$ modeling analysis that uses the NOx_OLM option with an OLM source group, and if necessary or desired, that uses actual hourly background $NO_2$ data.

**Response:**

The Applicant revised construction emissions $NO_2$ modeling analysis using both the NOx_OLM option with an OLM source group and actual hourly background $NO_2$ data. The results of the modeling analysis incorporating the suggested changes are provided in Attachment DR-AIR-5, Air Quality Impacts Assessment.

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**DR-AIR-13**

**Information Required:**

Please revise the emissions calculations for the onsite dedicated vehicle exhaust emissions assuming only new model year vehicles are used.

**Response:**

Exhaust emissions for gasoline powered maintenance vehicles have been revised using model year 2013 emission factors, which will be the new model year when operations begin. The specific emission factors used are shown in Table DR-AIR-13-1, and the corresponding emissions are shown in Table DR-AIR-13-2. The emission factors and emissions calculations are provided in Tables E-3.7a and E-3.7c in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations.

**Table DR-AIR-13-1 Gasoline and Diesel Power Maintenance Vehicle Emission Factors**

| Vehicle Type | NOx (lb/mi) | VOC (lb/mi) | CO (lb/mi) | SOx (lb/mi) | Exh. PM10 (lb/mi) | Tire + Brake PM10 (lb/mi) | Exh. PM2.5 (lb/mi) | Tire + Brake PM2.5 (lb/mi) |
|---|---|---|---|---|---|---|---|---|
| Gasoline | 9.18E-05 | 4.16E-05 | 1.20E-03 | 1.07E-05 | 1.07E-05 | 4.59E-05 | 9.90E-06 | 1.64E-05 |
| Diesel | 4.16E-03 | 4.24E-04 | 2.12E-03 | 4.14E-05 | 1.19E-04 | 1.40E-04 | 1.19E-04 | 1.09E-04 |

**Table DR-AIR-13-2 Maintenance Vehicle Emissions for the Project[1]**

| Period[2] | NOx | VOC | CO | SOx | PM10 | PM2.5 |
|---|---|---|---|---|---|---|
| AHU/AHC (lb/hr) | 0.015 | 0.002 | 0.009 | 0.0002 | 0.0004 | 0.0004 |
| MHU/MHC (lb/hr) | 0.060 | 0.006 | 0.033 | 0.001 | 0.002 | 0.002 |
| MDU/MDC (lb/day) | 0.393 | 0.041 | 0.237 | 0.004 | 0.012 | 0.011 |
| AA (lb/yr) | 134.4 | 14.1 | 81.0 | 1.4 | 3.9 | 3.6 |
| 30-DA (lb/day) | 0.393 | 0.041 | 0.237 | 0.004 | 0.12 | 0.011 |

1. Only exhaust PM10 and exhaust PM2.5 emissions are presented in this table; fugitive emissions are not included in these emissions estimates. These estimates also incorporate revised vehicle travel distances as discussed in the responses to DR-AIR-16 and DR-AIR-19. More detailed emissions calculations, including fugitive emissions can be found in Table E.3-7c in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations.

2. Abbreviations are SCAQMD-defined emission periods for permit application purposes. AHU = Average Hourly Uncontrolled (lb/hr); AHC = Average Hourly Controlled (lb/hr); MHU = Maximum Hourly Uncontrolled (lb/hr); MHC = Maximum Hourly Controlled (lb/hr); MDU = Maximum Daily Uncontrolled (lb/day); MHC = Maximum Daily Controlled (lb/day); AA = Annual Average (Controlled) (lb/yr); 30-DA = 30-Day Average (Controlled) (lb/day).

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**DR-AIR-14**

**Information Required:**

Please identify if the applicant would be willing to stipulate to a condition of certification that would require a review of available alternative low-emission vehicle technologies to replace the proposed diesel and gasoline fueled vehicles used for operations maintenance if lower emission alternative technology vehicles are both available and not cost prohibitive.

**Response:**

The PSPP is not currently exploring the use of alternative vehicle technologies such as electric or hydrogen fueled vehicles. As shown in Table DR-AIR-13-2 above, vehicle (tailpipe) emissions during facility operations are estimated to be well below one ton per year of all criteria pollutants. While entrained road dust fugitive emissions are expected to exceed one ton per year, the use of alternative fueled vehicles will not reduce the fugitive emissions. As concluded in the AFC, the PSPP has not identified any direct or indirect significant adverse air quality impacts from the use of on-site vehicles and, therefore, mitigation as suggested in this data request is not warranted. As an alternative, the Applicant would be willing to accept a condition similar to that recommended by Staff for the Beacon Solar Energy Project, as follows:

*The project owner shall use 2013 model year or newer vehicles, meeting California model year on-road vehicle emission standards, for onsite parabolic mirror washing activities and all other facility maintenance*

*activities. Other vehicle/fuel types may be allowed assuming that the emission profile for those vehicles, including fugitive dust generation emissions, is comparable to the vehicles types identified above.*

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**DR-AIR-15**

**Information Required:**

Please clarify the estimations and assumptions used in determining the number of mirror washing events per year.

**Response:**

The mirrors will be washed on an as-needed basis. For the purpose of estimating the wash truck vehicle mileage and wash water consumption, the Applicant estimates that the mirrors will be washed once monthly in the six months surrounding winter (assumed to be October through March) and twice monthly from mid-spring through mid-fall (assumed to be April through September). This schedule results in 18 mirror washing events per year. However, as noted, the mirrors would be washed as-needed to maintain optimum performance.

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**DR-AIR-16**

**Information Required:**

Please provide a clear and defensible explanation of why the amount of parabolic trough pipe length is equivalent to the mirror washing vehicle mileage for each washing cycle event, or revise this estimate as necessary to obtain a more reasonable total vehicle mileage estimate for mirror washing.

**Response:**

The vehicle travel distances have been revised to account for the additional distances required for refilling the water tank, refilling the soil stabilizer tanks, refueling, and activity-specific considerations. The assumptions used to develop the revised travel distance for each of the required maintenance activities is explained briefly below and summarized in Table DR-AIR-16-1. A more detailed, step-by-step explanation is provided in Table E.3-20 in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations.

<u>Mirror Wash Vehicle Travel.</u> The total number of individual rows of mirrors is multiplied by the length of an individual row; added to this figure is the perpendicular length through the solar field to account for travel from row to row. This sum is the minimum travel distance in the solar field for a single pass. As the washing process is now understood, only one-half of the mirror is washed per day. The mirror is stowed in the vertical upright position facing east, and the bottom half of the mirror is washed on the first day. The following day, the mirror is stowed facing west and the other half is washed. Thus, the minimum travel distance is doubled to account for the actual physical washing process.

The mirror wash truck is assumed to have a capacity of 5,000 gallons of water, and the washing activity itself requires about 0.7 gallons per linear foot of mirror. Based on these values, the water truck can wash five full rows of mirrors before a truck refill is required. The average travel distance to refill the truck was

calculated from the solar field back to the power block where the water storage tank is located. Each refill trip would require travel from the solar field to the power block and back to the solar field; thus for every refill trip, the average distance is doubled.

The travel distance through the solar field for washing is added to the travel distance for the refill trips to determine the total travel distance required for the mirror washing activity with water refill. It is assumed that the water wash truck would be refueled at the power block by a mobile fueling truck during a water refill stop; thus additional travel for fueling is not required. Each mirror washing event is expected to require approximately 10 days to complete.

Weed Abatement Application. Weed abatement is performed four times per year. Similar to the travel for mirror washing, the total number of individual rows of mirrors is multiplied by the length of an individual row; added to this figure is the perpendicular length through the solar field to account for travel from row to row. Additional travel is assumed along the ends of the mirror rows. It is assumed that the weed abatement truck will not require refilling, as the herbicide would be applied to living plants only, and, based on observations of the Kramer Junction SEGS facility, vegetation growth is minimal. Refueling is assumed to occur offsite by the contractor prior to arrival at the site; thus no additional mileage for refueling is included in the distance estimate. Each weed abatement event is expected to require approximately 10 days to complete.

Soil Stabilizer Application. Soil stabilizers are applied four times per year to the normal travel paths used by maintenance vehicles. Similar to the travel for mirror washing, the total number of individual rows of mirrors is multiplied by the length of an individual row; added to this figure is the perpendicular length through the field to account for travel from row to row. In addition to the travel in a single pass, it was also assumed that the perpendicular lengths would be stabilized a second time for stabilization of the paths required for header inspections. The soil stabilizer truck is assumed to hold 5,000 gallons of solution, and the stabilizer application activity itself requires about 0.8 gallons per linear foot of roadway. Based on these figures, the soil stabilizer truck can treat the roadway between four full rows of mirrors before a refill is required. The average distance of travel from the solar field back to the power block where the stabilizer supply is located was calculated. Each refill trip would require travel from the solar field to the power block and back to the solar field; thus for every refill trip, the average distance is doubled.

The travel distance through the solar field for soil stabilizer application is added to the travel distance for the refill trips to determine the total travel distance required for the soil stabilizer application activity plus refill. It is assumed that the soil stabilizer truck will be refueled at the power block by a mobile fueling truck during a refill stop; thus additional travel for fueling is not required. Each soil stabilizer application event is expected to require approximately 10 days to complete.

Water Truck. Water truck travel distance is calculated based on the volume of RO reject water generated per day that has to be applied for dust suppression and an application rate of three gallons per linear foot. RO reject water would be generated and applied to the solar field up to 365 days per year.

Maintenance Truck Travel. The piping headers will be physically inspected once per operating day (assumed to be 365 days per year); the distance traveled is equal to the piping length of the header itself, with some additional distance required due to backtracking, as the HTF header is not a simple loop. In addition, the mirrors would have to be physically inspected following every high wind event. For the purpose of this estimate, 18 high wind events are assumed to occur per year, and the travel distance is equal to the minimum travel distance calculated for the solar field, as explained in the mirror wash description above. Maintenance vehicles are assumed to have the spare parts and supplies necessary to effect repairs without additional travel to the maintenance stores area at the power block. Refueling is

assumed to occur offsite; mileage is calculated based on the refueling frequency and the distance to the nearest offsite refueling facility. Maintenance inspections would be required every operating day, assumed to be 365 days per year.

**Table DR-AIR-16-1 Maintenance Vehicle Travel Distance**

| Vehicle Use | Vehicle Type | Distance | | |
|---|---|---|---|---|
| | | Miles/task | Miles/day | Miles/year |
| Mirror Wash Truck | Water Trucks, Freightliner 5,000 gallon | 1,449 | 144.9 | 26,090 |
| Weed Abatement | Water Trucks, Freightliner 5,000 gallon | 316 | 31.6 | 1,263 |
| Soil Stabilizer Application | Water Trucks, Freightliner 5,000 gallon | 909 | 90.9 | 3,638 |
| Water Trucks | Water Trucks, Freightliner 5,000 gallon | 3 | 3 | 1,071 |
| Maintenance Vehicles | On-Site Pick Up Truck 1/2 Ton | --- | 32 | 10,825 |

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**DR-AIR-17**

**Information Required:**

Please provide an estimate of the $SF_6$ onsite inventory and leakage emissions both in operation and construction phases to complete the GHG emission estimates.

**Response:**

Sulfur hexafluoride ($SF_6$) will not be used during the construction period. The onsite inventory of $SF_6$ during operations will be not more than 100 pounds in circuit breakers per power block, for a total of not more than 200 pounds for the Project. The $SF_6$ leakage rate from operating equipment is guaranteed to not exceed 0.5 percent per year and can be less than 0.2 percent per year with current best technology. At the maximum guaranteed leak rate of 0.5 percent, this corresponds to 1.0 pounds per year of $SF_6$ emissions, or 11.97 metric tons/year of $CO_2$ equivalent ($CO_2e$). The more probable, technically feasible leak rate is 0.2 percent, which corresponds to approximately 4.8 metric tons/year or 143.4 metric tons $CO_2e$ emissions over the 30-year plant lifetime.

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**DR-AIR-18**

**Information Required:**

Please provide GHG emission estimates for the entire construction period.

**Response:**

GHG emissions for the construction period are summarized in Table DR-AIR-18-1. A detailed explanation of the GHG emissions calculation procedure is provided as Attachment DR-AIR-18, Construction Greenhouse Gas Emission Estimates.

**Table DR-AIR-18-1 Construction GHG Emissions**

| **Aspect of Construction** | **Project Total (metric tons $CO_2$ equivalent)** |
|---|---|
| Construction Equipment Total | 41,398 |
| Onsite Motor Vehicle Total | 1,780 |
| Offsite Motor Vehicle Total | 93,177 |
| **Project Total (metric tons $CO_2$ equivalent)** | **136,354** |
| Annualized over Project Life (30 years) (metric tons $CO_2$ equivalent/year) | 4,545 |

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**DR-AIR-19**

**Information Required:**

> Please confirm that there will be no gasoline or diesel vehicle refueling storage at the site and that either fuel/lube trucks will be used for onsite refueling or the onsite dedicated vehicles will have to drive to the nearest gasoline station, which is about 25 miles roundtrip from the site, to refuel. If gasoline or diesel storage is used at the site, provide information for any proposed onsite gasoline or diesel storage and refueling facilities including throughput information and permitting requirements.

**Response:**

There are no fuel storage facilities planned for the Project. The diesel-fueled equipment (i.e., mirror wash trucks, soil stabilizer application trucks, and emergency fire water pump and generator engines) will be refueled by a mobile fuel truck that will travel to the Project site. The gasoline powered maintenance trucks will be refueled at the nearest retail gasoline station. The vehicle-miles-traveled for fueling operations are summarized in Table DR-AIR-19-1. Detailed calculations of the refueling mileage are also provided in Table E.3-8a in the spreadsheet with filename *Palen DR Operating Emissions.xlsx* on the CD-ROM in Attachment DR-AIR-2, Emission Calculations.

**Table DR-AIR-19-1 Refueling Mileage Summary**

| Vehicle Use | | Miscellaneous Solar Vehicle Refueling | Maintenance Truck Refueling |
|---|---|---|---|
| Vehicle Type | | Water Trucks, Freightliner 5,000 gallon | 1/2–Ton Pickup Truck |
| Fuel Type | | Diesel | Gasoline |
| Number of Refueling Trips (Maximum) | Trips per day | 1 | 2 |
| | Trips per year | 12 | 52 |
| Point of Origin / Destination | | Riverside | Blythe |
| Round Trip Distance | miles/trip | 280 | 25 |
| Miles Traveled | miles/day | 280 | 50 |
| | miles/year | 3,360 | 1,300 |

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**DR-AIR-20**

**Information Required:**

Please indicate if the additional vehicle mileage required for offsite refueling of the dedicated onsite vehicles or fuel/lube truck mileage is considered in the total vehicle miles estimates and emissions estimates, or please correct the estimates accordingly.

**Response:**

Emission estimates have been revised to include emissions from periodic delivery of diesel fuel to the Project site via a mobile refueling truck. The mobile refueler is assumed to travel from Riverside, a one-way travel distance of 140 miles. The mobile refueler is assumed to make 12 fuel deliveries per year. The number of mobile refueler trips to the site is based on the assumption that the diesel-fueled vehicles would have fuel tanks large enough for the travel required for one full month of activities.

Maintenance vehicle emission estimates have been revised to reflect periodic refueling at a local retail gasoline station, assumed to be located in Blythe, a roundtrip travel distance of approximately 25 miles. Refueling is assumed to occur a total of 52 times per year. The number of refueling trips to a retail gasoline station is based on the assumption that the gasoline-fueled vehicles would have fuel tanks large enough for the travel required for one full week of activities.

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**DR-AIR-21**

**Information Required:**

Please provide a description explaining the purpose of the emergency generator engine including why the applicant believes the selected size is appropriate for the solar facility.

**Response:**

The emergency generator is required to provide motive power to three principle areas of the facility: 1) Freeze Protection Pump; 2) Balance of Plant (BOP) Motor Control Center (MCC); and 3) HTF MCC. The BOP MCC and HTF MCC equipment that will require emergency power are shown in Table DR-AIR-21-1, and there may be other small loads connected to the power supply to allow the facility to shut down safely. A 2 MW output generator is proposed for the facility, which requires a 2,922 Hp diesel-fired engine. The engine will meet EPA Tier 2 emission standards.

**Table DR-AIR-21-1 Emergency Loads**

| BOP MCC | HTF MCCs | |
|---|---|---|
| Heat Trace XFMR | Power supply cabinet channel A - H | Anticondensation heater LV-motors |
| Main Fire Alarm Panel | Nitrogen system Heater switchboard | HTF control valve behind reheater 1 to 4 |
| CEMS HVAC | Nitrogen system Junction Box-Power | Centralization box signals |
| 480V Power Panel | PLC Main nitrogen supply | Anticondensation heater LV-motor |
| STG Turning Gear | Field Supervisory Control 1 and 2 | Fire alarm control panel supply 1 and 2 |
| ST Turbine Lube Oil Pump | Fiber optic termination cabinet | Centralization box signals |
| Fire Water Jockey Pump | HTF control system supply 1 and 2 | Distribution box heaters |
| Battery Charger A | Nitrogen control valves in front of expansion vessels | Filler valve of HTF system |
| UPS Bypass | Tracing of main service water pipe | Tracing of overflow vessel 1 to 8 |
| CEMS Skid | Control valve in ullage pipe | Control valve in ullage pipe |
| Gen Breaker | Transformer temperature monitoring cabinet | Anticondensation heater LV-motors |
| GSU Fans Feeder | Shutoff devices | Overflow return pumps |
| | Control valve in front of reclamation flash vessel | HTF drain pumps |

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**DR-AIR-22**

**Information Required:**

Please confirm that 500 hours of operation is sufficient for HTF freeze protection.

**Response:**

Based on the system performance modeling, historical ambient temperature data and cost considerations, the Applicant has determined that the HTF heater will not be needed for Project operations. Instead, the heat required for HTF freeze protection will be provided by the auxiliary boiler. The Applicant has determined that 100 hours of operation per year by the auxiliary boiler will be sufficient for HTF freeze protection. Please see responses to DR-AIR-23 and -24 for additional information.

**DR-AIR-23**

**Information Required:**

Please confirm that the sole purpose of the auxiliary heaters is for HTF freeze protection and that they will not be used directly for power generation or for rapid start support.

**Response:**

As noted in response to DR-AIR-22, the Applicant has determined that the HTF heater is not required for Project operation, and this device has been eliminated from the facility design.

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**DR-AIR-24**

**Information Required:**

Please confirm that the use of the auxiliary boilers is strictly for rapid start support through overnight low load (25 percent) operation and early morning full load operation and that they will not be used directly for power generation or for HTF freeze protection.

**Response:**

The auxiliary boiler will be used to support rapid startup each morning, specifically to establish the steam seals in the steam turbine and maintain the air-cooled condenser (ACC) in an evacuated condition so that the facility can generate power as soon as the solar-generated steam is sufficient to drive the steam turbine. In addition, as noted in response to DR-AIR-22 and -23, the auxiliary boiler will be used for HTF freeze protection up to a maximum of 10 hours per day, and up to a maximum of 100 hours per year. The maximum daily operation of the boiler is expected to be 15 hours per day at 25 percent load, two hours per day at full load for start up support, and up to 10 hours per day for HTF freeze protection. The maximum daily operation of the boiler for these three purposes would not occur on the same day. Operating hours are summarized in Table DR-AIR-24-1. The auxiliary boiler will not be used directly for power generation.

**Table DR-AIR-24-1 Hours of Operation**

| Function | Maximum Daily Operation | Maximum Annual Operation |
|---|---|---|
| Start up Support | 2 hours at 100% load | 500 hours at 100% load |
| HTF Freeze Protection | 10 hours at 100% load | 100 hours at 100% load |
| Standby | 15 hours at 25% load | 4,500 hours at 25% load |
| Total | 17 hours<br>(12 at 100% and 5 at 25%) | 5,100 hours |

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**DR-AIR-25**

**Information Required:**

Please identify the equivalent MWh generated or enabled by the rapid start support use of these boilers.

**Response:**

The equivalent MWh generated or enabled by the rapid start support use of these boilers is determined by estimating the time required to evacuate the ACC if the seal steam was lost, as steam is required to establish the seal. According to the ACC equipment manufacturer, approximately one hour is required to evacuate the ACC. Based on this duration, use of the auxiliary boiler enables an additional net output of 27 Gigawatt-hours per year, per power block, for a total of 54 GWh per year for the Project.

In addition, use of the auxiliary boiler reduces the wear and tear on the steam turbine by avoiding the heat-up/cool-down cycle that would occur without the boiler. This provides the direct benefit of longer service intervals and less downtime.

**DR-AIR-26**

**Information Required:**

Please provide a list from the SCAQMD of large stationary source projects with permitted emissions, for projects with greater than 5 tons of permitted emissions of any single criteria pollutant. Include projects located within six miles of the project site that have been recently permitted, but did not start operation prior to 2009, or are in the process of being permitted.

**Response:**

SCAQMD had been contacted prior to preparation of the AFC, and had not indentified any sources within six miles of PSPP that should be included in a cumulative modeling analysis. Furthermore, aerial photographs in the vicinity of the PSPP were reviewed, and no sources were found occurring within six miles of the Project.

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**DR-AIR-27**

**Information Required:**

Please provide a cumulative impacts modeling analysis in consultation with Energy Commission staff, if necessary, based on the project list provided by SCAQMD.

**Response:**

Based on the response to DR-AIR-26, no cumulative air quality impact analysis is needed for PSPP.

**DR-AIR-28**

**Information Required:**

Please identify if SCAQMD requires an ambient air quality analysis for this project.

**Response:**

The SCAQMD does not require ambient air quality modeling for the PSPP. Modeling is required only if equipment emissions exceed the thresholds established in SCAQMD Rule 1303, Appendix A, Table A-1. Pursuant to SCAQMD rules, the determination is made on a "permit unit" basis, as permit units are defined in the SCAQMD permit application guidance. The emissions from individual permit units at the PSPP facility do not exceed the emission rates specified in Table A-1 of the rule and, therefore, modeling is not required for the Project by the SCAQMD.

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**DR-AIR-29**

**Information Required:**

Please provide formal communication from the SCAQMD to show that either they have formally approved the use of the Blythe meteorological data for this project site or would allow its use.

**Response:**

Please see Attachment DR-AIR-29, Communication with the SCAQMD.

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**DR-AIR-30**

**Information Required:**

Please provide copies of any official submittals and correspondence to or from the SCAQMD within 5 days of their submittal to or their receipt from the SCAQMD.

**Response:**

The correspondence with the SCAQMD regarding this Project since the submittal of the AFC in August 2009 is limited to the submittal of the Determination of Compliance application and the SCAQMD's October 23 letter notifying the Applicant that the applications were data adequate; copies of both have been provided to CEC. As requested, future correspondence will be provided in a timely manner.

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**DR-AIR-31**

**Information Required:**

Please indicate which ownership party would have primary responsibility for each of the shared infrastructures and operating functions, such as any shared water wells, the

shared maintenance and warehouse buildings, the shared HTF land farming contaminated soil remediation site, responsibility for maintenance vehicle procurement and maintenance, etc.

**Response:**

As described in the Introduction to these Data Responses, both units will be owned and operated by one single entity, Palen Solar I, LLC (PSI). The permit applications to the SCAQMD are currently being revised to reflect the single owner and operator. In addition, all shared facilities will be owned, managed and maintained by PSI.

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**DR-AIR-32**

**Information Required:**

Please indicate which unit (Unit #1 and Unit #2) will be owned and permitted through SCAQMD by which ownership entity.

**Response:**

As described in the Introduction to these Data Responses, both units will be owned and operated by one single entity, Palen Solar I, LLC (PSI). The permit applications to the SCAQMD are currently being revised to reflect the single owner and operator.

**Attachment DR-AIR-2**

**Emission Calculations**
**Provided on CD-ROM**

# Attachment DR-AIR-5

## Air Quality Impact Assessments
## To Be Provided by January 13, 2010

# Attachment DR-AIR-18

# Construction Greenhouse Gas Emission Estimates

Prepared for:
**Solar Millennium**
**Palen Solar Power Project**

# Attachment DR-AIR-18 Construction Greenhouse Gas Emissions Calculations

AECOM, Inc.
January 2010
**Document No.: DR-AIR-18**

Prepared for:
**Solar Millennium**
**Palen Solar Power Project**

# Attachment DR-AIR-18 Construction Greenhouse Gas Emissions Calculations

Prepared By Howard Balentine

Reviewed By Russ Kingsley

AECOM, Inc.
January 2010
**Document No.: DR-AIR-18**

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# 1.0 Introduction

This Document contains a description of greenhouse gas (GHG) emissions calculated for construction of the Palen Solar Power Project (PSPP, or Project). Section 2 describes the methodology used to calculate emissions, results are presented in Section 3, and references are provided in Section 4. Table 1 at the end of this document provides the computed GHG emissions factors for construction equipment obtained from the OFFROAD2007 Burden model output. Table 2 provides the computed GHG emission factors for motor vehicles obtained from the EMFAC2007 BURDEN model output

# 2.0 Construction Greenhouse Gas Emissions

GHG emissions will arise from the operation of construction equipment and motor vehicles. This report describes the calculation methodology for GHG emissions associated with Project construction. GHG emissions during each month of construction were calculated separately, and the monthly emissions were summed over the construction duration for each Project component to calculate total GHG emissions.

## 2.1 Overview of Calculation Methodology

Emissions were computed for three GHGs: carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$). When the respective emissions for a given GHG is multiplied by the corresponding global warming potential (GWP), the emissions of each gas is expressed as its equivalent amount of $CO_2$ emissions, assuming a 100-year quantification period. The sum of the individual $CO_2$ equivalent ($CO_2e$) emissions for each of the three gases results in the project total $CO_2$ equivalent emissions.

There are multiple emission factors available in the literature and published protocols for computation of GHG emissions from fuel combustion. These factors tend to differ by the units of the emission factors and the assumptions of a given heat (or carbon) content of the fuel. However, almost all of these emission factors are ultimately based on a standard set of emission factors published by the Intergovernmental Panel on Climate Change (IPCC, 2006). For example, the Air Resources Board (ARB) reporting guidance for mandatory GHG reporting (ARB, 2008) references the ARB AB-32 Mandatory Reporting Guidance document (ARB, 2008) which, in turn, references an EPA GHG inventory guidance document (EPA, 2003), which, in turn, states that EPA GHG calculation methodology for mobile sources is consistent with IPCC 2006 guidance.

The GHG emissions for construction are based on output from the OFFROAD2007 (ARB, 2007a) and EMFAC2007 (ARB, 2007b) BURDEN models. These models were used to compute the criteria pollutant emissions during construction for the PSPP. The same model runs are used as a basis for estimating GHG emissions during construction because both models produce estimates of $CO_2$ emissions. In addition, the OFFROAD2007 model directly provides estimates of $N_2O$ and $CH_4$ emissions from diesel equipment[1].

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[1] While OFFROAD2007 output provides $N_2O$ emissions as an output, the $N_2O$ values output by OFFROAD2007 for all equipment sizes and equipment types are zero. However, $N_2O$ emissions are a small fraction of $CO_2e$ emissions from equipment during construction activities, even when the much larger GWP of $N_2O$ compared to $CO_2$ is taken into account. Therefore, the zero values for $N_2O$ emissions are used without modification or adjustment. The assumption of zero for $N_2O$ emissions from construction equipment is well within the very large uncertainty associated with the quantification process for estimating construction emissions and has an insignificant impact on the overall GHG emission estimates during construction of the facility.

For past projects, the CEC has requested that the GHG emission computations for mobile sources follow the methodology contained in the ARB mandatory reporting guidance document. These emission factors are in terms of kilograms of $CO_2$ per gallon for motor fuels and gram per mile for $N_2O$ and $CH_4$. For the PSPP, the GHG emission estimates from construction activities are based on the ARB OFFROAD2007 and EMFAC2007 BURDEN models, which, as discussed above, are ultimately based on IPCC 2006 emission factors.

The composite GHG emission factors used for a given run of OFFROAD2007 and EMFAC2007 are not explicitly listed in the model output but can be readily computed from model output. The emission factors can be computed on either 1) an hours of operation (or mileage) basis or 2) a fuel consumption basis, because total GHG emissions by GHG are listed, along with hours of operation or mileage accumulation for a given equipment/vehicle type, and the fuel consumption. Both sets of emission factors are ultimately the same with only unit conversions applied, along with assumptions of energy content per unit volume and fuel consumption/fuel economy assumptions. In other words, the OFFROAD2007 and EMFAC2007 output data can be used to compute GHG emission factors on different bases, depending on the intended use. As needed, the emission factors can be readily converted from one basis to the other using output data from the model. For example, if the on-road emission factors are computed on a per-volume of fuel used basis, they are easily converted to a mileage basis by dividing by the fuel economies used by EMFAC2007. Likewise, if the emission factors are on a per-hour-of-operation basis, they can readily be converted to units of emissions per volume of fuel consumed by dividing by the default specific fuel consumption provided in the OFFROAD2007 output.

The activity data developed to estimate emissions from equipment and vehicles for the PSPP are naturally compiled in terms of hours of operation (equipment) and miles traveled (vehicles). Therefore, the most direct method for using OFFROAD2007 and EMFAC2007 output to compute GHG emissions is to use the model output to compute composite GHG emission factors that are on a per-hour-of-operation basis for equipment and on a per-mile basis for vehicles.

Therefore, for this analysis, the construction equipment GHG emission factors are derived from OFFROAD2007 output by dividing the total emissions for each GHG and equipment class by the hours of operation for that GHG and equipment class. Likewise, GHG emission factors for motor vehicles are derived from EMFAC2007 output by dividing the total $CO_2$ emissions for each vehicle type by the output activity (miles) for that vehicle type. Once computed, unit conversions are applied to adjust the emission factors to the desired metric units (kg/mile). This straight-forward approach avoids the necessity to assuming a specific fuel consumption or fuel economy that may differ from that used in OFFROAD2007 or EMFAC2007, thereby potentially biasing the estimate of the total GHG emissions.

EMFAC2007 only provides estimates of $CO_2$ emissions. To estimate $N_2O$ and $CH_4$ emissions, the mobile source emission factors in the California Climate Action Registry (CCAR) General Reporting Protocol Version 3.1 (CCAR, 2009) was used. These emission factors are on a gram-per-mile basis, are ultimately based on the IPCC 2006 emission factors, and are identical to those contained in the ARB mandatory reporting regulation.

## 2.2 Construction Equipment Exhaust GHG Emissions

The combustion of fuel to provide power for the operation of various construction activities and equipment results in the generation of GHG, including $CO_2$, $CH_4$, and $N_2O$. The following predictive emission equation was used to calculate exhaust emissions from construction equipment:

$$\text{Exhaust Emissions}_{ij}\,(\text{MT}) = EF_{ij} \times T_j / 1000 \qquad \text{(Eq. 2-1)}$$

Where:

$EF_{i,j}$ = Emission factor for specific GHG *i* from construction equipment type *j* (kg/hour)

$T_j$ = Operating time for equipment of type *j* (hr)

1000 = kilograms per metric ton (kg/MT)

The exhaust emission factor $E_{ij}$ is computed from the OFFROAD2007 output by dividing the total emissions for a given GHG *i* and equipment type *j* by the operating hours of that equipment type in the OFFROAD2007 run. The OFFROAD2007 model calculates total daily emissions of $CO_2$, $N_2O$, and $CH_4$ by equipment category (crane, dozer, grader, etc.) and type of fuel (diesel, gasoline, etc.) within engine horsepower ranges in a geographic area, such as statewide or within a given jurisdiction (e.g., South Coast Air Quality Management District). The model also calculates total daily operating hours within the geographic area by equipment category, fuel and horsepower range. For the PSPP, OFFROAD2007 was run to generate statewide average emissions and activity data for 2010 for equipment with engines meeting Tier 3 emission standards, consistent with the revised construction criteria pollutant analysis for the PSPP prepared in Data Response DR-AIR- 8.

The total GHG emissions are the summation over all of the operating equipment with application of the appropriate GWP for each GHG. The GWP used for this analysis are those required by the ARB mandatory reporting rule and are equal to 1 for $CO_2$, 21 for $CH_4$, and 310 for $N_2O$.

The OFFROAD2007 GHG emission estimates, the hours of operation, the computed emission factors, and the projected hours of operation for the diesel off-road equipment anticipated to be used during construction of the PSPP are provided in Table 1 at the end of this document.

## 2.3 Motor Vehicle Exhaust Emissions

The combustion of fuel in motor vehicle engines results in the generation of GHGs, including $CO_2$, $CH_4$ and $N_2O$. The following predictive equation was used to calculate exhaust emissions from motor vehicles:

$$\text{Exhaust Emissions}_{ij}\,(\text{MT}) = EF_{ij} \times VMT_j \times CF_i / 1000 \qquad \text{(Eq. 2-1)}$$

Where:

$EF_{,i,j}$ = Emission factor for specific GHG *i* from motor vehicle type *j* (kg/mile or g/mile)

$VMT_j$ = Mileage for vehicle type *j* (miles)

$CF_i$ = EF units conversion factor (1.0 for $CO_2$, 0.001 for $CH_4$ and $N_2O$ to convert from g/mi to kg/mi)

1000 = kilograms per metric ton (kg/MT)

The exhaust emission factor $E_{ij}$ for $CO_2$ is computed from the EMFAC2007 BURDEN output by dividing the total emissions for a given GHG *i* and vehicle type *j* by the mileage accumulation for that vehicle type in the EMFAC2007 run. For the PSPP, EMFAC2007 was run to generate statewide emissions and activity data for 2010. The EMFAC2007 Model calculates total daily emissions of $CO_2$, $N_2O$, and $CH_4$ by vehicle type (light-duty truck, heavy-heavy duty diesel vehicle, etc.) and type of fuel (diesel, gasoline, etc.) in a geographic area, such as the Mojave Desert Air Quality Management District jurisdiction. For $N_2O$ and $CH_4$, the exhaust emission factors come from the CCAR General Reporting Protocol Table C.6 (CCAR, 2009). As stated above, these $N_2O$ and $CH_4$ emission factors are identical to those required by ARB under the AB-32 mandatory GHG reporting.

The total GHG emissions are the summation over all of the operating vehicle types with application of the appropriate GWP for each GHG. The GWP used for this analysis are those required by the ARB mandatory reporting rule and are equal to 1 for $CO_2$, 21 for $CH_4$, and 310 for $N_2O$.

The 2009 OFFROAD2007 BURDEN GHG emission estimates, accumulated mileage, the computed emission factors, and the projected operating miles for vehicles anticipated to be used during construction of the PSPP are in Table 2 at the end of this document.

Emissions were calculated from estimates of 1) the types, number, horsepower rating and daily operating hours for construction equipment; and 2) the types, number and daily miles traveled by onsite and offsite motor vehicles. These estimates were made by construction month for construction of the solar facility. The monthly emissions are based on 22 working days per month, consistent with the emission calculations for the criteria pollutants emitted during construction activities. The monthly emissions for equipment and vehicles for each GHG were summed to produce monthly and project total $CO_2e$ emissions estimates.

Detailed GHG construction emission calculations are provided in the spreadsheet with filename DR-AIR-8 and 18 Palen Construction Emission on the CD-ROM in Attachment DR2, Emission Calculations.

# 3.0 GHG Emission Calculation Results and Context

Global warming is a global issue, not a local issue, and there is no significance criterion yet established by the CEC for $CO_2e$ emissions. Lacking a significance criterion for construction emissions, a more robust evaluation of the potential impact of construction $CO_2e$ emissions for a solar power plant is to compute the emissions for construction and operation over the lifetime of the facility and compare those total emissions to the emissions that would be emitted from an alternative source of electrical power generation. An appropriate alternative to consider for comparison would be a modern combustion turbine combined cycle (CTCC) natural gas fired power plant.

To this end, the emissions from construction and operation of a CTCC facility based on a 30-year lifetime were estimated from information provided in the Application for Certification (AFC) for a current CTCC power plant seeking licensing approval before the CEC. The facility chosen is the Oakley Generating Station (Docket 09-AFC-04, previously named the Contra Costa Generating Station) (CEC, 2009), a nominal 624 MW greenfield facility. For this 2x1 facility (two combustion turbines with one steam turbine), the reported $CO_2e$ emissions from the 33 month construction period is 10,524 metric tons (MT).

The appropriate operational $CO_2$ emission factor to apply to a modern CTCC facility is the California Public Utility Commission limit on new power plant, i.e., $CO_2$ emissions of 1,100 pounds-per-megawatt-hour of electrical generation. The AFC for the Oakley Generating Station provides an equivalent availability factor for the facility of 92 percent to 98 percent, with an average of 95 percent. The equivalent availability factor takes into account both the hours of operation and the operating load for the facility.

Table 4 presents the estimated GHG emissions ($CO_2e$) from construction and operation over a 30-year lifetime for the PSPP and an equivalent CTCC plant providing the same nominal generating capacity (500 MW). From Table 4, the construction emissions for the PSPP are 68,300 MT, including emissions from on-site and off-site construction activities, compared to the construction emissions for the Oakley Generating Station of 10,500 MT. Both quantities are rounded to the nearest 100 MT. Please note that no adjustment was made to the construction emission estimate for Oakley to adjust for the size of the facility compared to that for the PSPP. There are larger GHG emissions associated with the solar plant construction due to a much larger area requiring scraping and grading, cut and fill, solar mirror assembly and installation, etc., during construction of the facility. However, the operational GHG emissions from a CTCC plant dwarf the operational GHG emissions from a solar plant. Overall, the lifetime emission burden for the solar facility is 0.6 percent of the lifetime emission burden of the equivalent CTCC power plant.

# 4.0 References

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# TABLES

**Table 1. Construction Equipment GHG Emission Factors**

| Equipment Description | | | | | OFFROAD Emissions (tons/day) | | | OFFROAD Activity (hrs/day) | Computed OFFROAD Emission Factor (kg/hr) | | | Composite Emissions Factor (CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Fuel | Size (hp) | Model Year | ARB Off-Road Model Category | CO2 | N2O | CH4 | Activity (hrs) | CO2 | N2O | CH4 | CO2e (kg/hr)[a] |
| 375 cfm Compressor | Diesel | 20 | 2008 | Air Compressors | 9.56E-02 | 0.00E+00 | 1.04E-05 | 13 | 6.54E+00 | 0.00E+00 | 7.12E-04 | 6.55E+00 |
| Air Compressor Ingersol Rand, P65WK | Diesel | 23.5 | 2008 | Air Compressors | 9.56E-02 | 0.00E+00 | 1.04E-05 | 13 | 6.54E+00 | 0.00E+00 | 7.12E-04 | 6.55E+00 |
| Backhoe, 450E | Diesel | 124 | 2007 | Tractors/Loaders/Backhoes | 2.29E+01 | 0.00E+00 | 1.08E-03 | 452 | 4.59E+01 | 0.00E+00 | 2.17E-03 | 4.60E+01 |
| Concrete Pump Rig, B50 | Diesel | 130 | 2007 | Other Construction Equipment | 2.00E+00 | 0.00E+00 | 7.35E-05 | 38 | 4.83E+01 | 0.00E+00 | 1.78E-03 | 4.84E+01 |
| Crane 20 Tn Grove, YB7722 | Diesel | 130 | 2007 | Cranes | 3.91E+00 | 0.00E+00 | 1.82E-04 | 98 | 3.64E+01 | 0.00E+00 | 1.70E-03 | 3.64E+01 |
| Dozer,Cat, D10T | Diesel | 580 | 2006 | Crawler Tractors | 3.59E+00 | 0.00E+00 | 2.05E-04 | 15 | 2.11E+02 | 0.00E+00 | 1.20E-02 | 2.11E+02 |
| Excavator, 365C | Diesel | 404 | 2006 | Excavators | 8.81E+01 | 0.00E+00 | 5.69E-03 | 754 | 1.06E+02 | 0.00E+00 | 6.85E-03 | 1.06E+02 |
| Folklift, DP45K | Diesel | 124 | 2007 | Forklifts | 1.47E+01 | 0.00E+00 | 7.85E-04 | 524 | 2.54E+01 | 0.00E+00 | 1.36E-03 | 2.54E+01 |
| Generator, XQ400 | Diesel | 328 | 2006 | Generator Sets | 5.00E+00 | 0.00E+00 | 1.36E-04 | 30 | 1.53E+02 | 0.00E+00 | 4.15E-03 | 1.53E+02 |
| Grade-All, TL1055 | Diesel | 125 | 2007 | Rough Terrain Forklifts | 1.19E+01 | 0.00E+00 | 5.22E-04 | 190 | 5.66E+01 | 0.00E+00 | 2.50E-03 | 5.67E+01 |
| Loader, 972H | Diesel | 287 | 2006 | Rubber Tired Loaders | 4.26E+01 | 0.00E+00 | 2.20E-03 | 360 | 1.07E+02 | 0.00E+00 | 5.55E-03 | 1.08E+02 |
| Motor Grader, 160M | Diesel | 213 | 2006 | Graders | 3.47E+01 | 0.00E+00 | 1.93E-03 | 403 | 7.80E+01 | 0.00E+00 | 4.34E-03 | 7.81E+01 |
| Paving Machine, AP1055D | Diesel | 224 | 2006 | Pavers | 1.08E+00 | 0.00E+00 | 5.15E-05 | 11 | 8.83E+01 | 0.00E+00 | 4.20E-03 | 8.84E+01 |
| Roller, CB-534D | Diesel | 130 | 2007 | Rollers | 1.33E+01 | 0.00E+00 | 4.70E-04 | 247 | 4.90E+01 | 0.00E+00 | 1.73E-03 | 4.90E+01 |
| Scraper Cat, 657G | Diesel | 564 | 2006 | Scrapers | 8.76E+00 | 0.00E+00 | 4.81E-04 | 32 | 2.51E+02 | 0.00E+00 | 1.38E-02 | 2.52E+02 |
| Scraper Cat, 657G, Blade Engine | Diesel | 410 | 2006 | Other Construction Equipment | 1.03E+01 | 0.00E+00 | 4.21E-04 | 81 | 1.15E+02 | 0.00E+00 | 4.69E-03 | 1.15E+02 |
| Sheeps Foot, 825G | Diesel | 315 | 2006 | Rollers | 2.54E+00 | 0.00E+00 | 9.95E-05 | 23 | 9.93E+01 | 0.00E+00 | 3.89E-03 | 9.94E+01 |
| Vibratory Roller, 825H | Diesel | 354 | 2006 | Rollers | 2.54E+00 | 0.00E+00 | 9.95E-05 | 23 | 9.93E+01 | 0.00E+00 | 3.89E-03 | 9.94E+01 |
| Scraper Cat 623 | Diesel | 330 | 2006 | Scrapers | 3.09E+01 | 0.00E+00 | 1.70E-03 | 193 | 1.46E+02 | 0.00E+00 | 8.00E-03 | 1.46E+02 |
| Asphalt Paver, Cat AP1055B | Diesel | 174 | 2007 | Pavers | 6.20E+00 | 0.00E+00 | 2.47E-04 | 97 | 5.81E+01 | 0.00E+00 | 2.32E-03 | 5.82E+01 |
| Backhoe, Cat, 430E | Diesel | 97 | 2008 | Tractors/Loaders/Backhoes | 1.70E+02 | 0.00E+00 | 6.91E-03 | 6575 | 2.34E+01 | 0.00E+00 | 9.54E-04 | 2.35E+01 |
| 175-250 kW Gen Set | Diesel | 400 | 2006 | Generator Sets | 5.00E+00 | 0.00E+00 | 1.36E-04 | 30 | 1.53E+02 | 0.00E+00 | 4.15E-03 | 1.53E+02 |
| Light Tower 5 KW | Diesel | 8 | 2008 | Generator Sets | 1.38E+00 | 0.00E+00 | 1.29E-04 | 271 | 4.63E+00 | 0.00E+00 | 4.33E-04 | 4.63E+00 |
| 600 A Temp Power | Diesel | 400 | 2006 | Generator Sets | 5.00E+00 | 0.00E+00 | 1.36E-04 | 30 | 1.53E+02 | 0.00E+00 | 4.15E-03 | 1.53E+02 |
| 200 A Temp Power | Diesel | 135 | 2007 | Generator Sets | 1.58E+00 | 0.00E+00 | 4.03E-05 | 22 | 6.45E+01 | 0.00E+00 | 1.65E-03 | 6.45E+01 |
| Compactor, Cat 826H | Diesel | 410 | 2006 | Rollers | 2.54E+00 | 0.00E+00 | 9.95E-05 | 23 | 9.93E+01 | 0.00E+00 | 3.89E-03 | 9.94E+01 |
| 185 cfm Compressor | Diesel | 20 | 2008 | Air Compressors | 9.56E-02 | 0.00E+00 | 1.04E-05 | 13 | 6.54E+00 | 0.00E+00 | 7.12E-04 | 6.55E+00 |
| 999 Manitiwoc | Diesel | 390 | 2006 | Cranes | 5.91E+00 | 0.00E+00 | 3.14E-04 | 66 | 8.16E+01 | 0.00E+00 | 4.34E-03 | 8.17E+01 |
| 2250 Manitiwoc 300 Ton-Upper engine | Diesel | 450 | 2006 | Cranes | 5.91E+00 | 0.00E+00 | 3.14E-04 | 66 | 8.16E+01 | 0.00E+00 | 4.34E-03 | 8.17E+01 |
| 2250 Manitiwoc 300 Ton -carrier engine | Diesel | 460 | 2006 | Cranes | 5.91E+00 | 0.00E+00 | 3.14E-04 | 66 | 8.16E+01 | 0.00E+00 | 4.34E-03 | 8.17E+01 |
| Crane, 40-Ton, Grove, RT600 | Diesel | 173 | 2007 | Cranes | 3.91E+00 | 0.00E+00 | 1.82E-04 | 98 | 3.64E+01 | 0.00E+00 | 1.70E-03 | 3.64E+01 |
| Dozer, Cat D-9 | Diesel | 410 | 2006 | Crawler Tractors | 3.96E+01 | 0.00E+00 | 2.26E-03 | 306 | 1.17E+02 | 0.00E+00 | 6.72E-03 | 1.18E+02 |
| Dozer, Cat D-6 | Diesel | 150 | 2007 | Crawler Tractors | 3.32E+01 | 0.00E+00 | 1.66E-03 | 548 | 5.49E+01 | 0.00E+00 | 2.75E-03 | 5.50E+01 |
| Dozer, Cat 824 | Diesel | 354 | 2006 | Rubber Tired Dozers | 1.23E+01 | 0.00E+00 | 8.75E-04 | 93 | 1.20E+02 | 0.00E+00 | 8.51E-03 | 1.20E+02 |
| Loader, Cat, 972G | Diesel | 275 | 2006 | Rubber Tired Loaders | 4.26E+01 | 0.00E+00 | 2.20E-03 | 360 | 1.07E+02 | 0.00E+00 | 5.55E-03 | 1.08E+02 |
| Motor Grader, Cat 140H | Diesel | 150 | 2007 | Graders | 4.27E+01 | 0.00E+00 | 2.00E-03 | 690 | 5.62E+01 | 0.00E+00 | 2.63E-03 | 5.62E+01 |
| Diesel Welder 400 Amp | Diesel | 31 | 2008 | Welders | 6.15E+00 | 0.00E+00 | 2.08E-04 | 475 | 1.18E+01 | 0.00E+00 | 3.98E-04 | 1.18E+01 |
| Hydro Crane 70-75 Ton RT | Diesel | 275 | 2006 | Cranes | 5.91E+00 | 0.00E+00 | 3.14E-04 | 66 | 8.16E+01 | 0.00E+00 | 4.34E-03 | 8.17E+01 |
| Hydro Crane 30-35 Ton RT | Diesel | 155 | 2007 | Cranes | 3.91E+00 | 0.00E+00 | 1.82E-04 | 98 | 3.64E+01 | 0.00E+00 | 1.70E-03 | 3.64E+01 |
| Tower Crane (Lieberr 630) | Diesel | 275 | 2006 | Cranes | 5.91E+00 | 0.00E+00 | 3.14E-04 | 66 | 8.16E+01 | 0.00E+00 | 4.34E-03 | 8.17E+01 |
| Forklift 10000# RT | Diesel | 100 | 2007 | Forklifts | 8.14E+00 | 0.00E+00 | 5.99E-04 | 522 | 1.42E+01 | 0.00E+00 | 1.04E-03 | 1.42E+01 |
| Forklift 30000# | Diesel | 130 | 2007 | Forklifts | 1.47E+01 | 0.00E+00 | 7.85E-04 | 524 | 2.54E+01 | 0.00E+00 | 1.36E-03 | 2.54E+01 |
| CAT IT 28 Utility Loader | Diesel | 50 | 2008 | Rubber Tired Loaders | 1.00E+00 | 0.00E+00 | 5.16E-05 | 65 | 1.41E+01 | 0.00E+00 | 7.26E-04 | 1.41E+01 |
| Truck Crane | Diesel | 130 | 2007 | Cranes | 3.91E+00 | 0.00E+00 | 1.82E-04 | 98 | 3.64E+01 | 0.00E+00 | 1.70E-03 | 3.64E+01 |
| 40'- 60' Manlift | Diesel | 50 | 2008 | Aerial Lifts | 1.44E+00 | 0.00E+00 | 4.01E-05 | 147 | 8.89E+00 | 0.00E+00 | 2.48E-04 | 8.89E+00 |
| 90' Manlift | Diesel | 70 | 2008 | Aerial Lifts | 2.47E+00 | 0.00E+00 | 6.08E-05 | 130 | 1.73E+01 | 0.00E+00 | 4.24E-04 | 1.73E+01 |
| Scissor Lift | Diesel | 50 | 2008 | Aerial Lifts | 1.44E+00 | 0.00E+00 | 4.01E-05 | 147 | 8.89E+00 | 0.00E+00 | 2.48E-04 | 8.89E+00 |

Global warming potentials: CO2 = 1.0, CH4 = 21, N2O = 310

**Table 2. Vehicle GHG Emission Factors**

| Vehicle Description | | EMFAC BURDEN Emissions (tons/day) | EMFAC BURDEN Activity (1000 mi /day) | Computed OFFROAD Emission Factor (kg/mi) | N2O Emission Factor (kg/mi) | CH4 Emission Factor (kg/mi) | Composite Emissions Factor (CO2e) |
|---|---|---|---|---|---|---|---|
| Equipment Type | Vehicle Class | CO2 | Activity | CO2 | N2O | CH4 | CO2e (kg/hr)[a] |
| On-Site Welding Truck | MHD-CAT | 8.05E+01 | 108 | 6.76E-01 | 1.77E-05 | 3.26E-05 | 6.82E-01 |
| On-Site Oil/Lube Truck International | LHD2-DSL | 1.08E+02 | 185 | 5.29E-01 | 4.80E-06 | 5.10E-06 | 5.31E-01 |
| On-Site Fuel Truck | MHD-DSL | 9.60E+02 | 576 | 1.51E+00 | 4.80E-06 | 5.10E-06 | 1.51E+00 |
| On-Site Flatbed Truck, 1 Ton | MHD-CAT | 8.05E+01 | 108 | 6.76E-01 | 1.77E-05 | 3.26E-05 | 6.82E-01 |
| On-Site Flatbed Truck | MHD-DSL | 9.60E+02 | 576 | 1.51E+00 | 4.80E-06 | 5.10E-06 | 1.51E+00 |
| On-Site Pick Up Truck | LDT1-CAT | 3.19E+03 | 5893 | 4.92E-01 | 1.01E-05 | 1.57E-05 | 4.95E-01 |
| On-Site Stake Truck | LDT2-CAT | 7.26E+03 | 13429 | 4.90E-01 | 1.01E-05 | 1.57E-05 | 4.94E-01 |
| On-Site Utility Truck | LHD2-DSL | 1.08E+02 | 185 | 5.29E-01 | 4.80E-06 | 5.10E-06 | 5.31E-01 |
| On-Site Concrete Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| On-Site Concrete Trucks BOP | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| On-Site Watering Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| On-Site Watering Truck BOP | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| On-Site Dump Truck | MHD-DSL | 9.60E+02 | 576 | 1.51E+00 | 4.80E-06 | 5.10E-06 | 1.51E+00 |
| On-Site Pick Up Truck 1/2 Ton | LDT2-CAT | 7.26E+03 | 13429 | 4.90E-01 | 1.01E-05 | 1.57E-05 | 4.94E-01 |
| On-Site Pick Up Truck 3/4 Ton | LDT2-CAT | 7.26E+03 | 13429 | 4.90E-01 | 1.01E-05 | 1.57E-05 | 4.94E-01 |
| On-Site Transportation Tractor | LDT2-DSL | 7.98E+00 | 21 | 3.45E-01 | 1.50E-06 | 1.00E-06 | 3.45E-01 |
| On-Site Small Tow Tractors | LDT1-DSL | 1.14E+02 | 298 | 3.46E-01 | 1.50E-06 | 1.00E-06 | 3.46E-01 |
| On-Site Special Trucks | LDT2-CAT | 7.26E+03 | 13429 | 4.90E-01 | 1.01E-05 | 1.57E-05 | 4.94E-01 |
| On-Site Gators | LDT1-CAT | 3.19E+03 | 5893 | 4.92E-01 | 1.01E-05 | 1.57E-05 | 4.95E-01 |
| Off-Site Flat Bed Trucks | MHD-DSL | 9.60E+02 | 576 | 1.51E+00 | 4.80E-06 | 5.10E-06 | 1.51E+00 |
| Off-Site Asphalt Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Cement Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Construction Worker Commute | LDA-CAT | 1.22E+04 | 28099 | 3.93E-01 | 7.90E-06 | 1.47E-05 | 3.96E-01 |
| Off-Site Dump Trucks | MHD-DSL | 9.60E+02 | 576 | 1.51E+00 | 4.80E-06 | 5.10E-06 | 1.51E+00 |
| Off-Site Equipment/Material Delivery Tru | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Low Boy Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Pickup Trucks | LDT1-CAT | 3.19E+03 | 5893 | 4.92E-01 | 1.01E-05 | 1.57E-05 | 4.95E-01 |
| Off-Site Pipe Hauling Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Fuel Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Watering Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |
| Off-Site Concrete Trucks | HHD-DSL | 7.15E+03 | 3473 | 1.87E+00 | 4.80E-06 | 5.10E-06 | 1.87E+00 |

**On-Road Vehicle CH4 and N2O Emission Factors**

| | EF (g/mi) | | |
|---|---|---|---|
| Vehicle Class | N2O | CH4 | Table Entry |
| LDA-NCAT | 0.0647 | 0.0704 | Gasoline Passenger Cars, Model Years 1984-1993 |
| LDA-CAT | 0.0079 | 0.0147 | Gasoline Passenger Cars, Model Year 2005 |
| LDA-DSL | 0.0010 | 0.0005 | Diesel Passenger Cars, Model Years 1983-2004 |
| LDT1-NCAT | 0.1035 | 0.0813 | Gasoline Light Trucks, Model Years 1987-1993 |
| LDT1-CAT | 0.0101 | 0.0157 | Gasoline Light Trucks, Model Year 2005 |
| LDT1-DSL | 0.0015 | 0.0010 | Light Duty Diesel Trucks, Model Years 1996-2004 |
| LDT2-NCAT | 0.1035 | 0.0813 | Gasoline Light Trucks, Model Years 1987-1993 |
| LDT2-CAT | 0.0101 | 0.0157 | Gasoline Light Trucks, Model Year 2005 |
| LDT2-DSL | 0.0015 | 0.0010 | Light Duty Diesel Trucks, Model Years 1996-2004 |
| MDV-NCAT | 0.1035 | 0.0813 | Gasoline Light Trucks, Model Years 1987-1993 |
| MDV-CAT | 0.0101 | 0.0157 | Gasoline Light Trucks, Model Year 2005 |
| MDV-DSL | 0.0015 | 0.0010 | Light Duty Diesel Trucks, Model Years 1996-2004 |
| LHD1-NCAT | 0.0515 | 0.4090 | Gasoline Heavy Duty Vehicles, Model Years 1985-1996 |
| LHD1-CAT | 0.0177 | 0.0326 | Gasoline Heavy Duty Vehicles, Model Year 2005 |
| LHD1-DSL | 0.0048 | 0.0051 | Diesel Heavy Duty Vehicles, All Model Years |
| LHD2-NCAT | 0.0515 | 0.4090 | Gasoline Heavy Duty Vehicles, Model Years 1985-1996 |
| LHD2-CAT | 0.0177 | 0.0326 | Gasoline Heavy Duty Vehicles, Model Year 2005 |
| LHD2-DSL | 0.0048 | 0.0051 | Diesel Heavy Duty Vehicles, All Model Years |
| MHD-NCAT | 0.0515 | 0.4090 | Gasoline Heavy Duty Vehicles, Model Years 1985-1996 |
| MHD-CAT | 0.0177 | 0.0326 | Gasoline Heavy Duty Vehicles, Model Year 2005 |
| MHD-DSL | 0.0048 | 0.0051 | Diesel Heavy Duty Vehicles, All Model Years |
| HHD-NCAT | 0.0515 | 0.4090 | Gasoline Heavy Duty Vehicles, Model Years 1985-1996 |
| HHD-CAT | 0.0177 | 0.0326 | Gasoline Heavy Duty Vehicles, Model Year 2005 |
| HHD-DSL | 0.0048 | 0.0051 | Diesel Heavy Duty Vehicles, All Model Years |

Source: Table 13.4, The Climate Registry, General Reporting Protocol, Ver 1.0.

**Table 3. PSPP and Equivalent CTCC Power Plant Construction and Operation GHG Emissions Over a Projected 30-Year Operational Lifetime**

| Project | Nominal Size (MW) | Construction Period (months) | Construction GHG Emissions (MT CO2e) | Annual Operational GHG Emissions (MT CO2e / year) | 30-Year Facility Lifetime GHG Emission Burden (MT CO2e) | PSPP Emissions as Percent of CTCC Plant (%) |
|---|---|---|---|---|---|---|
| PSPP | 1,000 | 39 | 68,300 | 9,700 | 359,300 | 0.6% |
| Generic CTCC | 1,000 | 33 | 10,500 | 2,076,200 | 62,296,500 | |

All GHG emissions rounded to the nearest 100 MT. PSPP emissions include emissions from on-site and off-site construction activities. Generic CTCC operational emissions based on CPUC limit of 1,100 lbs $CO_2$/MWh, yearly operation of 8760 hours, and an equivalent availability factor of 95%. The construction emission estimates are representative of those for the Oakley Generating Station (09-AFC-04), a nominal 624 MW CTCC facility. The Generic CTCC facility emission estimate is underestimated because it does not include $CH_4$ or $N_2O$ emissions from facility operation.

# Attachment DR-AIR-29

# SCAQMD Correspondence

**From:** Hamel, Richard
**Sent:** Monday, December 28, 2009 3:54 PM
**To:** 'Jillian Baker'
**Subject:** Palen Solar Power Project

Jillian,

I am writing you with respect to meteorological data use for our AERMOD modeling analysis for the Palen Solar Power Project, located east of Desert Center, CA. In the early stages of the project (around July or August), my colleague Matthew Stresing had a telephone conversation with you asking whether it would be acceptable to use Blythe Airport as the surface station, because of its proximity and similarity to the project site. The nearest site for which SCAQMD has processed met data is Indio, which is not only about twice as far as Blythe Airport from the project, but also lies within a valley and would not be representative of the Palen site. Your response at the time was that it would be acceptable to use Blythe Airport as long as we properly justified its used in the modeling report submitted as part of the AFC for the project.

Could you please confirm the above to be correct? Please do not hesitate to contact me at the phone number below if you have any questions or concerns.

Thank you for your time and Happy Holidays.

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