Appendix D

Air Quality Analyses

APPENDIX D-1

OVERVIEW OF THE CONSTRUCTION EMISSIONS SPREADSHEET MODEL

OVERVIEW OF THE CNSTEMIS MODEL

Emissions from construction and demolition activities have been estimated using a detailed spreadsheet model (CNSTEMIS). The CNSTEMIS spreadsheet model calculates criteria pollutant emissions, diesel particulate emissions, and greenhouse gas emissions from construction or demolition activities and equipment. Criteria pollutant emission estimates are provided for reactive organic compounds, nitrogen oxides, carbon monoxide, sulfur oxides, inhalable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). Particulate matter emissions from diesel engines contain known and suspected carcinogens, and consequently have been designated as a toxic air contaminant by the California Air Resources Board. Exhaust emissions of PM_{10} from construction and demolition equipment provide the estimate of diesel particulate matter emissions. Greenhouse gas emission estimates are provided for carbon dioxide, methane, and nitrous oxide. The overall global warming potential of greenhouse gas emissions also is calculated in terms of carbon dioxide equivalents.

The CNSTEMIS spreadsheet model uses a conventional approach to estimating emissions from construction equipment and activity. In a normal application, users:

- Divide the construction or demolition project into activity phases that have similar equipment requirements;
- Identify equipment types needed for each construction or demolition phase;
- Identify how many items of each type will be needed, the typical horsepower rating for the item, and the typical engine load factor;
- Identify the hours per day with active use for each equipment item;
- Identify the fraction of each use hour when the equipment will actually be operating;
- Identify the overall disturbed area size for each phase of construction or demolition activity;
- Identify the duration of each construction or demolition phase;
- Identify the typical area size that will be disturbed on a given day during each phase of construction or demolition activity;
- Identify typical fugitive dust emission rates for each phase of construction or demolition activity; and
- Identify which construction or demolition phases overlap with each other.

Version 11J of the CNSTEMIS model includes a database of 514 entries covering 114 basic equipment types. Entries for each equipment type are subdivided into engine size and fuel type categories that correlate with emission standards that have been adopted in recent years by the US Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). In addition to equipment powered by conventional diesel, gasoline, and compressed gas (propane/CNG/LNG/LPG) engines, the database includes information for electric arc welders, oxy-fuel welders, oxy-fuel cutting torches, plasma cutting torches, stationary diesel engines, large equipment powered by diesel-electric or turbine engines, and stationary gas turbine generators. Database entries also address multi-engine equipment designs for scrapers, concrete pavers, concrete finisher-vibrators, and off-road haul trucks. Metal fume emissions have been incorporated into the PM_{10} emission rates for welders and cutting torches. Fugitive PM_{10} emissions have been incorporated into the emission rates for rock drills, jackhammers, pavement breakers, pavement scarifiers, concrete/industrial saws, and abrasive blasting equipment. Default database entries are provided for the appropriate range of small, medium, and large engine sizes for each equipment type. The current database provides default data for 514 combinations of equipment type, engine size range, and fuel type. Default engine sizes are representative of current equipment models from several major manufacturers (Caterpillar, Komatsu, Terex, John Deer, Case, Bobcat, Gradall, GOMACO, LeeBoy, TSE, Vermeer, APE, Hercules, and others) as well as older equipment models that are still in use.

Greenhouse gas emission rates used in the CNSTEMIS model are based on Appendix C of the California Climate Action Registry (CCAR) 2007 general greenhouse gas emissions reporting protocol. Most of the greenhouse gas emission rates in the CCAR protocol document are based on equipment or vehicle fuel consumption rates. Equipment fuel consumption estimates used in the CNSTEMIS model are derived from horsepower-hour based fuel use data presented in documentation reports for the 2005 version of the EPA NONROAD model. The CNSTEMIS model computes the overall global warming potential of carbon dioxide, methane, and nitrous oxide emissions using carbon dioxide equivalence factors identified by the Intergovernmental Panel on Climate Change (IPCC). Users can select from the 1995, 2001, or 2007 IPCC equivalence factor data sets. The 2007 data set is the default selection.

The main calculation sheet of the CNSTEMIS model allows construction or demolition projects to be divided into four activity phases. Multiple CNSTEMIS workbooks can be used for projects involving more than four activity phases. Separate CNSTEMIS workbooks by calendar year are encouraged when construction or demolition activity will occur in more than one calendar year. The main calculation sheet provides for simple data entry by the user: lookup table codes for equipment types by engine size range and fuel type; number of items of each type by construction activity phase; and active hours per day for each equipment type by construction activity phase. Default equipment parameters (engine horsepower, average load factor, and typical use time within active hours) are automatically loaded into the calculation sheet. User can modify default equipment parameters under each activity phase. An optional calculation section is provided for computing cut and fill balances and associated bulldozer and scraper requirements if that information is not available from other sources.

CNSTEMIS users can select from three primary emission rate datasets: emission rates based on the original 1991 EPA non-road equipment database (useful only for estimates of emission rates in the absence of emission standards); emission rates adjusted for California and EPA emission standards and fuel sulfur limits (for projects in California); or emission rates adjusted for EPA emission standards and fuel sulfur limits (for projects in states other than California). When the user specifies the construction activity year, the equipment database sheet calculates appropriate average emission rates for the mix of older and newer equipment models of each equipment entry, recognizing the fleet replacement period for each equipment type and the implementation years for relevant California or EPA emission standards and fuel sulfur limits. Equipment entries are assigned fleet replacement times of 10, 15, 20, 25, or 30 years. Users can modify the fleet replacement times in the database if desired.

In addition to equipment engine emissions, CNSTEMIS calculates emissions from several other construction-related sources:

- fugitive dust emissions from general construction and demolition site disturbance;
- fugitive dust from mechanical or explosive building demolition;
- fugitive dust from construction blasting;
- volatile organic compound emissions from the curing of asphalt pavement;
- volatile organic compound emissions from paints and surface coatings; and
- PM_{10} aerosol emissions from spray painting activities.

In addition to accounting for active dust control program effects, version 11J of the CNSTEMIS model allows emission calculations for fugitive dust from site disturbance to account for the seasonal frequency of precipitation events, frozen ground conditions, and snow cover. Fugitive dust emission estimates also can be adjusted to reflect the seasonal effects of persistently high soil moisture conditions from shallow perched water tables, seeps, or other natural factors. Natural dust control factors are applied to the residual fugitive dust generated after accounting for active dust control program effects.

The fugitive dust database sheet in the model provides a range of default fugitive dust generation rates for construction activity and building demolition, information on the PM_{10} and $PM_{2.5}$ content of soils according to soil texture class, information on water application rates for fugitive dust control, a calculator to estimate the required number of water trucks, and a calculator to estimate fugitive PM_{10} and $PM_{2.5}$ emissions from construction blasting. The fugitive volatile organic compound (VOC) database sheet includes a database of 49 categories of paints and coatings; a database of federal, state, and California air pollution control district limits for the VOC content of architectural coatings; and a calculator to generate project-specific fugitive VOC emission rates for up to four categories of coatings (e.g., exterior paints, interior paints, roof coatings, and floor coatings). The VOC emission rates account for the number and thickness of applied paint coats, which can include up to three coating types (for example, primers, main coats, and top coats) in each coating category. Internal calculations convert the coating thickness to a coating coverage value (square feet per gallon), which can be compared to a table of default coverage values for various types of coatings.

A building construction data worksheet allows users to calculate the square footage of exterior and interior wall areas, floor areas, ceiling areas, and roof areas for each building or group of buildings in a project. Building component square footage values account for building footprint area, building height, number of stories, and building shape (length to width ratio). Building component square footage data is useful for estimating the quantity of paint or architectural coatings required for individual buildings in a project. The building construction data worksheet also provides a convenient location to compute the acreage of project-related roadways, parking lots, or other features, or to develop a time schedule of project phases. The demolition debris sheet in CNSTEMIS allows users to estimate demolition debris volumes, tonnages, and debris haul truck loads when independent estimates are not available. Additional database sheets in the model provide information on typical material densities and typical heavy equipment work rates. A detailed unit conversion factor database sheet and a particle size unit conversion sheet also are included in the model.

The summary sheet in the CNSTEMIS model provides a comprehensive data summary for each phase of construction activity: disturbed acreages; total equipment item numbers; total equipment use hours; total equipment fuel use; off-site truck trips; construction worker commute trips; assumptions used for fugitive emissions calculations; and annual, quarterly, and daily summaries of criteria pollutant emissions, diesel particulate matter emissions, and greenhouse gas emissions. The summary sheet also provides a detailed tabulation of equipment items by activity phase, including the assumed horsepower, load factor, operating time factor, number of items, active hours per day, hourly fuel use rate, criteria pollutant emission rates, and greenhouse gas pollutant emission rates for each item type. A construction phase overlap calculator in the summary sheet identifies the extent of overlap among work phases by calendar quarter, allowing calculation of maximum day and maximum calendar quarter emissions. The construction phase overlap calculator allows the user to specify the number of work days by calendar quarter (with allowances for major holidays; the average default values are 64 days for a 5-day work week schedule, 77 days for a 6-day work week schedule, and 89 days for a 7-day work week schedule.

The $PM_{2.5}$ emission estimates provided by the CNSTEMIS model are extrapolated from the PM_{10} emission estimates using separate $PM_{2.5}$ fractions for engine exhaust, fugitive dust, and spray painting, with the option of setting $PM_{2.5}$ fractions separately for each of these categories by construction phase. Default $PM_{2.5}$ fractions for engine exhaust and spray painting are based on the California Air Resources Board CEIDARS (California Emission Inventory Data and Reporting System) database. The default fugitive dust $PM_{2.5}$ fraction can be based on soil texture class using the fugitive dust database sheet in the model, or a more generic fraction from the CEIDARS database can be used. Users can substitute alternative $PM_{2.5}$ fractions for any of the default values.

A data entry notes sheet in the CNSTEMIS workbook provides users with detailed instructions and cell-by-cell discussions of data entry areas in the key worksheets of the model. Supplemental instructions and notes are provided in the individual worksheets throughout the workbook.

COMPARISON OF CNSTEMIS AND THE URBEMIS CONSTRUCTION MODULE

The CNSTEMIS model had its origins as a simple Lotus 1-2-3 spreadsheet model developed in the mid 1980s using emission rate data from AP-42 (EPA 1985a, 1985b). Data from the EPA Nonroad Engine and Vehicle Emissions Study (EPA 1991) was incorporated into the spreadsheet in the early 1990s, and the model was subsequently converted to an Excel spreadsheet format. Early versions of the CNSTEMIS model were developed before construction and demolition emissions were included in the URBEMIS model, which was originally developed to estimate emissions from highway traffic associated with the operational phase of urban development projects. Modules addressing construction activities and various other emission sources are more recent additions to URBEMIS.

The CNSTEMIS model and the URBEMIS model are designed for different user audiences. The CNSTEMIS model has been developed to provide flexible calculation of project-specific emissions from any type of construction or demolition activity, with applicability to any US location, not just California. All features of the CNSTEMIS model can be modified by the user if necessary. In contrast, the URBEMIS model is designed for users with limited air quality analysis experience. Consequently, the construction module of URBEMIS model is designed to use simple default values, and is structured to evaluate common residential, commercial, office, and industrial development projects. While recent versions have improved flexibility for use by those with more extensive air quality analysis experience, the design of the URBEMIS model has never emphasized flexibility for detailed project-specific analyses of complex or unusual projects. The equipment database in URBEMIS is much smaller than that in CNSTEMIS, and is limited to diesel engine equipment. The construction equipment database in URBEMIS limits the potential for comprehensive analyses. In addition, several components of the construction module in URBEMIS use fixed coding that prevents user substitution of project-specific data. Similarities and differences between version 11J of the CNSTEMIS model and the construction activity module in URBEMIS2007 are noted in the table below.

Summary Comparison of Construction Emissions Analyses in the CNSTEMIS Model and URBEMIS2007

Component	CNSTEMIS-11J	URBEMIS2007
Source of uncontrolled equipment emission rates.	EPA 1991 nonroad engine and vehicle emissions study	CARB database
Incorporates emission and fuel sulfur standards for California locations.	Yes	Yes
Incorporates EPA emission and fuel sulfur standards for non-California locations.	Yes	No
Size of equipment database (equipment types and fuel type/engine size entries).	114 equipment types, 514 total entries. Users select from the 514 individual entries.	36 equipment types, 212 total entries (hidden from users). Users select only from the 36

Component	CNSTEMIS-11J	URBEMIS2007
		equipment types.
Engine/Fuel types in database.	Diesel, 2-Stroke Gasoline, 4-Stroke Gasoline, Compressed Gas, Diesel-Electric, Turbine-Electric, Gas Turbine	Diesel only
Database includes multi-engine equipment types.	Yes (scrapers, concrete pavers, concrete finisher-vibrators, off-road haul trucks)	No
Database includes specialized road construction equipment types.	Yes (cold planers, soil stabilizers, asphalt road reclaimers, roadbed trimmers, placer/spreaders, asphalt pavers, concrete pavers, concrete texture/curing machines, pavement scarifiers)	No. Only generic database entries for pavers, paving equipment, and surfacing equipment with no explanation of differences among these equipment categories.
Database includes agricultural and forestry equipment sometimes needed for land clearing.	Yes	No
Database includes hand-operated equipment.	Yes, numerous equipment types	Limited; only a few types
Program allows user expansion of equipment database.	Yes	No. Three generic "other equipment" entries provided in the database. Users can change equipment entry names, but cannot add new entries, change program defaults, or change emission rate data.
Program provides default equipment types and number of items by construction phase.	No. Users select expected equipment by phase from the database, with number of items for each type entered separately.	Yes. Default equipment types provided according to pre-defined construction phases. Default lists tend to be short, but vary somewhat by project size. Number of items based on overall project acreage. Users can modify default equipment lists.
Program provides default engine horsepower.	Yes. Defaults by relative size category for each equipment type. Users select equipment entries from multiple HP ranges, most tagged with general descriptions of size	Yes. Program default is statewide average engine size for equipment type. Users can override with alternative HP value, but program does not provide additional information

Component	CNSTEMIS-11J	URBEMIS2007
	categories (mini, small, medium, large, giant, etc.).	on equipment type HP ranges.
Program provides default load factor.	Yes, based mostly on EPA data	Yes, based on CARB OFFROAD model
Users can modify default horsepower value and load factor.	Yes	Yes
Program provides default equipment use hours per day.	No. Users specify active hours per day for each equipment entry in each construction phase.	Yes, with minor variations by construction phase and total project acreage. Users can modify default values.
Explicit consideration of percent operating time during active hours.	Yes, with user-modifiable defaults provided for each database entry.	No. Program calculates emissions assuming 100% operation time in each active hour.
Equipment fleet replacement cycle periods.	User-modifiable defaults of 10, 15, 20, 25, or 30 years assigned in the equipment database.	Based on the CARB OFFROAD model, but not further identified in URBEMIS2007 documentation. Other sources indicate the CARB OFFROAD model uses 2 to 32 years for different equipment types. No user modification option.
Equipment replacement rates can vary within an equipment type according to engine size.	Yes. User-modifiable default values identified in the equipment database.	CARB OFFROAD model data, but not further identified in URBEMIS2007 documentation. Other sources indicate the CARB OFFROAD model varies replacement period for small engine sizes in some equipment types. No user modification option.
Fugitive PM_{10} emissions included for rock drills, jackhammers, pavement breakers, pavement scarifiers, concrete saws, and abrasive blasting equipment.	Yes	No. Database includes concrete saws but does not include rock drills, jackhammers, pavement breakers, pavement scarifiers, or abrasive blasting equipment.
Fugitive metal fume emissions included for cutting torches and welders.	Yes	No. Database includes electric welders but does not include cutting torches.

Component	CNSTEMIS-11J	URBEMIS2007
Fugitive NOx emissions included for plasma cutting torches.	Yes	No. Database does not include cutting torches.
Includes calculation of both PM_{10} and $PM_{2.5}$ emissions.	Yes	Yes
Includes calculation of diesel particulate matter emissions.	Yes (equipment exhaust PM_{10})	Yes (equipment exhaust PM_{10})
Direct calculation of greenhouse gas emissions.	CO_2, CH_4, and N_2O, with 9 fuel type distinctions (California diesel, non-California diesel, biodiesel, gasoline, dual fuel, propane, CNG, LNG, and LPG). Choice of IPCC data sets for calculating CO_2 equivalents.	CO_2 only, diesel fuel only
Time frames for emissions summaries	Daily, Calendar Quarter, and Annual	Daily and Annual only
Calendar Year limits.	None	2005 through 2040 only
Flexibility for defining work phases.	Complete flexibility, no pre-defined phases. Basic workbook accommodates 4 phases. Multiple workbooks can be used to accommodate more than 4 phases. Example building construction, building demolition, and road construction phases provided in user instructions.	Users must select from 7 pre-defined phase types (demolition, mass grading, fine grading, trenching, building construction, asphalt paving, and architectural coating). User can duplicate and rename pre-defined phase types to accommodate a larger number of phases as long as duplicated phases have different start or end dates.
Ease of defining work phases for highway, bridge, airport, pipeline, or other less common types of construction or demolition projects.	Complete flexibility to define phases according to project characteristics. Basic workbook accommodates 4 phases. Multiple workbooks can be used to accommodate more than 4 phases.	Somewhat cumbersome procedure. Requires users to select and re-name pre-defined construction phases, modify default equipment lists, and modify other phase-based default data such as truck activity.
Flexible treatment of work phase overlaps.	Yes. Users specify which if any phases overlap within each calendar quarter.	Yes. Users specify start and end dates for each phase. For phases with intermittent activity, users must duplicate the phase and enter start and end dates for each intermittent activity period.

Component	CNSTEMIS-11J	URBEMIS2007
Options for specifying work days per week.	Yes. Users specify available work days by calendar quarter, with defaults provided for 5-day, 6-day, and 7-day work weeks (with allowances for major holidays). Users are not limited to fixed work-week lengths.	Yes, with choice of 3-day, 4-day, 5-day, 6-day, or 7-day work weeks.
Fugitive dust emissions from site disturbance included in all construction phases.	Yes	No. Only included for mass grading and fine grading phases.
Fugitive dust emission rates can be varied by phase to reflect the phase-specific extent of site disturbance.	Yes. Typically set as a percent of EPA or CARB default TSP rates, with PM_{10} and $PM_{2.5}$ fractions set separately (normally based on soil texture class).	No. Default values only, and only for mass grading and fine grading phases. Choice of 4 methods to calculate fugitive dust emission factors based on available construction details.
Database for identifying PM_{10} and $PM_{2.5}$ fractions of fugitive dust based on soil texture class.	Yes	No
Fugitive dust control factors can be varied by phase.	Yes. Guidance provided.	Limited. Users can apply items on a default list of mitigation measures only for mass grading and fine grading phases
Optional adjustment of fugitive dust from soil disturbance based on natural conditions (seasonal frequency of precipitation, frozen ground, snow cover, or naturally high soil moisture levels).	Yes. All optional factors applied to calendar quarter and annual fugitive dust emissions. Daily fugitive dust emissions typically adjusted only for naturally high soil moisture levels.	No
Includes fugitive dust from mechanical building demolition.	Yes. Separate user-modifiable defaults for masonry/stone versus wood facade types. Optional separation of fugitive dust generation between building knockdown and debris removal phases.	Yes. Fixed default for all building types.
Includes fugitive dust from explosive building demolition.	Yes. User-modifiable default, with optional separation of fugitive dust generation between building implosion	No

Component	CNSTEMIS-11J	URBEMIS2007
	and debris removal phases.	
Includes option for specifying dust control during mechanical or explosive building demolition.	Yes. Suggested control factors by type of control.	No
Calculation of demolition debris quantities.	Optional worksheet for direct calculation of debris volume, debris tonnage, and truck loads based on building size and shape, extent of interior walls, extent of debris grinding, truck capacity, etc. Also default suggestions based on building type for quick analysis.	Default calculation of truck loads from building volume and truck capacity. No debris tonnage estimates.
Includes fugitive dust from construction blasting.	Yes. User-modifiable default.	No
Includes option for specifying dust control during construction blasting.	Yes. Suggested control factors by type of control.	No
Calculation of painted surface areas.	Optional worksheet for direct calculation from building size and shape, extent of interior walls, extent of non-painted exterior area, etc. Also default tables for quick analysis.	Default calculation based on square footage of nonresidential buildings and number of residential units. Fixed default building square footage values for residential land uses. No option for user input of actual residential building sizes.
Flexibility of architectural coating emission calculations.	Optional worksheet for up to 4 surface coating categories at a time, each category allowing multiple coats of up to 3 different coatings with user-specified wet coating thickness (with resulting coverage factor shown).	Default calculations only. A fixed paint coverage factor and 2 fixed coating categories (exterior and interior) for each land use type, with mitigation option of specifying % reduction from use of low VOC coatings. No option for user-specified coating types or VOC content.
Accuracy of architectural coating emission calculations.	Proper calculation converting regulatory VOC content into actual volumetric VOC content. Internal database of properties for 49 coating types. Users can substitute	Incorrect calculation methodology, treating regulatory VOC content as actual volumetric VOC content. No provision for user correction. Internal database

Component	CNSTEMIS-11J	URBEMIS2007
	product-specific data. Internal database of regulatory VOC limits for EPA, CARB, and California APCDs.	of regulatory VOC limits for California APCDs.
Includes PM_{10} emissions from spray painting.	Yes. EPA default in fugitive ROG database.	No
Includes fugitive VOC emissions from the curing of asphalt pavement.	Yes. User-modifiable CARB default.	Yes. Fixed CARB default.
Direct calculation of emissions from on-site heavy truck activity.	Yes. 13 heavy truck types included in the equipment database.	Not in default setups. Users must add truck items to the default equipment list (using one of three truck types or "other equipment" database entries), and then modify as necessary the URBEMIS default use hours, HP ratings, and load factors.
Direct calculation of emissions from on-site light/medium duty vehicle activity (ATVs, pickups, vans, SUVs, etc.).	Utility ATVs (all terrain vehicles) included in database. No light/medium duty highway vehicles in database. Users should calculate light/medium duty highway vehicle emissions separately using URBEMIS2007 operational analysis or EMFAC2007 for projects in California and MOBILE6.2 for projects in other states.	No. No ATVs in database. Users should calculate light/medium duty highway vehicle emissions separately using URBEMIS2007 operational analysis procedures.
Direct calculation of emissions from construction worker commute vehicle traffic.	No. Users should calculate separately using URBEMIS2007 operational analysis or EMFAC2007 for projects in California and MOBILE6.2 for projects in other states. CNSTEMIS computes a direct estimate of worker commute trips by project phase.	Yes, for each construction phase. URBEMIS generates default trip data and vehicle type mix. Users can modify trip rate but not trip distance or vehicle mix. Fixed vehicle type mix (50% autos, 50% light trucks) seems to underestimate typical light and medium truck fractions for construction worker vehicles.
Direct calculation of emissions from off-site truck traffic.	No. Users should calculate separately using URBEMIS2007 operational analysis or EMFAC2007 for	Yes, for Demolition, Grading, Building Construction, and Asphalt Paving phases only. Users can specify truck

Component	CNSTEMIS-11J	URBEMIS2007
	projects in California and MOBILE6.2 for projects in other states. CNSTEMIS computes a direct estimate of off-site truck trips by project phase.	capacity and round trip mileage for soil hauling in the grading phases only. For other phases, URBEMIS generates fixed values for trip data and truck mixes.

The following tables list the equipment types included in the URBEMIS2007 and the CNSTEMIS-11J models.

EQUIPMENT TYPES INCLUDED IN THE URBEMIS2007 MODEL

Rubber Tired Dozers	Rubber Tired Loaders	Crawler Tractors
Tractors/Loaders/Backhoes	Skid Steer Loaders	Trenchers
Excavators	Scrapers	Motor Graders
Rollers	Cranes	Dumper/Tenders
Bore-Drill Rigs	Off-Highway Trucks	Water Trucks
Off-Highway Tractors	Sweepers/Scrubbers	Forklifts
Rough Terrain Forklifts	Aerial Lifts	Cement and Mortar Mixers
Pavers	Paving Equipment	Surfacing Equipment
Plate Compactors	Crushing/Processing Equipment	Concrete/Industrial Saws
Generator Sets	Air Compressors	Pumps
Signal Boards	Welders	Pressure Washers
Other Construction Equipment	Other General Industrial Equipment	Other Material Handling Equipment

EQUIPMENT TYPES INCLUDED IN THE CNSTEMIS-11J MODEL

Wheeled Dozer	Tracked Dozer	Wheeled Tractor
Tracked Tractor	Wheeled Loader	Tracked Loader
Backhoe-Loader	Wheeled Skid-Steer Loader	Tracked Multi-Terrain Loader
Trencher	Continuous Excavator	Tracked Shovel Excavator
Wheeled Shovel Excavator	Mining Shovel	Cable Excavator/Stripping Shovel
Clamshell/Dragline Excavator	Scraper	Motor Grader
Standard Roller/Compactor	Vibratory Roller/Compactor	Mobile Crane
Stationary (Derrick) Crane	Side-Boom Tractor	Tracked Wrecking Ball
Tracked Material Handler	Wheeled Material Handler	Tracked Carrier/Dumper

Wheeled Carrier/Dumper	Wheeled Pavement Breaker	Tracked Pavement Breaker
Excavator-Mounted Auger	Truck-Mounted Auger	Excavator-Mounted Pile Driver
Utility All Terrain Vehicles	Wheeled Cable Plow	Tracked Cable Plow
Directional Bore/Drill Rig	Dump Truck	Articulated Dump Truck
Off-Road Hauler	Equipment Transporter	Flatbed Truck
Cement Mixer Truck	Heavy Truck (mixed types)	Off-Highway Truck-Tractor Unit
Water Truck	Fuel Truck	Other Specialty Trucks
Street Sweeper	Standard Forklift	Rough Terrain Forklift
Extended Reach Forklift	Aerial Lift	Line Puller
Concrete Pump	Portable Cement/Mortar Mixer	Roofing Equipment
Roadbed Trimmer	Soil Stabilizer	Cold Planer/Pavement Profiler
Placer/Spreader	Asphalt Road Reclaimer	Asphalt Paver
Concrete Paver	Concrete Texture/Curing Machine	Concrete Finisher/Vibrator
Pavement Scarifier	Motorized Line Painter	Tampers & Rammers
Plate Compactor	Rock Drill Rig	Standard Pile Drivers
Jackhammer & Compressor	Concrete/Industrial Saws	Crushing/Grinding Equipment
Screening/Sorting Equipment	Generator Set < 600 hp	Air Compressors < 600 hp
Pumps < 600 hp	Light Set	Signal Board
Other Portable IC Engine Equipment	Stationary IC Engines < 600 hp	Stationary IC Engines 600+ hp
Gas Turbine Generator	Electric Arc Welder	Oxy-Fuel Welder
Plasma Cutting Torch	Oxy-Fuel Cutting Torch	Pressure Washer
Abrasive Blasting	Fans and Blowers	Post Hole Auger
Conveyor Equipment	Stackers	Stockpile Reclaimers
Chippers & Stump Grinders	Weed Trimmers and Cutters	Chain Saws
Agricultural Shredders	Agricultural Mowers	Rear Engine Riding Mowers
Tracked Brush Cutters	Wheeled Brush Cutters	Land Clearing Machine
Forestry Feller-Bunchers	Log Skidders	Forestry Forwarders
Knuckleboom Loaders	Timber Handler/Forestry Machine	Diesel-Electric Wheeled Loaders
Diesel-Electric Mining Shovels	Diesel-Electric Off-Road Haulers	Turbine-Electric Off-Road Haulers

Comparisons of diesel equipment emission rates generated by the CNSTEMIS model and URBEMIS2007 show that the CNSTEMIS model typically generates somewhat higher emission rates (grams per horsepower-hour) than does the URBEMIS2007 model. The differences are most likely due to the differences in uncontrolled emission rates (EPA database in CNSTEMIS) and differences in equipment fleet replacement times (generally longer in CNSTEMIS).

Differences in overall construction activity emission estimates between CNSTEMIS and URBEMIS are more difficult to predict. The CNSTEMIS database includes many types of equipment not covered by the URBEMIS database. The CNSTEMIS database includes equipment using gasoline and compressed gas fuels while the URBEMIS database is limited to diesel-fueled equipment. The larger database allows CNSTEIMS analyses to account for more types of equipment than can be addressed by URBEMIS. In general, URBEMIS uses only a short list of default equipment types for each construction phase, and the default equipment lists do not include many items commonly seen at construction sites (tracked dozers, wheeled loaders, heavy trucks, trenchers, skid steer loaders, aerial lifts, air compressors, etc.). On the other hand, URBEMIS tends to assume relatively high default use hours for most equipment types, with no adjustment for the fact that most items do not operate continuously, even in active hours. The CNSTEMIS model explicitly addresses this issue through an operating time factor (percent operating time during active use hours). CNSTEMIS users select equipment items by engine size range, rather than relying on statewide average engine size defaults as in URBEMIS. In many cases, the URBEMIS statewide average horsepower rating is higher than the midpoint of the size range distribution for an equipment type. Overall, the CNSTEMIS model allows for a more comprehensive and refined analysis of construction emissions than can be provided by the URBEMIS model.

REFERENCES

California Air Resources Board. 2006. **CEIDERS Table PMSIZEPROFILE.** Document downloaded from CARB Internet website: http://www.arb.ca.gov/app/emsinv/dist/utltab/lookup/display/_tab.php. Accessed on June 08, 2006.

California Climate Action Registry. 2007. **General Reporting Protocol Version 2.2: Reporting Entity-Wide Greenhouse Gas Emissions.** Document downloaded from CCAR website (www.climateregistry.org) on July 11, 2007.

Intergovernmental Panel on Climate Change. 2001. **Climate Change 2001: Technical Summary of the Working Group I Report.** Document downloaded from IPCC website (www.ipcc.org) on November 17, 2007.

Intergovernmental Panel on Climate Change. 2007. **Climate Change 2007: Technical Summary of the Working Group I Report.** Document downloaded from IPCC website (www.ipcc.ch) on June 23, 2008.

Jones & Stokes Associates. 2007. **Software Users Guide: URBEMIS2007 for Windows, Version 9.2.** Document downloaded from URBEMIS website (www.urbemis.com) on February 18, 2008.

Rimpo and Associates. 2008. **URBEMIS2007 Version 9.2.4.** Computer program downloaded from URBEMIS website (www.urbemis.com) on February 18, 2008.

Sacramento Metropolitan Air Quality Management District. 2009. **Road Construction Emissions Model Version 6.3.2.** Spreadsheet downloaded from SMAQMD website (www.airquality.org/ceqa/index.shtml) on November 17, 2009.

U.S. Environmental Protection Agency. 1985a. **Compilation of Air Pollutant Emission Factors. Volume I: Stationary Point and Area Sources.** 4th Edition. AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

U.S. Environmental Protection Agency. 1985b. **Compilation of Air Pollutant Emission Factors. Volume II: Mobile Sources.** 4th Edition. AP-42. Office of Mobile Sources. Ann Arbor, MI.

U.S. Environmental Protection Agency. 1991. **Nonroad Engine and Vehicle Emission Study - Report.** 21A-2001. Office of Air and Radiation. Washington, DC. [PB9212696 from National Technical Information Service, Springfield, VA].

U.S. Environmental Protection Agency. 1995. **Compilation of Air Pollutant Emission Factors. Volume I: Stationary Point and Area Sources.** AP-42 5th Edition with Supplements (1996 –

2009). Office of Air Quality Planning and Standards. Research Triangle Park, NC. Available online at www.epa.gov/ttn/chief/AP42/index.html.

U.S. Environmental Protection Agency. 2004. **Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression Ignition.** Report NR-009c. EPA420-P-04-009. Office of Transportation and Air Quality. Document downloaded from EPA website (www.epa.gov/otaq/models/nonrdmdl/nonroadmdl2005) on November 01, 2007.

APPENDIX D-2

ADDITIONAL CONSTRUCTION EMISSIONS ANALYSIS INFORMATION

CONSTRUCTION INFORMATION FOR THE PROPOSED PROJECT AND ALTERNATIVES

The proposed project includes three major facility components: the Solar Farm, the Gen-Tie Line, and the Red Bluff Substation. Appendix D-1 provides an overview of the CNSTEMIS spreadsheet model used for analysis of on-site construction emissions. Separate CNSTEMIS analyses have been prepared for each alternative of each component. For each facility component, individual CNSTEMIS spreadsheets have been prepared for each calendar year that would have construction activity. Multiple CNSTEMIS spreadsheets were created for a calendar year when there would be more than four construction activity phases during the year. Analyses of the seven alternative facility components required a total of 35 separate CNSTEMIS spreadsheets. The combinations of Solar Farm, Gen Tie Line, and Red Bluff Substation site for each of the three alternatives are listed below.

Alternative 1
- Solar Farm Layout B
- Gen-Tie Line Alignment A-1
- Red Bluff Substation Site A

Alternative 2
- Solar Farm Layout B
- Gen-Tie Line Alignment B-2
- Red Bluff Substation Site B

Alternative 3
- Solar Farm Layout C
- Gen-Tie Line Alignment A-2
- Red Bluff Substation Site A

Solar Farm development would occur over a 26-month period, with construction activity undertaken as a rolling sequence of activity on different subareas of the site. Construction would generally progress as incremental work areas from the south end to the north end of the project site. Tortoise exclusion fencing of the entire site would be the initial phase of activity, followed by threatened species removals and relocations. Temporary construction offices, sanitary facilities, and water supply facilities would be established prior to initiating subarea construction activities. Incremental construction of access roads and staging areas would generally lead the main construction activity sequence, followed by site clearing and grading, which would be followed by various facility construction activity stages. The overall construction process was analyzed in terms of the following 18 construction phases:

- Tortoise exclusion fencing;
- Access roads and staging areas;
- Temporary construction offices, water supply, and sanitary facilities;
- Security fencing and west side debris and drainage basins;

- Vegetation (site) clearing;
- Site grading;
- Installation of array support posts;
- Trenching and underground power cable installation;
- Soil compacting and dust palliative application;
- Installation of on-site power poles;
- Installation of on-site switchgear;
- Construction of the On-site Substation;
- Solar array assembly;
- Installation of on-site overhead power lines;
- Construction of permanent buildings;
- Functional testing;
- De-compaction of areas between solar arrays and dust palliative application; and
- Site cleanup.

Construction activity generally would occur over a standard five-day workweek with activity limited to daytime hours. For safety reasons, some electrical connection activity would typically occur at night when the solar panels are not energized, but this activity would not require any significant heavy equipment operations. For analysis purposes, it was assumed that construction activity would be initiated on about 11 acres per day (55.2 acres per week) for Solar Farm Layout B and on about 8 acres per day (39.8 acres per week) for Solar Farm Layout C.

Construction of the Gen-Tie Line would occur over an 8-month period beginning in January 2011, but the Gen-Tie Line would not be energized until late 2012 or later, depending on completion of the Red Bluff Substation. Final cleanup of the construction corridor would occur after the Gen-Tie Line is energized. The overall construction process was analyzed in terms of the following six construction phases:

- Site preparation;
- Tower foundations;
- Tower assembly and erection;
- Power line stringing;
- Testing; and
- Site cleanup.

Construction activity generally would occur over a standard five-day workweek with activity limited to daytime hours. Construction activity would progress in a linear fashion along the transmission corridor. In general, only a few acres would be actively disturbed at any one time during construction, with about five acres per day being disturbed during site preparation. The site preparation and tower foundation construction phases would overlap, but all other construction phases would occur sequentially. Normal dust control practices would be followed during construction.

The alternative Gen Tie Line routes would be of different lengths and would require somewhat different amounts of construction materials. Gen Tie Line A-1 would be about 12.2 miles long with 73 towers. Approximately 77 acres of the 233-acre transmission line corridor would be disturbed by construction activity. Gen Tie Line B-2 would be about 10 miles long, with 58 towers. Approximately 62 acres of the 189-acre transmission line corridor would be disturbed by construction. Gen Tie Line A-2 would be about 9.5 miles long with 55 towers. Approximately 62 acres of the 185-acre transmission line corridor would be disturbed by construction.

Construction of the Red Bluff Substation would occur over a 26-month period beginning in April 2011. Construction activity would include construction of the separate telecommunications site. Because the telecommunication site is so small, construction activity at that site has been included in the analysis of the main Substation site. The overall construction process was analyzed in terms of the following 11 construction phases:

- Access road construction
- Site fencing
- Site clearing
- Site grading and compaction
- Trenching and foundations
- Equipment pads
- Equipment installation
- Power line connections
- Testing
- Driveways, other paving, and security wall
- Site cleanup

At the time that emissions analyses were performed, the two Red Bluff Substation alternatives were each assumed to require 90 acres for the substation proper, 0.22 acres for the telecommunications site along Highway 177, plus additional land area for access roads, transmission line connections, drainage improvements (30 acres for Substation Site A and 20 acres for Substation Site b), and temporary construction staging areas. Current plans for the Red Bluff Substation have reduced the acreage requirement for the substation proper to 75 acres, reduced the area required for drainage improvements (20 acres for Substation Site A and 11 acres for Substation Site B), and have increased the area required for access roads and associated drainage improvements. The revisions to the Red Bluff Substation design were received too late to allow revisions of the CNSTEMIS analyses for the substation and associated facilities.

Emissions summaries from the CNSTEMIS analyses have been presented in Sections 4.2 and 4.5 of the EIS, and are not repeated here. The material that follows provides tabular summaries of additional information supporting the emission estimates presented in the EIS. This additional information is organized into groups of tables identifying:

- Construction schedules by activity phase;
- Equipment use by activity phase;
- Construction-related vehicle trips per day by activity phase; and
- Fugitive emissions parameters by activity phase.

SOLAR FARM CONSTRUCTION, LAYOUT B (ALTERNATIVES 1 AND 2)

Table D2-1.
Schedule For Solar Farm Layout B Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Exclusion Fencing	98	61	37	0	0
Roads and Staging Areas	89	44	15	15	15
Construction Offices	43	0	43	0	0
Security Fencing	148	0	42	64	42
Site Clearing	161	0	42	64	55
Site Grading	161	0	37	64	60
Array Support Posts	141	0	21	64	56
Trenching and Cables	141	0	16	64	61
Soil Compacting	141	0	21	64	56
On-Site Power Poles	49	0	7	21	21
Switchgear Facilities	140	0	16	64	60
On-Site Substation	43	0	21	22	0
Solar Array Assembly	141	0	21	64	56
On-Site Power Lines	49	0	7	21	21
Net Construction Days	**250**	**61**	**64**	**64**	**61**
2012 Activity					
Roads and Staging Areas	30	15	15	0	0
Site Clearing	181	61	64	56	0
Site Grading	181	56	64	61	0
Array Support Posts	201	51	64	64	22
Trenching and Cables	201	46	64	64	27
Soil Compacting	221	61	64	64	32
On-Site Power Poles	70	21	21	21	7
Switchgear Facilities	220	61	64	64	31
Solar Array Assembly	221	61	64	64	32
On-Site Power Lines	77	21	21	21	14
Permanent Buildings	54	54	0	0	0
Functional Testing	200	21	64	64	64
Net Construction Days	**253**	**61**	**64**	**64**	**64**
2013 Activity					
Functional Testing	21	21	0	0	0
Soil De-Compacting	21	21	0	0	0
Site Cleanup	21	21	0	0	0
Net Construction Days	**34**	**34**	**0**	**0**	**0**

Available Work Days Per Quarter	**61**	**64**	**64**	**64**

Table D2-2.
Equipment Use For Solar Farm Layout B Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Exclusion Fencing	36.2	7	16	1,492	4,087
Roads and Staging Areas	42.6	23	41	5,663	32,632
Construction Offices	9.7	11	25	2,763	6,757
Security Fencing	83.7	9	20	2,888	8,310
Site Clearing	1,766.4	18	30	10,635	36,703
Site Grading	1,766.4	27	47	19,385	169,124
Array Support Posts	1,545.6	26	47	13,174	36,006
Trenching and Cables	772.8	11	20	5,663	24,240
Soil Compacting	1,545.6	13	22	6,360	71,771
On-Site Power Poles	7.2	8	15	569	1,883
Switchgear Facilities	6.7	11	19	2,401	9,289
On-Site Substation	14.4	29	70	2,049	7,690
Solar Array Assembly	1,545.6	78	133	41,521	63,538
On-Site Power Lines	7.2	13	20	2,313	9,073
2011 Totals	**1,938.6**	**284**	**525**	**116,876**	**481,102**
2012 Activity					
Roads and Staging Areas	29.4	23	38	1,815	10,497
Site Clearing	1,987.2	18	30	11,868	40,451
Site Grading	1,987.2	27	47	21,792	190,109
Array Support Posts	2,208.0	27	48	19,041	54,991
Trenching and Cables	1,104.0	11	20	7,594	32,684
Soil Compacting	2,428.8	13	22	9,967	112,454
On-Site Power Poles	10.3	8	15	812	2,674
Switchgear Facilities	9.5	11	18	3,740	14,261
Solar Array Assembly	2,428.8	78	132	65,055	98,667
On-Site Power Lines	11.4	13	20	3,634	14,249
Permanent Buildings	2.9	15	34	1,032	3,082
Functional Testing	1.0	33	37	43,563	14,903
2012 Totals	**2,470.6**	**277**	**461**	**189,914**	**589,023**
2013 Activity					
Functional Testing	1.0	31	33	4,465	1,405
Soil De-Compacting	1,534.9	16	32	1,115	6,217
Site Cleanup	250.0	7	13	284	1,263

2013 Totals	1,784.9	54	78	5,864	8,885

Table D2-3.
Traffic Generation For Solar Farm Layout B Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Exclusion Fencing	29	42	4	5	0.2
Roads and Staging Areas	31	44	4	6	0.6
Construction Offices	30	43	4	5	3.5
Security Fencing	30	43	4	5	5.4
Site Clearing	38	54	5	6	2.3
Site Grading	37	53	5	6	0.8
Array Support Posts	46	66	6	8	8.1
Trenching and Cables	21	30	3	4	1.2
Soil Compacting	21	30	3	3	0.4
On-Site Power Poles	18	26	2	3	0.4
Switchgear Facilities	24	34	3	4	2.8
On-Site Substation	46	66	6	8	9.9
Solar Array Assembly	175	251	21	30	48.2
On-Site Power Lines	23	33	3	4	0.3
2011 Totals	**569**	**815**	**73**	**97**	**84**
2012 Activity					
Roads and Staging Areas	31	44	4	5	1.1
Site Clearing	38	54	4	6	0.2
Site Grading	37	53	4	5	0.8
Array Support Posts	47	67	4	5	8.0
Trenching and Cables	21	30	5	6	1.2
Soil Compacting	21	30	5	6	0.4
On-Site Power Poles	18	26	6	8	0.3
Switchgear Facilities	24	34	3	4	2.8
Solar Array Assembly	175	251	3	3	47.4
On-Site Power Lines	23	33	2	3	0.2
Permanent Buildings	30	43	3	4	2.8
Functional Testing	15	21	6	8	0.1
2012 Totals	**480**	**686**	**21**	**30**	**65**
2013 Activity					
Functional Testing	33	47	5	6	0.1

Soil De-Compacting	21	30	3	4	1.9
Site Cleanup	19	27	3	4	1.0
2013 Totals	**73**	**104**	**11**	**14**	**3**

Table D2-4.
Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction

Parameter	Exclusion Fencing	Access Roads and Staging Areas	Construction Offices	Security Fencing	Site Clearing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	75%	75%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	6.4%	6.1%	1.4%	2.9%	3.0%
Area Disturbed on a Typical Day, acres	0.37	0.48	9.68	0.57	11.00
Days of Disturbance	98	89	43	148	161
Uncontrolled TSP Rate, lbs/acre-day	40.0	80.0	80.0	40.0	80.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4	1.4	2.8
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-4 (continued).
Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction

Parameter	Site Grading	Array Support Posts	Trenching and Cables	Soil Compacting	On-Site Power Poles
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	3.1%	1.5%	3.4%	3.3%	3.3%
Area Disturbed on a Typical Day, acres	11.00	11.00	5.50	11.00	0.15
Days of Disturbance	161	141	141	141	49
Uncontrolled TSP Rate, lbs/acre-day	80.0	60.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	2.8	2.1	1.4	0.7	0.7
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-4 (continued).
Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction

Parameter	Switchgear Facilities	On-Site Substation	Solar Array Assembly	On-Site Power Lines
Assumed Soil Texture Class	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%	75%

Natural Dust Control, Daily Basis	0%	0%	0%	0%
Natural Dust Control, Annual Basis	1.5%	2.2%	3.3%	3.3%
Area Disturbed on a Typical Day, acres	0.05	14.40	11.00	0.15
Days of Disturbance	140	43	141	49
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.7	0.7
Demolition PM10, total pounds	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%

Table D2-5.
Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction

Parameter	Access Roads and Staging Areas	Site Clearing	Site Grading	Array Support Posts	Trenching and Cables
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	50%	50%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	5.4%	4.6%	4.4%	3.8%	4.1%
Area Disturbed on a Typical Day, acres	0.98	11.00	11.00	11.00	5.50
Days of Disturbance	30	181	181	201	201

Uncontrolled TSP Rate, lbs/acre-day	80.0	80.0	80.0	60.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	2.8	2.8	2.1	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-5 (continued).
Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction

Parameter	Soil Compacting	On-Site Power Poles	Switchgear Facilities	Solar Array Assembly	On-Site Power Lines
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	4.5%	4.6%	3.9%	4.5%	4.6%
Area Disturbed on a Typical Day, acres	11.00	0.15	0.04	11.00	0.15
Days of Disturbance	221	70	220	221	77
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.7	0.7	0.7
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00

Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-5 (continued).
Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction

Parameter	Permanent Buildings	Functional Testing
Assumed Soil Texture Class	sand	sand
Soil PM10 Fraction	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%
Natural Dust Control, Daily Basis	0%	0%
Natural Dust Control, Annual Basis	9.4%	3.5%
Area Disturbed on a Typical Day, acres	2.88	1.00
Days of Disturbance	54	200
Uncontrolled TSP Rate, lbs/acre-day	80.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	0.7
Demolition PM10, total pounds	0	0
Construction Blasting PM10, total pounds	0	0
Acres of asphalt paving	0.00	0.00
Painted Surface Area, square feet	20,864	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%

Table D2-6.
Fugitive Emissions Parameters For Solar Farm Layout B, 2013 Construction

Parameter	Functional Testing	Soil De-Compacting	Site Cleanup
Assumed Soil Texture Class	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	9.4%
Area Disturbed on a Typical Day, acres	1.00	73.09	11.90
Days of Disturbance	21	21	21
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	16.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.3
Demolition PM10, total pounds	0	0	0
Construction Blasting PM10, total pounds	0	0	0
Acres of asphalt paving	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%

SOLAR FARM CONSTRUCTION, LAYOUT C (ALTERNATIVE 3)

Table D2-7.
Schedule for Solar Farm Layout C Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Exclusion Fencing	86	61	25	0	0
Roads and Staging Areas	89	44	15	15	15
Construction Offices	43	0	43	0	0
Security Fencing	129	0	42	64	23
Site Clearing	160	0	42	64	54
Site Grading	160	0	37	64	59
Array Support Posts	140	0	21	64	55
Trenching and Cables	140	0	16	64	60
Soil Compacting	140	0	21	64	55
On-Site Power Poles	49	0	7	21	21
Switchgear Facilities	140	0	16	64	60
On-Site Substation	43	0	21	22	0
Solar Array Assembly	140	0	21	64	55
On-Site Power Lines	49	0	7	21	21
Net Construction Days	**249**	**61**	**64**	**64**	**60**
2012 Activity					
Roads and Staging Areas	30	15	15	0	0
Site Clearing	180	61	64	55	0
Site Grading	173	56	64	53	0
Array Support Posts	192	51	64	64	13
Trenching and Cables	192	46	64	64	18
Soil Compacting	220	61	64	64	31
On-Site Power Poles	70	21	21	21	7
Switchgear Facilities	220	61	64	64	31
Solar Array Assembly	215	61	64	64	26
On-Site Power Lines	77	21	21	21	14
Permanent Buildings	54	54	0	0	0
Functional Testing	200	21	64	64	64
Net Construction Days	**253**	**61**	**64**	**64**	**64**
2013 Activity					
Functional Testing	21	21	0	0	0
Soil De-Compacting	21	21	0	0	0
Site Cleanup	21	21	0	0	0
Net Construction Days	**34**	**34**	**0**	**0**	**0**

Available Work Days Per Quarter	61	64	64	64

Table D2-8.
Equipment Use for Solar Farm Layout C Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Exclusion Fencing	17.3	7	16	1,103	3,217
Roads and Staging Areas	39.0	22	40	5,328	30,481
Construction Offices	9.7	11	25	2,763	6,757
Security Fencing	45.9	9	20	2,200	6,627
Site Clearing	1,273.6	15	25	7,775	27,123
Site Grading	1,273.6	21	38	14,889	127,558
Array Support Posts	1,114.4	22	40	10,722	30,745
Trenching and Cables	557.2	11	20	4,786	21,484
Soil Compacting	1,114.4	11	19	5,233	57,285
On-Site Power Poles	6.0	8	15	569	1,880
Switchgear Facilities	5.0	11	19	2,376	9,009
On-Site Substation	14.4	29	70	2,049	7,690
Solar Array Assembly	1,114.4	60	108	31,475	49,824
On-Site Power Lines	6.0	13	20	2,088	8,413
2011 Totals	**1,385.5**	**250**	**475**	**93,354**	**388,093**
2012 Activity					
Roads and Staging Areas	19.5	22	36	1,590	9,229
Site Clearing	1,432.8	15	25	8,716	30,214
Site Grading	1,965.6	21	38	16,097	137,889
Array Support Posts	2,184.0	22	41	14,703	42,128
Trenching and Cables	1,092.0	11	20	6,431	28,264
Soil Compacting	1,751.2	11	19	8,224	89,993
On-Site Power Poles	8.6	8	15	812	2,673
Switchgear Facilities	7.1	11	19	3,729	14,074
Solar Array Assembly	1,711.6	60	107	48,306	75,725
On-Site Power Lines	9.5	13	20	3,280	13,211
Permanent Buildings	2.9	15	34	1,033	3,089
Functional Testing	1.0	26	30	33,763	11,950
2012 Totals	**1,741.1**	**235**	**404**	**146,684**	**458,440**
2013 Activity					
Functional Testing	1.0	24	26	3,436	1,098
Soil De-Compacting	1,192.4	13	25	844	5,555
Site Cleanup	200.0	7	13	283	1,328

2013 Totals	**1,392.4**	**44**	**64**	**4,563**	**7,981**

Table D2-9.
Traffic Generation From Solar Farm Layout C Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Exclusion Fencing	29	42	4	5	0.2
Roads and Staging Areas	30	43	4	5	0.6
Construction Offices	30	43	4	5	3.5
Security Fencing	30	43	4	5	5.2
Site Clearing	35	50	4	6	2.2
Site Grading	31	44	4	5	0.6
Array Support Posts	42	60	5	7	6.1
Trenching and Cables	21	30	3	4	0.9
Soil Compacting	19	27	2	3	0.3
On-Site Power Poles	18	26	2	3	0.4
Switchgear Facilities	24	34	3	4	2.1
On-Site Substation	46	66	6	8	9.9
Solar Array Assembly	157	225	19	26	36.7
On-Site Power Lines	23	33	3	4	0.3
2011 Totals	**535**	**766**	**67**	**90**	**69**
2012 Activity					
Roads and Staging Areas	30	43	4	5	1.0
Site Clearing	35	50	4	6	2.2
Site Grading	31	44	4	5	0.6
Array Support Posts	42	60	4	5	6.1
Trenching and Cables	21	30	5	6	0.9
Soil Compacting	19	27	5	6	0.3
On-Site Power Poles	18	26	6	8	0.3
Switchgear Facilities	24	34	3	4	2.1
Solar Array Assembly	157	225	3	3	37.6
On-Site Power Lines	23	33	2	3	0.2
Permanent Buildings	30	43	3	4	2.9
Functional Testing	15	21	6	8	0.1
2012 Totals	**445**	**636**	**21**	**30**	**54**
2013 Activity					
Functional Testing	26	37	3	5	0.2

Soil De-Compacting	18	26	2	3	1.3
Site Cleanup	19	27	2	4	0.6
2013 Totals	**63**	**90**	**7**	**12**	**2**

Table D2-10.
Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction

Parameter	Exclusion Fencing	Access Roads and Staging Areas	Construction Offices	Security Fencing	Site Clearing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	75%	75%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	7.1%	6.1%	1.4%	2.7%	3.0%
Area Disturbed on a Typical Day, acres	0.20	0.44	9.68	0.36	7.96
Days of Disturbance	86	89	43	129	160
Uncontrolled TSP Rate, lbs/acre-day	40.0	80.0	80.0	40.0	80.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4	1.4	2.8
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-10 (continued).
Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction

Parameter	Site Grading	Array Support Posts	Trenching and Cables	Soil Compacting	On-Site Power Poles
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	3.1%	1.6%	3.4%	3.3%	3.3%
Area Disturbed on a Typical Day, acres	7.96	7.96	3.98	7.96	0.12
Days of Disturbance	160	140	140	140	49
Uncontrolled TSP Rate, lbs/acre-day	80.0	60.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	2.8	2.1	1.4	0.7	0.7
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-10 (continued).
Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction

Parameter	Switchgear Facilities	On-Site Substation	Solar Array Assembly	On-Site Power Lines
Assumed Soil Texture Class	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%	75%

Natural Dust Control, Daily Basis	0%	0%	0%	0%
Natural Dust Control, Annual Basis	1.5%	2.2%	3.3%	3.3%
Area Disturbed on a Typical Day, acres	0.04	14.40	7.96	0.12
Days of Disturbance	140	43	140	49
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.7	0.7
Demolition PM10, total pounds	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%

Table D2-11.
Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction

Parameter	Access Roads and Staging Areas	Site Clearing	Site Grading	Array Support Posts	Trenching and Cables
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	50%	50%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	5.4%	4.6%	4.5%	4.0%	4.1%
Area Disturbed on a Typical Day, acres	0.65	7.96	7.96	7.96	3.98
Days of Disturbance	30	180	173	192	192

Uncontrolled TSP Rate, lbs/acre-day	80.0	80.0	80.0	60.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	2.8	2.8	2.1	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-11 (continued).
Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction

Parameter	Soil Compacting	On-Site Power Poles	Switchgear Facilities	Solar Array Assembly	On-Site Power Lines
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	4.5%	4.6%	3.9%	4.5%	4.6%
Area Disturbed on a Typical Day, acres	7.96	0.12	0.03	7.96	0.12
Days of Disturbance	220	70	220	215	77
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.7	0.7	0.7
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00

Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-11 (continued).
Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction

Parameter	Permanent Buildings	Functional Testing
Assumed Soil Texture Class	sand	sand
Soil PM10 Fraction	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%
Natural Dust Control, Daily Basis	0%	0%
Natural Dust Control, Annual Basis	9.4%	3.5%
Area Disturbed on a Typical Day, acres	2.88	1.00
Days of Disturbance	54	200
Uncontrolled TSP Rate, lbs/acre-day	80.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	0.7
Demolition PM10, total pounds	0	0
Construction Blasting PM10, total pounds	0	0
Acres of asphalt paving	0.00	0.00
Painted Surface Area, square feet	20,864	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%

Table D2-12.
Fugitive Emissions Parameters For Solar Farm Layout C, 2013 Construction

Parameter	Functional Testing	Soil De-Compacting	Site Cleanup
Assumed Soil Texture Class	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	75%	75%	75%
Natural Dust Control, Daily Basis	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	9.4%
Area Disturbed on a Typical Day, acres	1.00	56.78	9.52
Days of Disturbance	21	21	21
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	16.0
Controlled PM10 Rate, lbs/acre-day	0.7	0.7	0.3
Demolition PM10, total pounds	0	0	0
Construction Blasting PM10, total pounds	0	0	0
Acres of asphalt paving	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%

GEN-TIE LINE CONSTRUCTION, ALIGNMENT A-1 (ALTERNATIVE 1)

Table D2-13.
Schedule for Gen Tie Line A-1 Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Site Preparation	15	15	0	0	0
Tower Foundations	45	45	0	0	0
Tower Assembly and Erection	65	15	50	0	0
Power Line Stringing	45	0	10	35	0
Testing	21	0	0	21	0
Net Construction Days	**176**	**60**	**60**	**56**	**0**
2012 Activity					
Site Cleanup	21	0	0	21	0
Net Construction Days	**21**	**0**	**0**	**21**	**0**
Available Work Days Per Quarter		**61**	**64**	**64**	**64**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-14.
Equipment Use for Gen Tie Line A-1 Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Site Preparation	76.7	7	21	407	2,781
Tower Foundations	1.0	24	56	1,588	6,182
Tower Assembly and Erection	38.4	9	15	1,697	6,622
Power Line Stringing	38.4	18	30	1,798	11,416
Testing	18.0	2	2	109	913
2011 Totals	**76.7**	**60**	**124**	**5,600**	**27,913**
2012 Activity					
Site Cleanup	18.0	4	4	70	192
2012 Totals	**18.0**	**4**	**4**	**70**	**192**

Table D2-15.
Traffic Generation From Gen Tie Line A-1 Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Site Preparation	20	0	0	35	3.7
Tower Foundations	30	0	0	53	23.5
Tower Assembly and Erection	20	0	0	35	2.4
Power Line Stringing	30	0	0	53	1.8
Testing	5	0	0	8	0.0
2011 Maximum	**50**	**0**	**0**	**88**	**27**
2012 Activity					
Site Cleanup	9	0	0	14	0
2012 Maximum	**9**	**0**	**0**	**14**	**0**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-16.
Fugitive Emissions Parameters For Gen Tie Line A-1, 2011 Construction

Parameter	Site Preparation	Tower Foundations	Tower Assembly and Erection	Power Line Stringing	Testing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%	0%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	3.3%	2.6%	2.9%
Area Disturbed on a Typical Day, acres	5.11	0.02	0.59	0.85	0.86
Days of Disturbance	15	45	65	45	21
Uncontrolled TSP Rate,	40.0	80.0	80.0	40.0	20.0

lbs/acre-day					
Controlled PM10 Rate, lbs/acre-day	1.4	2.8	2.8	1.4	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-17.
Fugitive Emissions Parameters For Gen Tie Line A-1, 2012 Construction

Parameter	Site Cleanup
Assumed Soil Texture Class	sand
Soil PM10 Fraction	7.0%
Active Dust Control Program Effectiveness	50%
Natural Dust Control, Daily Basis	0%
Natural Dust Control, Annual Basis	2.9%
Area Disturbed on a Typical Day, acres	0.86
Days of Disturbance	21
Uncontrolled TSP Rate, lbs/acre-day	20.0
Controlled PM10 Rate, lbs/acre-day	0.7
Demolition PM10, total pounds	0
Construction Blasting PM10, total pounds	0
Acres of asphalt paving	0.00
Painted Surface Area, square feet	0

PM2.5 fraction of engine exhaust PM10	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%
PM2.5 fraction of spray paint PM10	91.2%

GEN-TIE LINE CONSTRUCTION, ALIGNMENT A-2 (ALTERNATIVE 3)

Table D2-18.
Schedule for Gen Tie Line A-2 Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Site Preparation	15	15	0	0	0
Tower Foundations	45	45	0	0	0
Tower Assembly and Erection	65	15	50	0	0
Power Line Stringing	45	0	10	35	0
Testing	21	0	0	21	0
Net Construction Days	**176**	**60**	**60**	**56**	**0**
2012 Activity					
Site Cleanup	21	0	0	21	0
Net Construction Days	**21**	**0**	**0**	**21**	**0**
Available Work Days Per Quarter		**61**	**64**	**64**	**64**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-19.
Equipment Use for Gen Tie Line A-2 Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Site Preparation	62.3	7	21	407	2,781
Tower Foundations	1.0	24	56	1,566	5,976
Tower Assembly and Erection	31.2	9	15	1,693	6,581
Power Line Stringing	31.2	18	30	1,798	11,416
Testing	21.0	2	2	109	913
2011 Totals	**62.3**	**60**	**124**	**5,573**	**27,668**
2012 Activity					
Site Cleanup	21	4	4	70	192
2012 Totals	**21**	**4**	**4**	**70**	**192**

Table D2-20.
Traffic Generation From Gen Tie Line A-2 Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Site Preparation	20	0	0	35	3.7
Tower Foundations	30	0	0	53	20.2
Tower Assembly and Erection	20	0	0	35	1.9
Power Line Stringing	30	0	0	53	1.8
Testing	5	0	0	8	0.0
2011 Maximum	**50**	**0**	**0**	**88**	**24**
2012 Activity					
Site Cleanup	9	0	0	14	0
2012 Maximum	**9**	**0**	**0**	**14**	**0**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-21.
Fugitive Emissions Parameters For Gen Tie Line A-2, 2011 Construction

Parameter	Site Preparation	Tower Foundations	Tower Assembly and Erection	Power Line Stringing	Testing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%	0%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	3.3%	2.6%	2.9%
Area Disturbed on a Typical Day, acres	4.15	0.02	0.48	0.69	1.00
Days of Disturbance	15	45	65	45	21
Uncontrolled TSP Rate, lbs/acre-day	40.0	80.0	80.0	40.0	20.0

Controlled PM10 Rate, lbs/acre-day	1.4	2.8	2.8	1.4	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-22.
Fugitive Emissions Parameters For Gen Tie Line A-2, 2012 Construction

Parameter	Site Cleanup
Assumed Soil Texture Class	sand
Soil PM10 Fraction	7.0%
Active Dust Control Program Effectiveness	50%
Natural Dust Control, Daily Basis	0%
Natural Dust Control, Annual Basis	2.9%
Area Disturbed on a Typical Day, acres	1.00
Days of Disturbance	21
Uncontrolled TSP Rate, lbs/acre-day	20.0
Controlled PM10 Rate, lbs/acre-day	0.7
Demolition PM10, total pounds	0
Construction Blasting PM10, total pounds	0
Acres of asphalt paving	0.00
Painted Surface Area, square feet	0
PM2.5 fraction of engine	92.0%

exhaust PM10	
PM2.5 fraction of fugitive dust PM10	20.0%
PM2.5 fraction of spray paint PM10	91.2%

GEN-TIE LINE CONSTRUCTION, ALIGNMENT B-2 (ALTERNATIVE 2)

Table D2-23.
Schedule for Gen Tie Line B-2 Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Site Preparation	15	15	0	0	0
Tower Foundations	45	45	0	0	0
Tower Assembly and Erection	65	15	50	0	0
Power Line Stringing	45	0	10	35	0
Testing	21	0	0	21	0
Net Construction Days	**176**	**60**	**60**	**56**	**0**
2012 Activity					
Site Cleanup	21	0	0	21	0
Net Construction Days	**21**	**0**	**0**	**21**	**0**
Available Work Days Per Quarter		**61**	**64**	**64**	**64**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-24.
Equipment Use for Gen Tie Line B-2 Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Site Preparation	62.1	7	21	407	2,781
Tower Foundations	1.0	24	56	1,568	5,993
Tower Assembly and Erection	31.1	9	15	1,694	6,589
Power Line Stringing	31.1	18	30	1,798	11,416
Testing	12.0	2	2	109	913
2011 Totals	**62.1**	**60**	**124**	**5,576**	**27,691**
2012 Activity					
Site Cleanup	12.0	4	4	70	192
2012 Totals	**12.0**	**4**	**4**	**70**	**192**

Table D2-25.
Traffic Generation From Gen Tie Line B-2 Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Site Preparation	20	0	0	35	3.7
Tower Foundations	30	0	0	53	21.1
Tower Assembly and Erection	20	0	0	35	2.0
Power Line Stringing	30	0	0	53	1.8
Testing	5	0	0	8	0.0
2011 Maximum	**50**	**0**	**0**	**88**	**25**
2012 Activity					
Site Cleanup	9	0	0	14	0
2012 Maximum	**9**	**0**	**0**	**14**	**0**

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

Table D2-26.
Fugitive Emissions Parameters For Gen Tie Line B-2, 2011 Construction

Parameter	Site Preparation	Tower Foundations	Tower Assembly and Erection	Power Line Stringing	Testing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%	0%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	3.3%	2.6%	2.9%
Area Disturbed on a Typical Day, acres	4.14	0.02	0.48	0.69	0.57
Days of Disturbance	15	45	65	45	21

Uncontrolled TSP Rate, lbs/acre-day	40.0	80.0	80.0	40.0	20.0
Controlled PM10 Rate, lbs/acre-day	1.4	2.8	2.8	1.4	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-27.
Fugitive Emissions Parameters For Gen Tie Line B-2, 2012 Construction

Parameter	**Site Cleanup**
Assumed Soil Texture Class	sand
Soil PM10 Fraction	7.0%
Active Dust Control Program Effectiveness	50%
Natural Dust Control, Daily Basis	0%
Natural Dust Control, Annual Basis	2.9%
Area Disturbed on a Typical Day, acres	0.57
Days of Disturbance	21
Uncontrolled TSP Rate, lbs/acre-day	20.0
Controlled PM10 Rate, lbs/acre-day	0.7
Demolition PM10, total pounds	0
Construction Blasting PM10, total pounds	0
Acres of asphalt paving	0.00
Painted Surface Area, square	0

feet	
PM2.5 fraction of engine exhaust PM10	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%
PM2.5 fraction of spray paint PM10	91.2%

RED BLUFF SUBSTATION CONSTRUCTION, SITE A (ALTERNATIVES 1 AND 3)

Table D2-28.
Schedule for Red Bluff Substation A Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Access Road Improvements	40	0	40	0	0
Site Fencing	25	0	20	5	0
Site Clearing	60	0	0	59	1
Grading and Compacting	60	0	0	0	60
Net Construction Days	**185**	**0**	**60**	**64**	**61**
2012 Activity					
Trenching and Foundations	20	20	0	0	0
Equipment Pads	30	30	0	0	0
Equipment Installation	90	10	64	16	0
Power Line Connections	60	0	0	45	15
Testing	45	0	0	0	45
Net Construction Days	**245**	**60**	**64**	**61**	**60**
2013 Activity					
Testing	45	45	0	0	0
Driveways and Walls	40	15	25	0	0
Site Cleanup	15	0	15	0	0
Net Construction Days	**100**	**60**	**40**	**0**	**0**
Available Work Days Per Quarter		**61**	**64**	**64**	**64**

Construction phases would not overlap.

Table D2-29.
Equipment Use for Red Bluff Substation A Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Access Road Improvements	1.2	5	12	395	3,283
Site Fencing	3.5	6	14	298	848
Site Clearing	114.0	6	17	1,065	4,939
Grading and Compacting	114.0	9	17	1,642	11,678

2011 Totals	**118.7**	**26**	**60**	**3,401**	**20,747**
2012 Activity					
Trenching and Foundations	114.0	12	21	511	2,257
Equipment Pads	114.0	8	24	999	8,210
Equipment Installation	114.0	8	15	1,977	11,689
Power Line Connections	22.5	10	20	1,180	4,882
Testing	1.0	1	1	88	725
2012 Totals	**114.0**	**39**	**81**	**4,755**	**27,763**
2013 Activity					
Testing	1.0	1	1	88	717
Driveways and Walls	26.3	8	41	1,226	6,639
Site Cleanup	5.0	3	6	59	162
2013 Totals	**32.3**	**12**	**48**	**1,372**	**7,518**

Table D2-30.
Traffic Generation From Red Bluff Substation A Construction

Activity Phase	Total Workers	Daily Average 1-Way Vehicle Trips			
		To/From Shuttle Assembly Points	Shuttle Trips To/From Site	Personal Vehicle Trips To/From Site	Construction Truck Trips To/From Site
2011 Activity					
Access Road Improvements	6	0	0	10	2.2
Site Fencing	10	0	0	16	0.6
Site Clearing	8	0	0	13	0.4
Grading and Compacting	11	0	0	18	0.3
2011 Maximum	**11**	**0**	**0**	**18**	**2**
2012 Activity					
Trenching and Foundations	13	0	0	20	3.1
Equipment Pads	12	0	0	19	116.6
Equipment Installation	12	0	0	19	21.3
Power Line Connections	14	0	0	22	0.5
Testing	2	0	0	4	0.0
2012 Maximum	**14**	**0**	**0**	**22**	**117**
2013 Activity					
Testing	2	0	0	4	0.0
Driveways and Walls	10	0	0	20	86.9
Site Cleanup	5	0	0	10	0.5

2013 Maximum	**10**	**0**	**0**	**20**	**87**

Construction phases would not overlap.

Table D2-31.
Fugitive Emissions Parameters For Red Bluff Substation A, 2011 Construction

Parameter	Access Road Improvements	Site Fencing	Site Clearing	Grading and Compacting
Assumed Soil Texture Class	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%
Natural Dust Control, Annual Basis	1.4%	1.7%	2.9%	4.3%
Area Disturbed on a Typical Day, acres	0.03	0.12	1.90	1.90
Days of Disturbance	40	25	60	60
Uncontrolled TSP Rate, lbs/acre-day	80.0	40.0	80.0	80.0
Controlled PM10 Rate, lbs/acre-day	2.8	1.4	2.8	2.8
Demolition PM10, total pounds	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%

Table D2-33.
Fugitive Emissions Parameters For Red Bluff Substation A, 2012 Construction

Parameter	Trenching and Foundations	Equipment Pads	Equipment Installation	Power Line Connections	Testing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%	0%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	9.4%	9.4%	2.6%	3.3%	4.3%
Area Disturbed on a Typical Day, acres	5.70	11.40	11.40	22.50	1.00
Days of Disturbance	20	30	90	60	45
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0	20.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4	1.4	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-34.
Fugitive Emissions Parameters For Red Bluff Substation A, 2013 Construction

Parameter	Testing	Driveways and Walls	Site Cleanup
Assumed Soil Texture Class	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	0%	50%	50%
Natural Dust Control, Daily	0%	0%	0%

Basis			
Natural Dust Control, Annual Basis	9.4%	4.4%	1.4%
Area Disturbed on a Typical Day, acres	1.00	2.63	0.33
Days of Disturbance	45	40	15
Uncontrolled TSP Rate, lbs/acre-day	20.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4
Demolition PM10, total pounds	0	0	0
Construction Blasting PM10, total pounds	0	0	0
Acres of asphalt paving	0.00	22.81	0.00
Painted Surface Area, square feet	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%

RED BLUFF SUBSTATION CONSTRUCTION, SITE B (ALTERNATIVE 2)

Table D2-34.
Schedule for Red Bluff Substation B Construction

Activity Phase	Activity Duration, days	Work Days By Calendar Quarter			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011 Activity					
Access Road Improvements	15	0	15	0	0
Site Fencing	25	0	20	5	0
Site Clearing	60	0	0	59	1
Grading and Compacting	60	0	0	0	60
Net Construction Days	**160**	**0**	**35**	**64**	**61**
2012 Activity					
Trenching and Foundations	20	20	0	0	0
Equipment Pads	30	30	0	0	0
Equipment Installation	90	10	64	16	0
Power Line Connections	60	0	0	45	15
Testing	45	0	0	0	45
Net Construction Days	**245**	**60**	**64**	**61**	**60**
2013 Activity					
Testing	45	45	0	0	0
Driveways and Walls	40	15	25	0	0
Site Cleanup	15	0	15	0	0
Net Construction Days	**100**	**60**	**40**	**0**	**0**
Available Work Days Per Quarter		**61**	**64**	**64**	**64**

Construction phases would not overlap.

Table D2-35.
Equipment Use for Red Bluff Substation B Construction

Activity Phase	Acres Disturbed	On-Site Equipment Items	Total Items Including Off-Site Trucks	Equipment Use Hours At Site	On-Site Fuel Use, Gallons
2011 Activity					
Access Road Improvements	1.2	5	12	147	1,219
Site Fencing	3.1	6	14	298	848
Site Clearing	114.0	6	17	1,065	4,939
Grading and Compacting	114.0	9	17	1,642	11,678

2011 Totals	**118.3**	**26**	**60**	**3,152**	**18,683**
2012 Activity					
Trenching and Foundations	114.0	12	21	511	2,257
Equipment Pads	114.0	8	24	999	8,210
Equipment Installation	114.0	8	15	1,977	11,689
Power Line Connections	22.5	10	20	1,180	4,882
Testing	1.0	1	1	88	725
2012 Totals	**114.0**	**39**	**81**	**4,755**	**27,763**
2013 Activity					
Testing	1.0	1	1	88	717
Driveways and Walls	12.8	8	35	939	4,054
Site Cleanup	5.0	3	6	59	162
2013 Totals	**18.8**	**12**	**42**	**1,085**	**4,933**

Table D2-36.
Traffic Generation From Red Bluff Substation B Construction

Activity Phase	**Total Workers**	**Daily Average 1-Way Vehicle Trips**			
		To/From Shuttle Assembly Points	**Shuttle Trips To/From Site**	**Personal Vehicle Trips To/From Site**	**Construction Truck Trips To/From Site**
2011 Activity					
Access Road Improvements	6	0	0	10	1.2
Site Fencing	10	0	0	16	0.6
Site Clearing	8	0	0	13	0.4
Grading and Compacting	11	0	0	18	0.3
2011 Maximum	**11**	**0**	**0**	**18**	**1**
2012 Activity					
Trenching and Foundations	13	0	0	20	3.1
Equipment Pads	12	0	0	19	116.6
Equipment Installation	12	0	0	19	21.3
Power Line Connections	14	0	0	22	0.5
Testing	2	0	0	4	0.0
2012 Maximum	**14**	**0**	**0**	**22**	**117**
2013 Activity					
Testing	2	0	0	4	0.0
Driveways and Walls	10	0	0	20	37.6
Site Cleanup	5	0	0	10	0.5
2013 Maximum	**10**	**0**	**0**	**20**	**38**

Construction phases would not overlap.

Table D2-37.
Fugitive Emissions Parameters For Red Bluff Substation B Construction

Parameter	Access Road Improvements	Site Fencing	Site Clearing	Grading and Compacting
Assumed Soil Texture Class	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%	0%
Natural Dust Control, Annual Basis	1.4%	1.7%	2.9%	4.3%
Area Disturbed on a Typical Day, acres	0.08	0.12	1.90	1.90
Days of Disturbance	15	25	60	60
Uncontrolled TSP Rate, lbs/acre-day	80.0	40.0	80.0	80.0
Controlled PM10 Rate, lbs/acre-day	2.8	1.4	2.8	2.8
Demolition PM10, total pounds	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%

Table D2-38.
Fugitive Emissions Parameters For Red Bluff Substation B, 2012 Construction

Parameter	Trenching and Foundations	Equipment Pads	Equipment Installation	Power Line Connections	Testing
Assumed Soil Texture Class	sand	sand	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	50%	50%	50%	50%	0%
Natural Dust Control, Daily Basis	0%	0%	0%	0%	0%
Natural Dust Control, Annual Basis	9%	9%	3%	3%	4%
Area Disturbed on a Typical Day, acres	5.70	11.40	11.40	22.50	1.00
Days of Disturbance	20	30	90	60	45
Uncontrolled TSP Rate, lbs/acre-day	40.0	40.0	40.0	40.0	20.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4	1.4	1.4
Demolition PM10, total pounds	0	0	0	0	0
Construction Blasting PM10, total pounds	0	0	0	0	0
Acres of asphalt paving	0.00	0.00	0.00	0.00	0.00
Painted Surface Area, square feet	0	0	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%	91.2%	91.2%

Table D2-39.
Fugitive Emissions Parameters For Red Bluff Substation B, 2013 Construction

Parameter	Testing	Driveways and Walls	Site Cleanup
Assumed Soil Texture Class	sand	sand	sand
Soil PM10 Fraction	7.0%	7.0%	7.0%
Active Dust Control Program Effectiveness	0%	50%	50%
Natural Dust Control, Daily Basis	0%	0%	0%

Natural Dust Control, Annual Basis	9.4%	4.4%	1.4%
Area Disturbed on a Typical Day, acres	1.00	1.28	0.33
Days of Disturbance	45	40	15
Uncontrolled TSP Rate, lbs/acre-day	20.0	40.0	40.0
Controlled PM10 Rate, lbs/acre-day	1.4	1.4	1.4
Demolition PM10, total pounds	0	0	0
Construction Blasting PM10, total pounds	0	0	0
Acres of asphalt paving	0.00	9.67	0.00
Painted Surface Area, square feet	0	0	0
PM2.5 fraction of engine exhaust PM10	92.0%	92.0%	92.0%
PM2.5 fraction of fugitive dust PM10	20.0%	20.0%	20.0%
PM2.5 fraction of spray paint PM10	91.2%	91.2%	91.2%

APPENDIX D-3

URBEMIS VEHICLE EMISSIONS ANALYSIS INFORMATION

URBEMIS ANALYSES FOR ON-ROAD TRAFFIC EMISSIONS

Criteria pollutant and greenhouse gas emissions from construction-related traffic and from operational traffic were estimated using version 9.4 of the URBEMIS2007 model spreadsheet (Rimpo and Associates 2008) and supplemental spreadsheet analyses. URBEMIS2007 estimates carbon dioxide emissions from vehicle use, but does not estimate emission rates for methane or nitrous oxide. A spreadsheet analysis was used to estimate overall greenhouse gas emissions from worker commute travel. Emission rates for methane and nitrous oxide were obtained from Appendix C of the California Climate Action Registry 2007 general greenhouse gas emissions reporting protocol.

To simplify the number of URBEMIS runs required for the analysis, a series of generic URBEMIS runs were made for each relevant calendar year for each vehicle mix category that would comprise construction-related or operations traffic for the various project components (Solar Farm, Gen-Tie Line, and Red Bluff Substation). These generic URBEMIS runs used a mix of trip numbers (200 per day) and mean travel distances (75 miles per trip) that were high enough to avoid having any emission results round to zero. Subsequent spreadsheet analyses were used to convert the generic results from the URBEMIS runs into project-specific emission estimates. Because most travel would occur on freeways, an average travel speed of 55 mph was used for all URBEMIS runs.

Five general vehicle mixes were used for the generic URBEMIS runs, as indicated in Table D3-1. URBEMIS runs were made for 2011, 2012, and 2013 for each vehicle mix group. Separate runs were made for winter and summer temperature conditions. Separate URBEMIS runs also were made with roadway re-suspended dust turned on and off. URBEMIS runs with re-suspended dust turned on provided overall PM_{10} and $PM_{2.5}$ emission rates. URBEMIS runs with re-suspended dust turned off provided exhaust PM_{10} emission rates, which were used as the estimate of diesel particulate matter emissions. A monthly mean temperature values at the Eagle Mountain meteorological station were used to determine the weighting factors for winter and summer emission rates. Temperatures below or over 75 degrees Fahrenheit used to determine the number of months classified as winter or summer, respectively. Data from the Eagle Mountain meteorological station showed six months each for winter and summer temperature conditions. The construction worker personal vehicle mix presented in Table D3-1 reflects the high fraction of pickup truck and SUV vehicles expected for a construction project work force. The construction worker personal vehicle mix was also used for operational worker traffic analyses. The MHD truck mix was used for operational truck traffic at the Solar Farm. The LHT2 vehicle mix was used for operational maintenance inspection traffic for the Gen Tie Line and the Red Bluff Substation.

Table D3-1.
Vehicle Mix Groups Used for Generic URBEMIS Runs

Trip Type	Vehicle	Percent By	Temperature, Deg F	Average	Fuel Mix

	Type	Type	Winter	Summer	Speed, mph	
Construction Worker Personal Vehicles	LDA	25.6%	60	90	55	Default
	LDT1	16.3%	60	90	55	Default
	LDT2	37.4%	60	90	55	Default
	MDT	20.7%	60	90	55	Default
Shuttles	LHT2	100.0%	60	90	55	All Gasoline
Construction Trucks, most phases	HDD	100.0%	60	90	55	Default
Construction Trucks, site clearing and site cleanup	MHD	100.0%	60	90	55	All Diesel
Construction Trucks, selected Gen Tie Line phases	MHD	96.7%	60	90	55	Default
	HHD	3.3%	60	90	55	Default

LDA = light duty autos
LDT1 = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating up to 3,750 pounds
LDT2 = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating of 3,751 – 5,750 pounds
MDT = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating of 5,751 – 8,500 pounds
LHT2 = medium trucks and multi-passenger vehicles, gross vehicle weight rating of 10,001 – 14,000 pounds
MDT = heavy trucks, gross vehicle weight rating of 14,001 – 33,000 pounds
HHD = heavy trucks, gross vehicle weight rating of 33,001 – 60,000 pounds

The generic URBEMIS runs were all made using trip number and trip distance data that produced 15,000 vmt (vehicle miles traveled) per day. The URBEMIS estimates of criteria pollutant emissions for this generic amount of vehicle travel are summarized in Table D3-2. The companion estimates of greenhouse gas pollutant emissions for this generic amount of vehicle travel are summarized in Table D3-3.

Table D3-2.
URBEMIS Estimates of Criteria Pollutant Emissions For 15,000 VMT

Vehicle Group	Season	Pounds Per Day Produced By 15,000 VMT						
		ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$	DPM
2011 Emission Rates								
Personal Vehicles	Winter	6.31	12.58	91.08	0.13	25.71	4.86	1.21
	Summer	7.26	9.16	119.43	0.16	25.71	4.86	1.21
	Average	6.79	10.87	105.26	0.15	25.71	4.86	1.21

Shuttles	Winter	5.01	18.18	45.85	0.17	25.43	4.51	0.93
	Summer	4.24	12.95	47.13	0.17	25.43	4.51	0.93
	Average	4.63	15.57	46.49	0.17	25.43	4.51	0.93
HHD Trucks	Winter	21.84	425.85	91.39	0.53	43.10	20.00	18.60
	Summer	21.84	354.35	91.39	0.53	43.10	20.00	18.60
	Average	21.84	390.10	91.39	0.53	43.10	20.00	18.60
MHD Trucks	Winter	4.06	256.42	41.80	0.46	30.32	9.01	5.81
	Summer	4.06	213.37	41.80	0.46	30.32	9.01	5.81
	Average	4.06	234.90	41.80	0.46	30.32	9.01	5.81
Mixed Trucks	Winter	5.34	239.88	59.88	0.43	30.15	8.83	5.65
	Summer	5.28	198.28	60.51	0.43	30.15	8.83	5.65
	Average	5.31	219.08	60.20	0.43	30.15	8.83	5.65
2012 Emissions								
Personal Vehicles	Winter	6.09	11.71	86.76	0.13	25.71	4.86	1.21
	Summer	6.99	8.53	113.53	0.16	25.71	4.86	1.21
	Average	6.54	10.12	100.15	0.15	25.71	4.86	1.21
Shuttles	Winter	4.67	17.41	40.89	0.17	25.43	4.51	0.93
	Summer	3.90	12.02	41.96	0.17	25.43	4.51	0.93
	Average	4.29	14.72	41.43	0.17	25.43	4.51	0.93
HHD Trucks	Winter	19.66	373.94	85.28	0.53	41.45	18.48	16.95
	Summer	19.66	311.17	85.28	0.53	41.45	18.48	16.95
	Average	19.66	342.56	85.28	0.53	41.45	18.48	16.95
MHD Trucks	Winter	3.90	231.24	40.67	0.46	30.05	8.67	5.55
	Summer	3.90	192.42	40.67	0.46	30.05	8.67	5.55
	Average	3.90	211.83	40.67	0.46	30.05	8.67	5.55
Mixed Trucks	Winter	5.01	215.87	56.29	0.43	29.88	8.58	5.38
	Summer	4.96	178.46	56.82	0.43	29.88	8.58	5.38
	Average	4.99	197.17	56.56	0.43	29.88	8.58	5.38
2013 Emissions								
Personal Vehicles	Winter	5.89	10.89	82.65	0.13	25.73	4.88	1.22
	Summer	6.74	7.92	107.92	0.16	25.73	4.88	1.22
	Average	6.32	9.41	95.29	0.15	25.73	4.88	1.22
Shuttles	Winter	4.32	16.12	36.44	0.17	25.43	4.51	0.93
	Summer	3.62	11.13	37.34	0.17	25.43	4.51	0.93
	Average	3.97	13.63	36.89	0.17	25.43	4.51	0.93
HHD Trucks	Winter	17.51	324.81	79.10	0.53	39.86	17.02	15.36
	Summer	17.51	270.30	79.10	0.53	39.86	17.02	15.36
	Average	17.51	297.56	79.10	0.53	39.86	17.02	15.36
MHD Trucks	Winter	3.73	208.88	39.75	0.46	29.82	8.55	5.32
	Summer	3.73	173.79	39.75	0.46	29.82	8.55	5.32
	Average	3.73	191.34	39.75	0.46	29.82	8.55	5.32
Mixed Trucks	Winter	4.70	194.44	53.17	0.43	29.63	8.35	5.13
	Summer	4.65	160.75	53.61	0.43	29.63	8.35	5.13
	Average	4.68	177.60	53.39	0.43	29.63	8.35	5.13

ROG = reactive organic compounds (ozone and particulate matter precursors)

NO_x = nitrogen oxides (ozone and particulate matter precursors)
CO = carbon monoxide
SO_x = sulfur oxides
PM_{10} = inhalable particulate matter, particles generally smaller than 50 microns
$PM_{2.5}$ = fine particulate matter, particles generally smaller than 6 microns
DPM = diesel particulate matter (carcinogen)

Table D3-3.
Estimates of Greenhouse Gas Emissions For 15,000 VMT

Vehicle Group	Season	Pounds Per Day Produced By 15,000 VMT			
		CO_2	CH_4	N_2O	CO_2e
2011 Emissions					
Personal Vehicles	Winter	13,084.86	1.65	1.65	13,618.93
	Summer	16,514.08	1.65	1.65	17,048.15
	Average	14,799.47	1.65	1.65	15,333.54
Shuttles	Winter	16,875.21	1.98	1.65	17,417.55
	Summer	16,875.21	1.98	1.65	17,417.55
	Average	16,875.21	1.98	1.65	17,417.55
HHD Trucks	Winter	54,923.52	1.98	1.65	55,465.86
	Summer	54,923.52	1.98	1.65	55,465.86
	Average	54,923.52	1.98	1.65	55,465.86
MHD Trucks	Winter	49,724.67	1.98	1.65	50,267.01
	Summer	49,724.67	1.98	1.65	50,267.01
	Average	49,724.67	1.98	1.65	50,267.01
Mixed Trucks	Winter	45,926.01	1.98	1.65	46,468.35
	Summer	45,926.01	1.98	1.65	46,468.35
	Average	45,926.01	1.98	1.65	46,468.35
2012 Emissions					
Personal Vehicles	Winter	13,082.90	1.65	1.65	13,616.97
	Summer	16,518.44	1.65	1.65	17,052.51
	Average	14,800.67	1.65	1.65	15,334.74
Shuttles	Winter	16,875.00	1.98	1.65	17,417.34
	Summer	16,875.00	1.98	1.65	17,417.34
	Average	16,875.00	1.98	1.65	17,417.34
HHD Trucks	Winter	54,923.52	1.98	1.65	55,465.86
	Summer	54,923.52	1.98	1.65	55,465.86
	Average	54,923.52	1.98	1.65	55,465.86
MHD Trucks	Winter	49,724.67	1.98	1.65	50,267.01
	Summer	49,724.67	1.98	1.65	50,267.01
	Average	49,724.67	1.98	1.65	50,267.01
Mixed Trucks	Winter	45,926.01	1.98	1.65	46,468.35
	Summer	45,926.01	1.98	1.65	46,468.35
	Average	45,926.01	1.98	1.65	46,468.35
2013 Emissions					
Personal	Winter	13,081.22	1.65	1.65	13,615.29

Vehicles	Summer	16,524.23	1.65	1.65	17,058.30
	Average	14,802.73	1.65	1.65	15,336.79
Shuttles	Winter	16,874.81	1.98	1.65	17,417.15
	Summer	16,874.81	1.98	1.65	17,417.15
	Average	16,874.81	1.98	1.65	17,417.15
HHD Trucks	Winter	54,923.52	1.98	1.65	55,465.86
	Summer	54,923.52	1.98	1.65	55,465.86
	Average	54,923.52	1.98	1.65	55,465.86
MHD Trucks	Winter	49,724.67	1.98	1.65	50,267.01
	Summer	49,724.67	1.98	1.65	50,267.01
	Average	49,724.67	1.98	1.65	50,267.01
Mixed Trucks	Winter	45,926.01	1.98	1.65	46,468.35
	Summer	45,926.01	1.98	1.65	46,468.35
	Average	45,926.01	1.98	1.65	46,468.35

CO_2 = carbon dioxide, GWP multiplier = 1
CH_4 = methane, GWP multiplier = 25
N_2O = nitrous oxide, GWP multiplier = 298
CO_2e = carbon dioxide equivalents
GWP = global warming potential as CO_2e, based on multipliers from IPCC 2007

To assist in estimating travel distances within California for construction-related and operational vehicle trips, a map program was used to measure distances between the Solar Farm site and various communities. The results of that analysis are presented in Table D3-4. The analysis of emissions from construction-related truck trips was limited to truck travel in California. No attempt was made to estimate the residency pattern for construction workers, but the data in Table D3-4 were used to assist in making generalized travel distance estimates.

Table D3-4.
Highway Distances Between the Solar Farm Site and Surrounding Communities

Community	1-Way Miles	Miles in SCAQMD Jurisdiction	1-Way Miles By Air Basin			% Miles By Air Basin		
			South Coast	Salton Sea	Mojave Desert	South Coast	Salton Sea	Mojave Desert
Blythe	55	27	55	0	0	100.0%	0.0%	0.0%
Twentynine Palms	84	37	84	0	0	100.0%	0.0%	0.0%
Indio	60	60	16	44	0	26.7%	73.3%	0.0%
Palm Springs	81	81	16	65	0	19.8%	80.2%	0.0%
Salton City	89	75	16	73	0	18.0%	82.0%	0.0%
Brawley	123	75	16	107	0	13.0%	87.0%	0.0%
El Centro	138	75	16	122	0	11.6%	88.4%	0.0%
Yucca Valley	102	89	29	73	0	28.4%	71.6%	0.0%
Victorville	169	89	96	73	0	56.8%	43.2%	0.0%

Banning	101	101	16	72	13	15.8%	71.3%	12.9%
Morengo Valley	121	121	16	72	33	13.2%	59.5%	27.3%
Riverside	134	134	16	72	46	11.9%	53.7%	34.3%
Corona	145	145	16	72	57	11.0%	49.7%	39.3%
San Bernardino	133	133	16	72	45	12.0%	54.1%	33.8%
Fontana	137	137	16	72	49	11.7%	52.6%	35.8%
Ontario Airport	144	144	16	72	56	11.1%	50.0%	38.9%
Upland	150	150	16	72	62	10.7%	48.0%	41.3%

Criteria pollutant and greenhouse gas emission estimates associated with construction and operation of Project facilities have been presented in Sections 4.2 and 4.5 of the EIS, and are not repeated here. Section 4.2 of the EIS also summarizes daily and annual vehicle trips and VMT for construction and operational phases of each project component, so that data is not repeated here. The following sections provide additional information specific to the analyses of emissions from construction truck traffic, construction worker traffic, and operational traffic.

CONSTRUCTION-RELATED HEAVY-DUTY TRUCK TRAFFIC ANALYSES

Construction-related vehicle trip numbers were estimated using the CNSTEMIS model analyses (see Appendix D-1 and Appendix D-2). Sunlight and SCE provided preliminary estimates of construction-related truck traffic. Sunlight also provided estimates on the point of origin for most construction material deliveries. CNSTEMIS analyses allocated the applicant-supplied truck load estimates to appropriate construction phases and made further adjustments to reflect other expected truck traffic (including equipment transporters). Additional adjustments were made as necessary when changes were made to the project description. In particular, the decision to use on-site power screeners resulted in deleting estimates of sand and gravel deliveries to the Solar Farm site. Sunlight provided generalized estimates of average and maximum construction worker numbers for construction of the Solar Farm and Gen Tie Line. The CNSTEMIS model was used to develop estimates of the number of construction workers by activity phase so as to approximate Sunlight's estimate of the maximum work force. SCE provided estimates of work force requirements for the Red Bluff Substation according to type of construction activity. The SCE workforce numbers were extrapolated to the construction phases used in the CNSTEMIS analyses.

CONSTRUCTION WORKER COMMUTE TRAFFIC ANALYSES

Construction worker commute traffic for the Solar Farm was analyzed in terms of several components. Sunlight plans to provide a shuttle bus system transport most construction workers to and from the Solar Farm site, with shuttle assembly points in the Palm Springs and Blythe areas. Some workers, however, would commute to the Solar Farm site in personal vehicles, either by choice, because they miss the shuttle connection, or because their travel route makes it inconvenient to use the shuttle buses. The analysis assumed that 10.5 percent of workers would use personal vehicles, and that 40 percent of those workers would carpool with two workers per vehicle. The remaining 89.5 percent of workers were assumed to use the shuttle buses. To provide a conservative analysis, it was assumed that the 20-passenger shuttles would have an average occupancy of 15 workers per vehicle. Workers who use the shuttle bus system would still need to drive to and from the shuttle assembly points. It was assumed that 40 percent of those trips would be by 2-person carpools.

No shuttle system use was assumed in the analysis of construction worker commute traffic for the Gen Tie Line and the Red Bluff Substation. The analysis of the Gen Tie Line assumed that for most construction phases, 25 percent of the workers would carpool with two workers per vehicle. Construction of the Red Bluff Substation might be done by SCE crews or by contractor. SCE will require any contractors bidding on the project to provide a transportation plan for outlining procedures that would be used to reduce construction worker commute traffic. The analysis of construction worker commute traffic for the Red Bluff Substation assumed that for most construction phases, 50 percent of the workers would carpool with two workers per vehicle.

OPERATIONAL TRAFFIC ANALYSES

The only component of the Project that would have on-site operational employees would be the Solar Farm. The Solar Farm would have only 10 to 15 workers on-site on any given day. Due to the low number of on-site employees, the analysis of operational worker commute emissions assumed no shuttle system or carpooling.

References

California Climate Action Registry. 2007. **General Reporting Protocol Version 2.2: Reporting Entity-Wide Greenhouse Gas Emissions.** Los Angeles, CA

Intergovernmental Panel on Climate Change. 2007. **Climate Change 2007: Technical Summary of the Working Group I Report.** Internet website www.ipcc.ch. Accessed on June 23, 2008.

Rimpo and Associates. 2008. **URBEMIS2007 Version 9.2.4.** Computer program downloaded from URBEMIS website http://www.urbemis.com. Accessed on February 18, 2008.

APPENDIX D-4

WIND EROSION EMISSIONS ANALYSIS INFORMATION

FUGITIVE DUST EMISSIONS FROM WIND EROSION

Introduction

Wind can move soil particles by three general processes: surface creep (rolling along the ground surface), saltation (a bouncing movement along the ground surface caused by particle collisions that help force a particle into the air for a brief time before it falls back to the ground), and suspension transport (particles lofted into the air and remaining suspended for more than a minute). Surface creep and saltation typically account for most soil mass movement associated with wind erosion, and normally involve larger sand-size soil particles. Suspension transport normally involves smaller silt and clay size soil particles. From an air pollution standpoint, suspension transport of soil particles is the wind erosion process that generates fugitive dust.

The extent of fugitive dust generated by wind erosion is affected by numerous factors, including:

- Soil texture (the mix of clay, silt, and sand sized particles in a soil);
- Particle aggregation (mostly due to clay content);
- Soil moisture conditions;
- Organic matter content of soils;
- Non-erodible surface features (gravel, rocks, boulders, rock outcrops, etc.);
- Extent and density of vegetation cover;
- Surface crusting – mineral or biological crusts – especially between vegetation stems;
- Wind speed;
- Vertical air turbulence;
- Sedimentation of erodible material from upslope water erosion or from flood deposits; and
- Active disturbance of surface soils.

Soil moisture conditions and surface conditions are important factors determining the vulnerability of an area to wind erosion. In desert areas, soil moisture levels are high only during and after rainfall or flash flood events. Consequently, soil moisture levels in desert areas are high enough to influence wind erosion processes for only brief intermittent periods.

The surface features of greatest importance are non-erodible surface material, vegetation cover, mineralized soil crusts, and biological soil crusts. The most common types of non-erodible surface materials in deserts include scattered rocks and boulders, rock formation outcrops, and desert pavement. Desert pavements are areas with rock fragments of pebble to cobble size that cover an underlying layer of sand, silt, or clay. Desert pavement areas typically have little or no vegetation cover. The extent to which desert pavement reduces wind erosion and resulting fugitive dust depends on the density of the rock fragments covering the underlying soil.

Vegetation is commonly the primary feature affecting natural wind erosion conditions. Both live and dead vegetation can reduce wind erosion. Studies of the effect of vegetation on wind erosion show that:

- Canopy cover is a better predictor of wind erosion control than overall biomass.
- The effectiveness of vegetation cover in reducing wind erosion is strongly non-linear, with even low vegetation cover values providing meaningful reductions in wind erosion.
- Upright vegetation is more effective at reducing wind erosion than the same vegetation knocked flat against the ground.
- For a given biomass, vegetation with multiple thin stems is more effective at reducing wind erosion than vegetation with fewer thick stems.
- A vegetation structure with canopy cover distributed down to ground level is more effective than vegetation structure with the canopy limited to the tops of tall stems or trunks.

Vegetation plantings often provide a more effective windbreak than solid barriers of equivalent height. Solid barriers tend to generate air turbulence along the upwind side, over the top of the barrier, and at the ends of the barrier. This air turbulence increases localized wind erosion. Somewhat porous windbreaks, such as vegetation plantings, reduce wind speeds in the downwind area without off-setting increases in wind turbulence.

Surveys of the proposed solar farm site indicate that there are areas of desert pavement in both the northwest and southwest portions of the site. An estimated 20 to 30 percent of the overall site has moderate to strong desert pavement, with an additional 5 to 15 percent of the overall site having weakly developed desert pavement (Earth Systems Southwest 2010a). The remainder of the solar farm site is typical Mojave Desert vegetation on a sandy soil. Vegetation cover, mineral soil crusts, and biological soil crusts all help reduce fugitive dust from wind erosion from such areas. Existing vegetation at the solar farm site provides an estimated 15 percent canopy coverage, with little or no stable biological or mineral crusts in the open areas between desert shrubs (Hughes 2010).

Geotechnical studies conducted at the solar farm site indicate sandy soils throughout the site, with a typical silt plus clay content of 5 to 13 percent (Eberhart/United Consultants 2007; Earth Systems Southwest 2010b). The Natural Resources Conservation Service (NRCS) has conducted limited soil surveys on some private agricultural lands near Desert Center. Agricultural development of desert soils typically results in an increase in organic matter content, resulting in a more loamy texture to the soils than would occur without agricultural development. Agricultural lands near the solar farm site were generally characterized as gravelly loamy, coarse sand, or loamy sand with a high potential for wind erosion (Houdeshell 2010).

Overview of the WNDEROSN Model

Fugitive dust emissions from wind erosion have been estimated using a spreadsheet model (WNDEROSN) that was developed from analyses used to model wind erosion and dust storm conditions at Mono Lake in the early 1990s. The spreadsheet model generates a sigmoidal curve equation based on a minimum of two data points: a zero value point at the threshold wind speed for initiating wind erosion, and a practical maximum emission rate normally set at a wind speed of 50 mph. The sigmoidal curve equation can be fitted to data points for additional wind speed values if portable wind tunnel study data are available. Most environmental assessments, however, lack project-specific portable wind tunnel data, and thus rely on a default curve generated from the assumed wind speed threshold for initiating wind erosion and a practical maximum wind erosion rate based on comparison to emission rates from other types of soil disturbance.

The spreadsheet model also includes default emission reduction equations that can be used to assess the effects of vegetation cover on wind erosion. The vegetation cover effectiveness equations also can be used in assessing wind erosion reduction from other types of ground cover (desert pavement, solar arrays, etc.) by converting coverage values for those conditions into "equivalent vegetation cover" factors.

The spreadsheet model provides default maximum emission rates based on other types of soil disturbance, all of which have emission rates that vary according to soil clay plus silt content. The following types of conditions are used for setting the maximum wind erosion rate:

- Fugitive dust form agricultural tilling;
- Fugitive dust from general construction activity;
- Fugitive dust from vehicle travel on unpaved dirt roads, with an adjustment for silt depletion on heavily used unpaved roads; and
- Fugitive dust from vehicle travel on unpaved dirt roads, assuming no silt content depletion compared to adjacent soils.

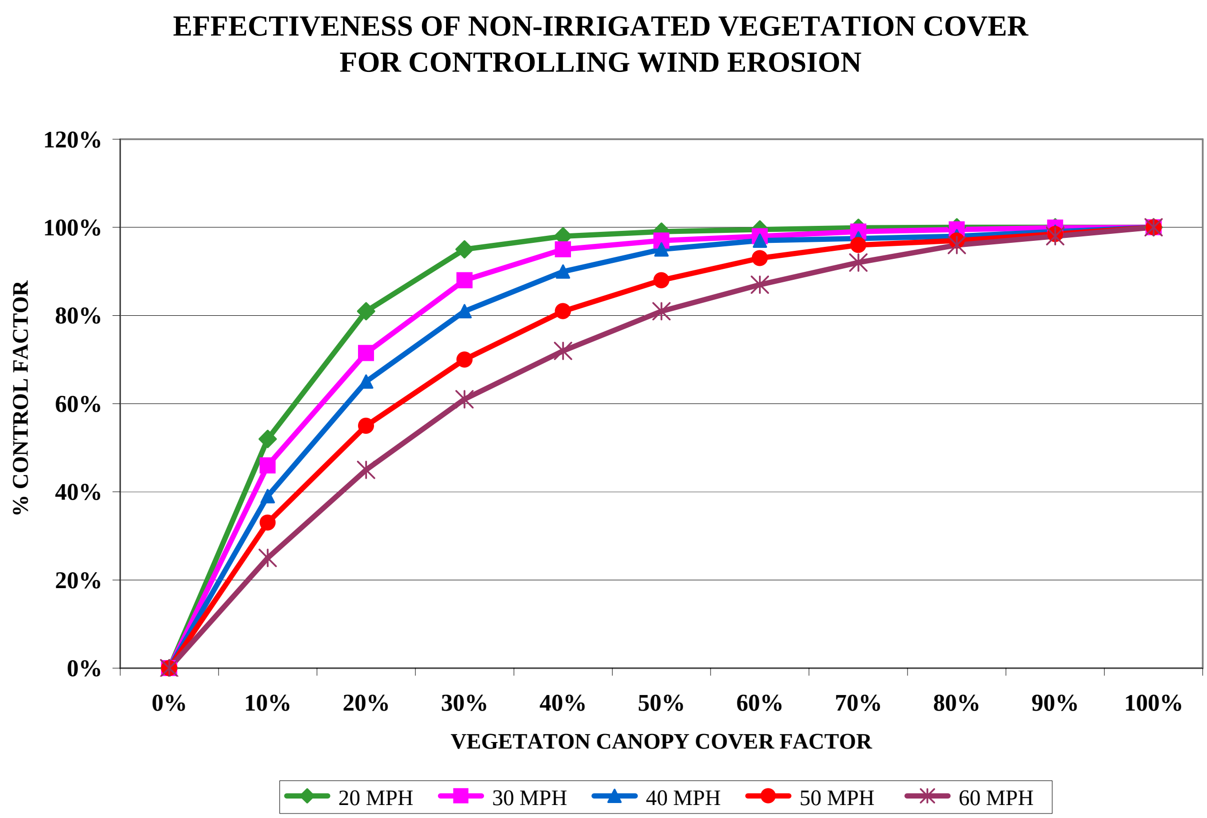
The spreadsheet model provides three general categories of default equations:

- Normal wind erosion conditions, using maximum wind erosion rates based on agricultural tilling or construction site fugitive dust, whichever is greater for the soil conditions of interest;
- Unusual wind erosion conditions (high silt content soils with little clay content, oxidized peat soils, diatomaceous earth sediments, etc.), using maximum wind erosion rates based on unpaved dirt roads with silt depletion compared to adjacent soils; and
- Extreme wind erosion conditions (unconsolidated volcanic ash deposits, etc.), using maximum wind erosion rates based on unpaved dirt roads with no silt depletion.

The normal wind erosion condition equations are applicable to the project area.

The basic equations generated by the WNDEROSN model apply to barren soil conditions. The model includes optional equations that can be used to estimate the wind erosion control effect of vegetation cover. The effectiveness of vegetation cover in reducing wind erosion varies with wind speed. Figure D4-1 illustrates the default vegetation cover effectiveness estimates used in the WNDEROSION model.

Figure D4-1



Parameters Used for the Desert Sunlight Analysis

The wind erosion analysis for the Solar Farm site was prepared as a net change analysis comparing the developed Solar Farm site conditions to existing natural conditions. All analyses used the normal wind erosion condition equations and a 7 percent clay plus silt content. Annual emission estimates were developed by estimating the annual wind speed frequency distribution for the project area, and then applying the wind erosion equations to that wind speed frequency distribution to generate an annual barren ground wind erosion emission estimate. The barren ground wind erosion data were then adjusted for natural conditions (ground cover by vegetation, desert pavement, and soil biological crusts) to produce an annual baseline wind erosion estimate. For the Solar Farm layout alternatives, the barren ground wind erosion data were adjusted for ground cover by Solar Farm facilities (converting ground cover by solar arrays, building and equipment pads, gravel roads, etc. to equivalent vegetation cover values) to produce annual developed site wind erosion estimates. The difference between annual wind erosion estimates for the developed Solar Farm layouts and baseline conditions represents the net change in wind erosion conditions for the site.

No site-specific wind speed data was readily available, so data from other locations was used to develop estimates for the project area. Hourly wind speed data was not readily available for the Blythe airfield. The closest location with a reasonable period of readily available hourly wind data was the Barstow-Daggett airfield in San Bernardino County (WebMet 2010). Hourly wind speed data from Barstow-Daggett for January 1980 through December 1990 were used to establish a basic wind speed frequency profile. A comparison of summary wind statistics for the Barstow-Daggett and Blythe airfields showed that wind speeds at Blythe were noticeably lower than concurrent wind speeds at Barstow-Daggett. The mean wind speed at Barstow-Daggett was 11.4 mph for 1996 – 2006, while the mean wind speed at Blythe was 7.9 mph for the same period (Western Regional Climate Center 2007). Consequently, the Barstow-Daggett hourly wind data were adjusted by the ratio of mean wind speeds to approximate a wind speed profile for Blythe. The estimated wind speed profile for Blythe was assumed to be representative of wind speeds in the Project area. This analysis procedure produced a mean wind speed estimate at Blythe of 8.1 mph for the 1980 through 1990 data, with a maximum hourly average wind speed of 36 mph. Table D4-1 summarizes the wind speed distribution generated from the 1980 through 1990 data.

Table D4-1.

Estimated Wind Speed Distribution for the Project Area

Wind Speed, mph	Incremental Percent of Hours	Cumulative Percent of Hours
0	8.654%	8.65%
1	0.004%	8.66%
2	2.083%	10.74%
3	5.676%	16.42%
4	9.583%	26.00%
5	6.121%	32.12%
6	6.300%	38.42%
7	12.800%	51.22%
8	10.982%	62.20%
9	3.572%	65.78%
10	6.287%	72.06%
11	6.117%	78.18%
12	5.556%	83.74%
13	1.606%	85.34%
14	1.684%	87.03%
15	3.544%	90.57%
16	3.915%	94.48%
17	0.617%	95.10%

Wind Speed, mph	Incremental Percent of Hours	Cumulative Percent of Hours
18	1.152%	96.25%
19	0.669%	96.92%
20	0.595%	97.52%
21	1.361%	98.88%
22	0.203%	99.08%
23	0.377%	99.46%
24	0.070%	99.53%
25	0.301%	99.83%
26	0.053%	99.88%
27	0.033%	99.91%
28	0.016%	99.93%
29	0.047%	99.98%
30	0.004%	99.98%
31	0.007%	99.99%
32	0.001%	99.99%
33	0.007%	100.00%
34	0.000%	100.00%
35	0.000%	100.00%
36	0.001%	100.00%
37	0.000%	100.00%
38	0.000%	100.00%
39	0.000%	100.00%
40	0.000%	100.00%
41	0.000%	100.00%
42	0.000%	100.00%
43	0.000%	100.00%
44	0.000%	100.00%
45	0.000%	100.00%

The wind erosion equation generated for the project area was based on sandy soils with a silt plus clay fraction of 7 percent and an 18-mph threshold for the initiation of wind erosion. The sigmoidal equation generated by the WNDEROSN model for the Solar Farm site was:

$$Q = \frac{0.00048907*0.514206*[0.944748+e^{(-4.85366+0.170731707*U)} - e^{(-1*(-.85366+0.170731707*U))}]}{[0.944748+e^{(-4.85366+0.170731707*U)} + e^{(-1*(-.85366+0.170731707*U))}]}$$

where:

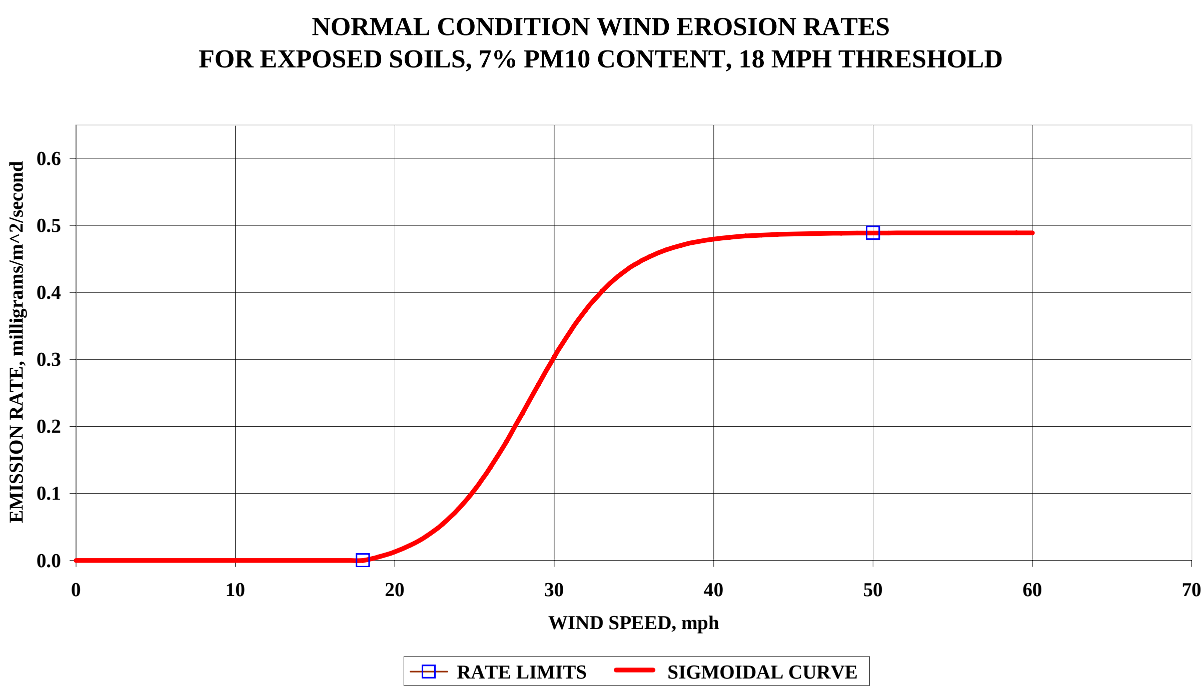
Q = wind erosion rate for PM_{10} in grams per square meter per second

e = the base for natural logarithms

U = hourly average wind speed in mph

Figure D4-2 illustrates the PM_{10} wind erosion rates estimated for the project area as a function of hourly average wind speed.

Figure D4-2



The wind erosion rates illustrated in Figure D4-2 represent barren soil conditions. Under existing conditions, these emission rates are reduced by the combination of vegetation cover, desert pavement cover, and soil biological crust cover. Desert pavement conditions vary in different portions of the site, with most desert pavement areas showing moderate to strong development. For simplicity in the wind erosion analysis, the overall desert pavement coverage was assumed to be equivalent to 35 percent area coverage with moderately strong desert pavement development. The Solar Farm site does not have extensive soil biological crusts. A nominal 5 percent of the Solar Farm site was assumed to have soil biological crusts. The remaining 60 percent of the Solar Farm site was assumed to have a vegetation cover of about 15 percent.

The vegetation cover effect equations in the WNDEROSN model were used to estimate wind erosion reductions attributable to desert pavement and soil crusts. This was accomplished by assigning a “vegetation cover equivalence factor” to these types of surface coverings. Soil biological crusts were assumed to be as effective in reducing wind erosion as vegetation with 35 percent vegetation canopy coverage. Desert pavement areas were assumed to be as effective in reducing wind erosion as vegetation with 50 percent canopy coverage. For existing conditions, the combination of vegetation, desert pavement, and soil biological crusts would be equivalent to vegetation with 28.3 percent canopy coverage across the entire Solar Farm site.

Development of the Solar Farm would remove existing vegetation, soil biological crusts, and desert pavement from the site, replacing these features with gravel road and parking areas; buildings and equipment pads; solar panel arrays; and open areas that have been compacted and treated with dust palliatives. Solar Farm operations would have limited site disturbance from periodic security, equipment inspection, and equipment maintenance activities. On-site traffic volumes would be quite low compared to the construction period. Areas covered by buildings and equipment pads would be completely protected from wind erosion. Areas covered by gravel surfaces or by solar arrays would be partially protected from wind erosion. Mitigation measures recommended in the EIS text include annual re-application of dust palliatives to gravel roads and open areas.

Evaluation of wind erosion rates for the Solar Farm alternatives required assigning a vegetation cover equivalence factor to each of the categories of physical features that would be present following construction. Buildings and equipment pads were assigned a vegetation cover equivalence factor of 100 percent. Gravel roads and parking areas were assigned a vegetation cover equivalence factor of 27 percent. Previous compaction and dust palliative applications for open areas of the site would reduce wind erosion from these areas. In addition, open areas between the solar panel arrays would receive wind shielding from the array structures, especially for the predominant wind directions. Given these considerations, open areas of the site were assigned a vegetation cover equivalence factor of 23 percent.

Approximately one third of the Solar Farm site would be directly covered by solar panel arrays. The solar panel arrays would have a windbreak effect that varies according to wind direction. The panel arrays would be aligned in an east-west direction, with the panels would be sloped to the south. The vegetation cover equivalence factor assigned to the areas directly covered by the solar panels was varied according to wind direction. For winds from the south, the vegetation cover equivalence factor was set equal to the area coverage factor for the solar panels (33 percent for Solar Farm Layout B and 34.1 percent for Solar Farm Layout C). For north winds, the vegetation cover equivalence factor was set at 5 percentage points less than the physical area coverage for the solar panels, since the slope of the panels would generate some downward wind turbulence when winds blow from the north. The linear solar array layout would result in only limited wind erosion reduction for winds from the east or west. The vegetation cover equivalence factor for east and west winds was set at 8 percent. Overall wind direction frequencies were assumed to be 35 percent for north winds, 5 percent for east winds, 45 percent for south winds, and 15 percent for west winds. Table D4-2 summarizes the vegetation cover equivalence factors and resulting wind erosion reduction factors used for the analysis.

Table D4-2.

Summary of Wind Erosion Control Factors for Solar Farm Features

Parameter	Wind Speed, mph	Vegetation Cover Equivalence Factor	Percent Reduction in Wind Erosion Rates		
			Existing Conditions	Solar Farm Layout B	Solar Farm Layout C
Vegetation Cover	20	15.0%	69.8%	0.0%	0.0%
	30	15.0%	58.2%	0.0%	0.0%
	40	15.0%	54.9%	0.0%	0.0%
	50	15.0%	44.8%	0.0%	0.0%
	60	15.0%	35.8%	0.0%	0.0%
Soil Biological Crusts	20	35.0%	96.5%	0.0%	0.0%
	30	35.0%	92.1%	0.0%	0.0%
	40	35.0%	84.5%	0.0%	0.0%
	50	35.0%	76.1%	0.0%	0.0%
	60	35.0%	66.7%	0.0%	0.0%
Desert Pavement	20	50.0%	99.1%	0.0%	0.0%
	30	50.0%	97.0%	0.0%	0.0%
	40	50.0%	93.8%	0.0%	0.0%
	50	50.0%	88.2%	0.0%	0.0%
	60	50.0%	81.0%	0.0%	0.0%
Gravel Surfaced Areas with dust palliative treatments	20	27.0%	0.0%	92.2%	92.2%
	30	27.0%	0.0%	85.4%	85.4%
	40	27.0%	0.0%	75.9%	75.9%
	50	27.0%	0.0%	66.2%	66.2%
	60	27.0%	0.0%	56.2%	56.2%

Parameter	Wind Speed, mph	Vegetation Cover Equivalence Factor	Percent Reduction in Wind Erosion Rates		
			Existing Conditions	Solar Farm Layout B	Solar Farm Layout C
Open Areas with dust palliative treatments	20	23.0%	0.0%	88.0%	88.0%
	30	23.0%	0.0%	79.6%	79.6%
	40	23.0%	0.0%	70.3%	70.3%
	50	23.0%	0.0%	60.0%	60.0%
	60	23.0%	0.0%	50.1%	50.1%
Solar Arrays, North Wind Conditions	20	28.0% - 29.1%	0.0%	93.0%	93.7%
	30	28.0% - 29.1%	0.0%	86.6%	87.7%
	40	28.0% - 29.1%	0.0%	77.2%	78.5%
	50	28.0% - 29.1%	0.0%	67.6%	69.1%
	60	28.0% - 29.1%	0.0%	57.7%	59.2%
Solar Arrays, East Wind Conditions	20	8%	0.0%	44.0%	44.0%
	30	8%	0.0%	39.5%	39.5%
	40	8%	0.0%	35.0%	35.0%
	50	8%	0.0%	27.4%	27.4%
	60	8%	0.0%	20.7%	20.7%
Solar Arrays, South Wind Conditions	20	33.0% - 34.1%	0.0%	95.8%	96.2%
	30	33.0% - 34.1%	0.0%	90.9%	91.6%
	40	33.0% - 34.1%	0.0%	82.6%	83.7%
	50	33.0% - 34.1%	0.0%	73.9%	75.2%
	60	33.0% - 34.1%	0.0%	64.3%	65.6%

Parameter	Wind Speed, mph	Vegetation Cover Equivalence Factor	Percent Reduction in Wind Erosion Rates		
			Existing Conditions	**Solar Farm Layout B**	**Solar Farm Layout C**
Solar Arrays, West Wind Conditions	20	8%	0.0%	44.0%	44.0%
	30	8%	0.0%	39.5%	39.5%
	40	8%	0.0%	35.0%	35.0%
	50	8%	0.0%	27.4%	27.4%
	60	8%	0.0%	20.7%	20.7%
Overall Site Conditions	**20**	**24.4% - 28.3%**	**93.2%**	**89.7%**	**90.0%**
	30	**24.4% - 28.3%**	**86.9%**	**81.9%**	**82.4%**
	40	**24.4% - 28.3%**	**77.6%**	**72.4%**	**72.8%**
	50	**24.4% - 28.3%**	**68.0%**	**62.3%**	**62.8%**
	60	**24.4% - 28.3%**	**58.1%**	**52.3%**	**52.8%**

Under existing conditions for the assumed wind speed distribution, natural vegetation and ground cover conditions provide a 90.5 percent reduction from barren ground wind erosion rates. Under developed Solar Farm conditions with the assumed wind speed distribution, the developed Solar Farm site would provide an 86.4 percent reduction from barren ground wind erosion rates under Solar Farm Layout B, and an 86.8 percent reduction from barren ground wind erosion rates under Solar Farm Layout C. Table D4-3 summarizes the net changes in wind erosion rates estimated by the WNDEROSN model.

Table D4-3.

Estimated Net Changes in Wind Erosion Rates for the Solar Farm Site

Parameter	Units	Solar Farm Site B	Solar Farm Site C
Site Acres	Acres	4,245	3,045
Barren Ground Wind Erosion Rate for PM_{10}	Tons Per Year	818.0	586.8
Natural Condition Wind Erosion Rate for PM_{10}	Tons Per Year	78.0	55.9
Developed Solar Farm Condition Wind Erosion Rate for PM_{10}	Tons Per Year	111.7	77.2
Net Change, Solar Farm versus Natural Conditions	**Tons Per Year**	**33.7**	**21.2**
Net Change, Solar Farm versus Natural Conditions	**Pounds Per Acre Per Year**	**15.863**	**13.943**

REFERENCES

Earth Systems Southwest. 2010a. **Estimate of Desert Pavement Coverage.** Letter report prepared for First Solar Electric, LLC.

Earth Systems Southwest. 2010b. **Geotechnical Engineering Services, Desert Sunlight Solar Farm 550MW Photovoltaic System, Desert Center Area of Riverside County, California.** Prepared for First Solar Electric, LLC.

Eberhart/United Consultants. 2007. **Phase 1 Geologic Reconnaissance Report Proposed Desert Sunlight Solar Energy Project Desert Center Area, Riverside County, California.** Prepared for Optisolar.

Houdeshell, Carrie-Ann. 2010. MLRA Soil Survey Leader, Natural Resources Conservation Service, Victorville, CA. Personal communication with Stephanie Pacheco, Tetra Tech, March 3, 2010.

Hughes, Kent W. 2010. Ironwood Consulting. Personal communication with Bob Sculley, Tetra Tech, March 2, 2010

APPENDIX D-5

GREENHOUSE GAS EMISSIONS AVOIDED THROUGH DISPLACEMENT OF ALTERNATIVE POWER GENERATION SOURCES

INTRODUCTION

The proposed Solar Farm would have a power generation capacity of 550 MW under Solar Farm Layout B, and 413 MW under Solar Farm Layout C. These power generation capacities translate into an estimated 1.2 billion kilowatt-hours of electrical power generation per year for Solar Farm Layout B and 901 million kilowatt-hours or electrical power generation per year for Solar Farm C. Southern California Edison (SCE) and Pacific Gas and Electric (PG&E) have signed power purchase agreements with Desert Sunlight. Based on their respective power purchase agreements, SCE would receive 45.45 percent of the power generated by the Solar Farm and PG&E would receive 54.55 percent of the power.

Electrical power is distributed through an integrated transmission system grid with multiple inter-connected power generation sources. Electrical power demand at any time is balanced among available sources of power generation. Any new source of power generation added to the grid necessarily affects power generation by other power plants that are connected to the transmission grid, since total power generation must be balanced against current power demand. Consequently, power generation by the Proposed Project will effectively displace other power generation sources that otherwise would be used to meet the prevailing electrical power demand in the SCE and PG&E service areas.

POWER GENERATION MIXES FOR SCE AND PG&E

Both SCE and PG&E rely on a mix of power generation sources to meet electrical power demands in their respective service areas. Tables D5-1 and D5-2 summarize current (2009) overall power generation mixes for SCE and PG&E, respectively. Also included in Tables D5-1 and D5-2 are average greenhouse gas emission rates associated with each type of power source.

Table D5-1.
Summary of 2009 Power Generation Mix for SCE

Power Plant Type	Percent of Annual Power Generation	Emission Factor, Pounds per Kilowatt-Hour			
		CO_2	CH_4	N_2O	GWP as CO_2e
Coal	10.0%	0.710	0.000075	0.000011	**0.715**
Large Hydro	5.0%	0.000	0.000000	0.000000	**0.000**
Natural Gas	50.7%	0.399	0.000007	0.000001	**0.399**
Nuclear	17.9%	0.000	0.000000	0.000000	**0.000**
Biomass/Waste	2.0%	0.706	0.000226	0.000030	**0.720**
Geothermal	9.0%	0.057	0.000000	0.000000	**0.057**
Small Hydro	1.0%	0.000	0.000000	0.000000	**0.000**
Solar	1.0%	0.000	0.000000	0.000000	**0.000**
Wind	3.0%	0.000	0.000000	0.000000	**0.000**

Power Plant Type	Percent of Annual Power Generation	Emission Factor, Pounds per Kilowatt-Hour			
		CO_2	CH_4	N_2O	GWP as CO_2e
Other	0.5%	0.000	0.000000	0.000000	**0.000**
Total	**100.0%**	**0.292**	**0.000015**	**0.000002**	**0.293**
Renewable Sources	**16.4%**	**0.116**	**0.000027**	**0.000004**	**0.118**

CO_2 = carbon dioxide, GWP multiplier = 1
CH_4 = methane, GWP multiplier = 25
N_2O = nitrous oxide, GWP multiplier = 298
CO_2e = carbon dioxide equivalents
GWP = global warming potential as CO_2e, based on multipliers from IPCC 2007
Data Sources: Southern California Edison (2009); California Air Resources Board (2008)

Table D5-2.
Summary of 2009 Power Generation Mix for PG&E

Power Plant Type	Percent of Annual Power Generation	Emission Factor, Pounds per Kilowatt-Hour			
		CO_2	CH_4	N_2O	GWP as CO_2e
Coal	2.0%	0.710	0.000075	0.000011	**0.715**
Large Hydro	15.8%	0.000	0.000000	0.000000	**0.000**
Natural Gas	46.3%	0.399	0.000007	0.000001	**0.399**
Nuclear	19.7%	0.000	0.000000	0.000000	**0.000**
Biomass/Waste	3.9%	0.706	0.000226	0.000030	**0.720**
Geothermal	3.9%	0.057	0.000000	0.000000	**0.057**
Small Hydro	3.9%	0.000	0.000000	0.000000	**0.000**
Solar	0.5%	0.000	0.000000	0.000000	**0.000**
Wind	3.0%	0.000	0.000000	0.000000	**0.000**
Other	1.0%	0.000	0.000000	0.000000	**0.000**
Total	**100.0%**	**0.229**	**0.000014**	**0.000002**	**0.230**
Renewable Sources	**16.3%**	**0.185**	**0.000055**	**0.000007**	**0.188**

CO_2 = carbon dioxide, GWP multiplier = 1
CH_4 = methane, GWP multiplier = 25
N_2O = nitrous oxide, GWP multiplier = 298
CO_2e = carbon dioxide equivalents
GWP = global warming potential as CO_2e, based on multipliers from IPCC 2007
Data Sources: Pacific Gas & Electric (2009); California Air Resources Board (2008)

Based on 2009 data, both SCE and PG&E obtain slightly more than 16 percent of their power generation from renewable energy sources. Both utilities, however, are still below the Renewable Portfolio Standard of 20 percent by 2010.

GREENHOUSE GAS EMISSIONS AVOIDED THROUGH THE USE OF DESERT SUNLIGHT POWER INSTEAD OF ALTERNATIVE POWER SOURCES

Because operation of electrical power distribution grids balances power generation from multiple power sources against prevailing power demand, the addition of power from the Desert Sunlight project would necessary result in compensating reductions in power generation from other power plants connected to the grid. As discussed in the EIS text, operation of the Solar Farm and associated substations will directly and indirectly generate small amounts of greenhouse gases throughout the operational life of the Project. Direct greenhouse gas emissions would come primarily from sulfur hexafluoride emissions associated with substation equipment. Indirect greenhouse gas emissions would come from vehicle traffic associated with operation and maintenance activities for the Solar Farm, Gen-Tie Line, and Red Bluff Substation.

The small quantities of direct and indirect greenhouse gas emissions associated with Solar Farm operations would be more than off-set by greenhouse gas emissions avoided through the use of solar power instead of alternative power sources. Relative power generation costs and operational flexibility would typically be dominant factors in determining which power generation sources are displaced by power from the Desert Sunlight Project. An additional consideration, however, is the fact that all power plants are subject to scheduled and unscheduled maintenance shutdowns. Consequently, power from the Desert Sunlight Project could, over the course of a year, displace or replace power from any other existing power generation source being used by SCE and PG&E. The existing power mixes for SCE and PG&E have been used to provide a conservative estimate of the greenhouse gas emissions avoided through use of power generated by the Desert Sunlight Project. Tables D5-3 and D5-4 summarize the amounts of greenhouse gas emissions avoided annually through use of Desert Sunlight power from Solar Farm Layouts B and C, respectively.

Table D5-3.
Avoided Greenhouse Gas Emissions For SCE and PG&E
Using Power From Solar Farm Layout B

Utility	Annual Power Received From the Solar Farm B, kilowatt-hours per year	Avoided Greenhouse Gas Emissions, Tons Per Year			
		CO_2	CH_4	N_2O	GWP as CO_2e
SCE	545,454,545	79,678.9	4.203	0.574	**79,955.0**
PG&E	654,545,455	74,852.1	4.422	0.575	**75,133.9**
Total	**1,200,000,000**	**154,531.0**	**8.625**	**1.148**	**155,088.9**

CO_2 = carbon dioxide, GWP multiplier = 1
CH_4 = methane, GWP multiplier = 25
N_2O = nitrous oxide, GWP multiplier = 298
CO_2e = carbon dioxide equivalents
GWP = global warming potential as CO_2e, based on multipliers from IPCC 2007

Table D5-4.
Avoided Greenhouse Gas Emissions For SCE and PG&E
Using Power From Solar Farm Layout C

Utility	Annual Power Received From the Solar Farm B, kilowatt-hours per year	Avoided Greenhouse Gas Emissions, Tons Per Year			
		CO_2	CH_4	N_2O	GWP as CO_2e
SCE	409,586,777	60,130.8	3.172	0.433	**60,339.1**
PG&E	491,504,132	57,050.2	3.370	0.438	**57,265.0**
Total	**901,090,909**	**117,181.0**	**6.542**	**0.871**	**117,604.1**

CO_2 = carbon dioxide, GWP multiplier = 1
CH_4 = methane, GWP multiplier = 25
N_2O = nitrous oxide, GWP multiplier = 298
CO_2e = carbon dioxide equivalents

REFERENCES

California Air Resources Board. 2008. **Regulation for the Mandatory Reporting of Greenhouse Gas Emissions. Appendix A – ARB Compendium of Emission Factors and Methods to Support Mandatory Reporting of Greenhouse Gas Emissioins.** Internet website: www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm. Accessed on March 03, 2010.

Pacific Gas and Electric. 2009. **Projected 2009 PG&E Power Content Label.** Internet website: www.pge.com/mybusiness/myaccount/explanationofbill/billinserts/previous/2009/feb.shtml. Accessed on March 29, 2010.

Southern California Edison. 2009. **Projected 2009 SEC Power Content Label.** Internet website: www.sce.com, search results for “power content label”. Accessed on March 29, 2010.