California Energy Commission
DOCKETED
11-AFC-4
TN # 66280
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July 20, 2012

Pierre Martinez
Project Manager
Systems Assessment & Facility Siting Division
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814

Subject: Applicant's Response to Data Requests, Set 2A, #159 (11-AFC-04)

Dear Mr. Martinez:

On behalf of Rio Mesa Solar I, LLC and Rio Mesa Solar II, LLC, please find enclosed our response to Data Requests, Set 2A #159. Electronic copies will be sent to the Staff and the Proof of Service List.

Sincerely,

Todd Stewart
Director, Project Development

Enclosure: Data Response #159

Cc: POS List

**BrightSource Energy, Inc.**
1999 Harrison Street
Suite 2150
Oakland, CA 94612

www.BrightSourceEnergy.com

**DATA REQUEST NO. 159:**

159. Please provide a three-dimensional graphical model of the southern 250 MW (net) facility proposed for Rio Mesa SEGF under full-load, partial-load and full standby status, illustrating the composite effect of convective heat and radiant flux. The modeled convective heat should include elevated temperature of the receiver tower and heliostat surfaces on surrounding air. The modeled radiant flux must include all radiant energy, including (1) ambient solar energy; (2) energy reflected and/or radiated from heliostats to the receiver tower, the standby locations, and the surrounding air; and (3) energy reflected and/or radiated from the receiver tower

a. The partial-load model should be based on typical load level expected during spring and fall midday operating conditions.
b. The radiant flux model should show the density conditions as contours at 2.5 kW/m2, 10 kW/m2, 25 kW/m2, 50 kW/m2 and 150 kW/m2.
c. The graphical model of the convective heat patterns should show the data at the receiver tower and the heliostats for the following conditions: still-air and at 2m/sec. wind speed.
d. Where separate convective and radiant models are used, provide numerical values of cumulative or additive effect.
e. Please provide this modeled radiant flux data for vertical space, from the ground surface to twice the height of the receiver tower or to the highest altitude where cumulative energy flux is 2.5 kW/m2 or greater. The radial boundaries of the modeled area should include the farthest heliostat row from the receiver.
f. The boundaries of the analysis should identify the location of the microphyll woodland habitat that would be retained within the mirror field in Section 22.
g. Please describe significant differences (if any) among expected energy flux contours at the central and northern facilities and the modeled energy flux contours at the southern facility. Should the northern facility be removed from the project proposal, then continue to describe the significant differences between the central and southern facility.

**RESPONSE:**

Part a. See below

Part b. Complied with except that we substituted 5kW/m$^2$ for 2.5kW/m$^2$ (Please see Cautionary note on flux less than 10kW/m$^2$ below

Part c. This data was provided earlier in Applicants Reply Brief to the March 19 Status Conference. Please refer to the "Air Temperature Surrounding the SRSG" document dated 23 February 2012, and included as part of the Risk Characterization Study.

Part d. Flux and radiant heat are two different issues and are not cumulative. The radiant heat at the SRSG extends only a few feet from the boiler surface

Part e. Complied, See below

Part f. Complied, See Figure 3

Part g. Complied, See below

**BACKGROUND: ENERGY FLUX CONTOUR MODEL**

In order for staff to make informed conclusions about the impact of power levels generated by the project on avian species, a clear picture needs to be provided. Previous data requests and data responses have provided partial models (Data Responses to Data Request Set 1A, Nos. 55 and 57), but the models and descriptions do not clearly identify energy states under various operating conditions, sources of these concentrations (heliostats, receiver tower, or standby locations), and the possible projection of these concentrations outside the boundaries of the solar array.

Staff has requested that Applicant provide a "three-dimensional graphical model" as part of this Data Request. Unfortunately, the tools at hand cannot create such a graphical model that would provide the clarity that we believe Staff is looking for. Therefore, Applicant is providing a series of two dimensional images in plan and profile orientation that we believe provide the necessary information for Staff to understand the flux levels over the field.

***Note of caution for modeled flux below 10kW/m$^2$***

Please note that our confidence level in the expected accuracy of our model at fluxes lower than 10kW/m$^2$ is limited. Below are the reasons for it:

1. The model assumes a conical beam shape emanating from each heliostat, the calculated flux maps are then computed as a superposition of all such beam shapes. Actual heliostats are designed with a focal distance such that the beam shape changes along its path. The discrepancy between the modeled beam and actual beam is larger at short distances (closer to the mirror) where the shape of the mirror has a greater effect than the optical path. Therefore, at distances shorter than 100-150m from the heliostats the accuracy of the flux maximal quantifier data is expected to be less accurate,

2. The model was originally created to predict the flux at the SRSG, which has high fluxes at set distances, and which are contributed by many heliostats. As such, each heliostat may be assumed a statistical behavior. It was thoroughly validated over a several years

during operating SEDC. However, since these Data Requests have addressed previously untested questions, we have not similarly validated the model results at these lower flux levels where only a small number of heliostats contribute to the calculations.

Because our confidence level in flux accuracy below 10kW/m$^2$ is lower than at the higher levels, we believe that showing maps of flux at only 2.5kW/m$^2$ would be of a quality that we cannot confirm. Therefore, we have substituted a flux level of 5kW/m$^2$ as the minimum flux level that we are comfortable portraying with the modeling program at this time.

**Flux terms defined:**

**Flux density** is the flux falling normal (or perpendicular) to the body, which is direction related.

**Flux "Maximal Quantifier" (Intensity)** is the total flux accumulated in one square meter (m$^2$), which is calculated by summing the different flux densities, each calculated at the plane in which the flux will be at its maximum level. The maximum level would be at a perpendicular orientation to the propagation of the flux irradiance. The flux maximal quantifier will be always higher than the flux density, and can be considered a conservative upper bound on the flux at any given surface.

The computed flux levels from the model in the following images represent the maximal flux quantifier.

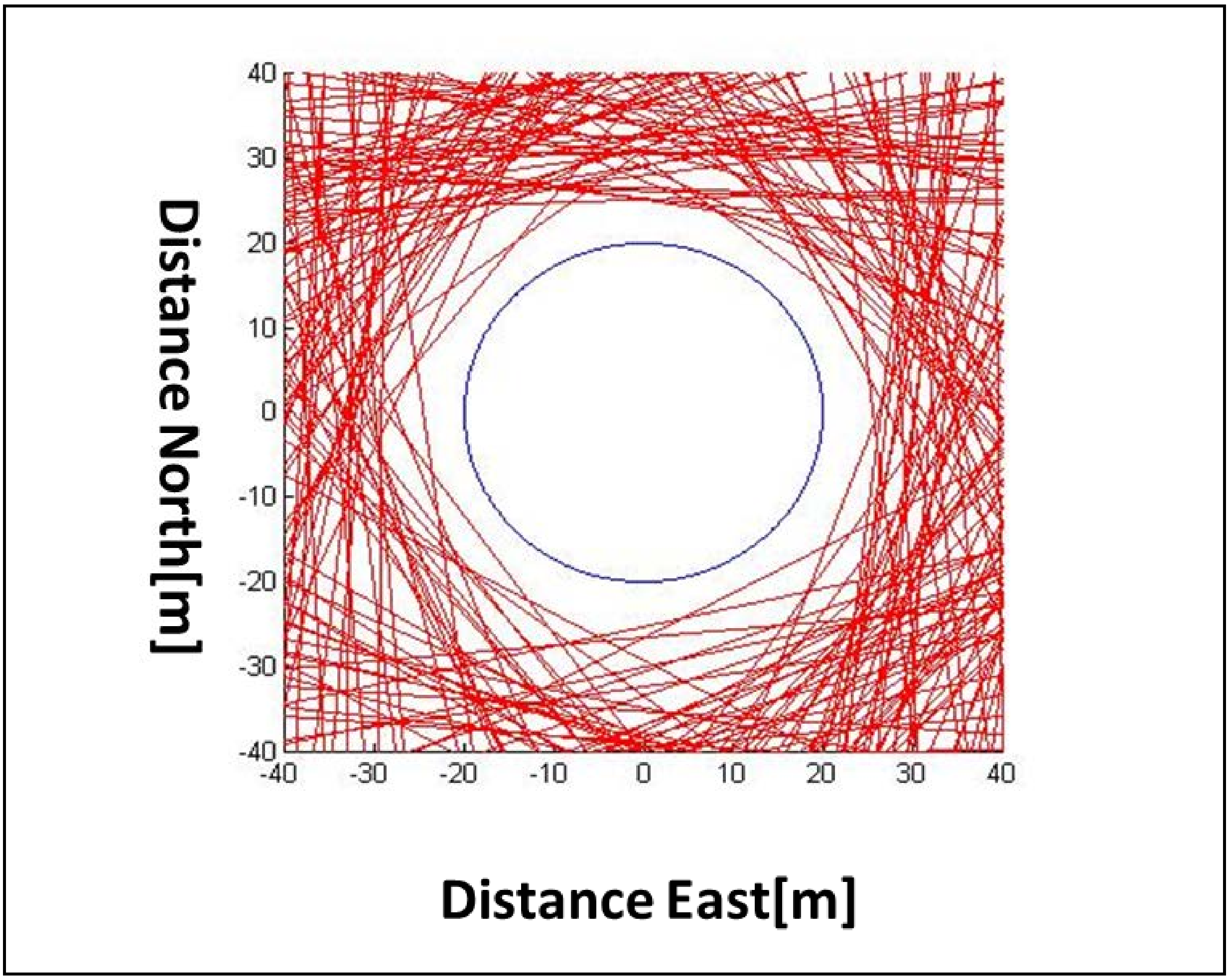
There is no significant difference between expected flux maps due to the seasons (summer, fall, winter & spring). Flux map differences are related to the condition of full load with zero standby, full load with partial stand by, and full standby condition. It should be noted that the full standby condition will not occur during normal operation, and that this condition would occur for possibly a few minutes over an entire year during an unusual or emergency episode.

As requested, Applicant computed the flux during a spring day (day 80 of the year), using RMS south tower solar field. The following scenarios were modeled:

- Full load with zero standby (all heliostats are aimed at the SRSG)
- Full load with 15% stand-by This represents the highest expected standby concentration during operation.
- Full Standby

Heliostats in the standby mode are modeled to be aiming to a torus-like or halo shape which surrounds the receiver, as illustrated in Figure 1 below which shows looking from above the SRSG, the solar ray paths of the center of heliostat beams around the SRSG (blue circle).

Figure 1



40
30
20
10
0
-10
-20
-30
-40
-40
-30
-20
-10
0
10
20
30
40
Distance North[m]
Distance East[m]

**Computer Model Results Discussion:** The following Figures show flux maximal quantifier including the solar radiation as reflected by the heliostats and its propagation through the air.

***Full load with 0% stand-by***

As can be seen in the profile views in Figure 2 below, flux intensity higher then 5kW/m$^2$ starts at approximately 100m in elevation and at a horizontal distance of approximately 400m from the tower center. Flux intensity of 50kW/m$^2$ starts at an elevation of approximately 160m and extends 150m from the tower center. Flux above 150kW/m$^2$ starts at an elevation of approximately 180m and extends out only 50m from the tower center (40m from the SRSG face).

The flux intensity due to spillage (radiation that misses the receiver) is relatively low, and has been computed to be in the range of only 5-10kW/m$^2$, and is limited to a maximum height of 280m (920ft) above ground level. Although not shown on Figure 2, flux of 2.5kW/m$^2$ is not expected to exceed 300m in height above the ground.

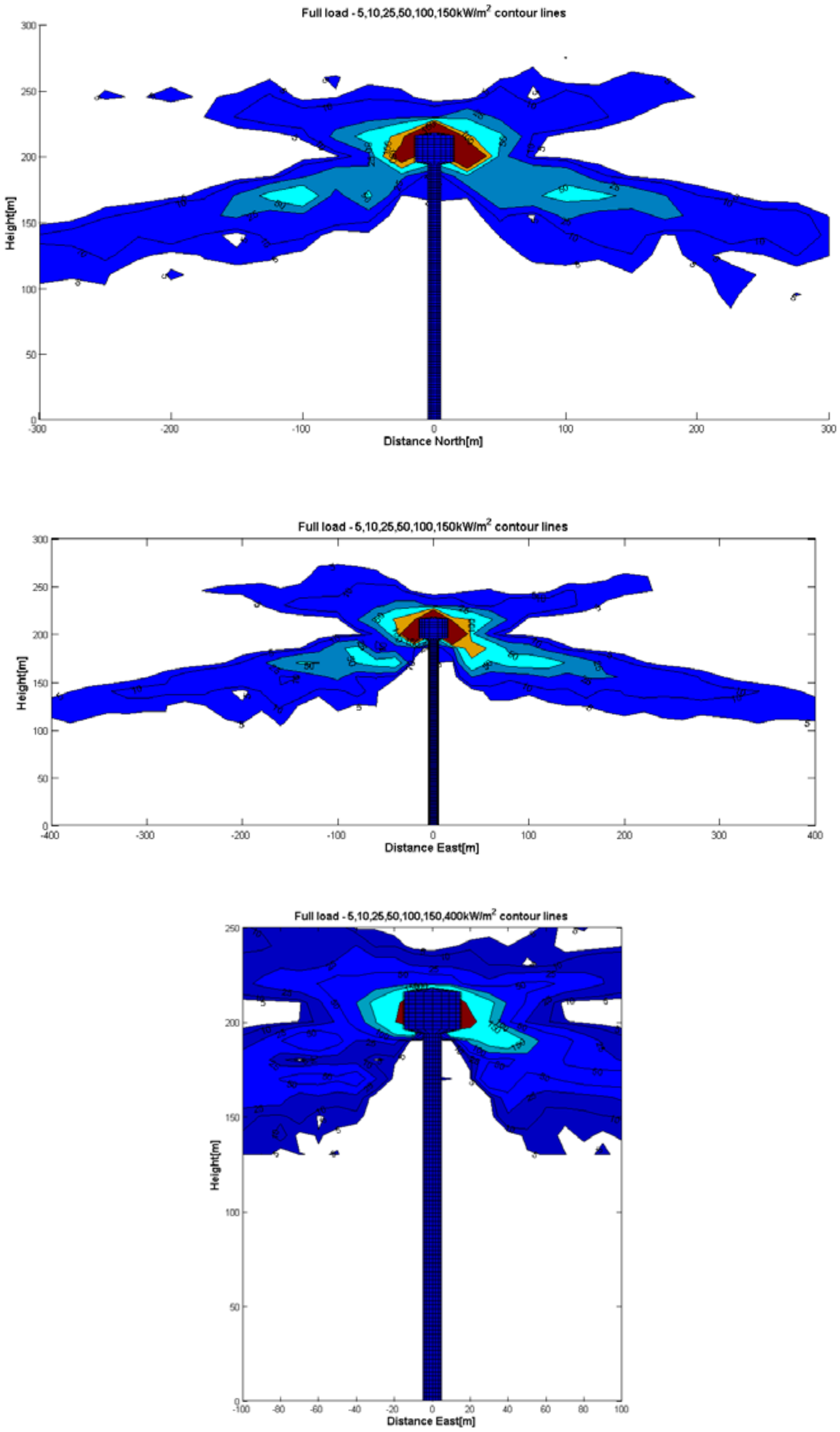
The total air space volume with a flux maximal quantifier of greater then 5kW/m$^2$ is approximately 0.88% (Figure 3). The diametrical span of this flux level is approximately 400m from the tower center and the volume is approx. 23x10$^6$ m$^3$ while the total air volume over the solar field is approximately 2.6x10$^9$m$^3$ (one unit). As shown in the images above, the volume occupied by flux greater than 10kW/m$^2$ and 50kW/m$^2$ is much smaller and is less than 0.4% and 0.04% from the total air volume of the solar field respectively.

***Full load with 15% stand-by***

In the images in Figure 4 we consider the scenario in which the receiver is at full load with 15% of the heliostat at standby. As discussed earlier, this represents the maximum standby condition under normal operation. Profile views of this scenario are given in Figure 3. When considering a direct comparison with the Full Load zero standby scenario, we see that the standby has little effect of the distribution of flux around the receiver. The primary discernible difference between the two scenarios, is that during partial standby the area close to the tower experiences an increase in the 50kW/m$^2$ flux width to approximately 40-50m. The majority of the area is in the low flux range, and flux intensity due to spillage has a profile similar to the no standby case.

***Full Stand-By***

The full stand-by is not a normal operational mode. Regardless, we computed a full standby scenario with a result of 150w/m$^2$ irradiance (Figure 5). As mentioned above the heliostats were modeled to be aiming at a point tangent to a circle around the receiver. The resulting flux shape is torus-like, and therefore the slice side views show no flux in the center.



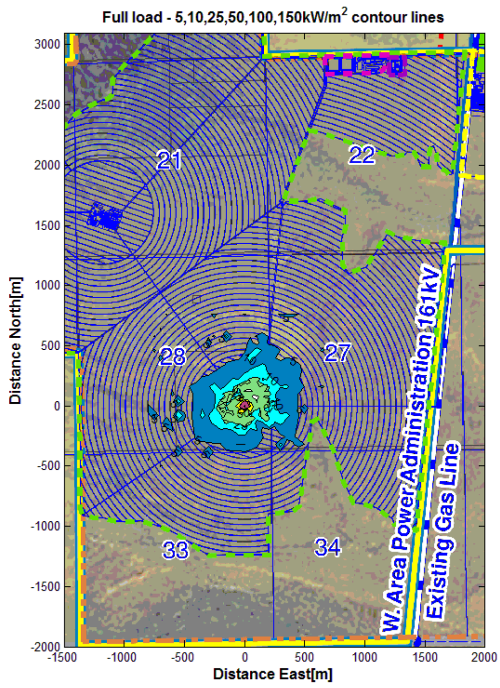

Profile views of Maximal Flux Quantifier at full load (with no standby)

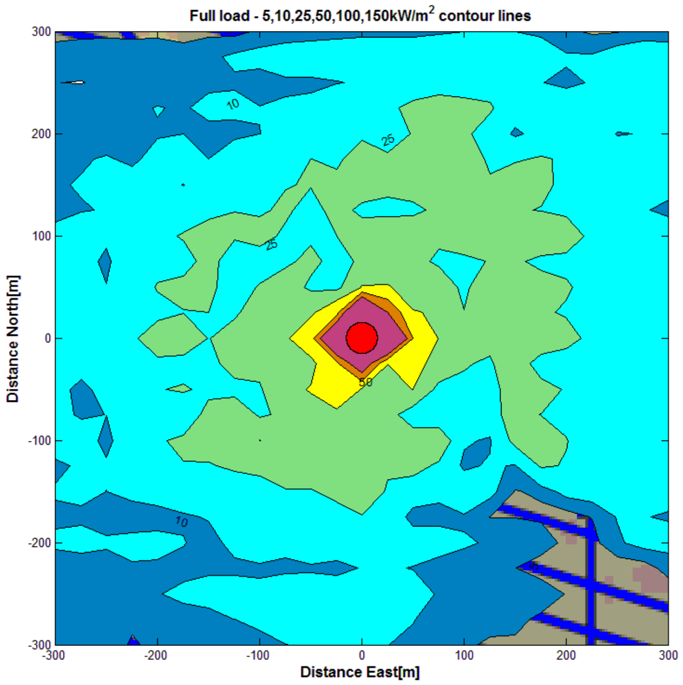
Top: View from East (25m resolution)

Middle: View from South (25m resolution)

Bottom: Enlarged view from South (10m resolution)

Figure 2: Full load with 0% stand-by



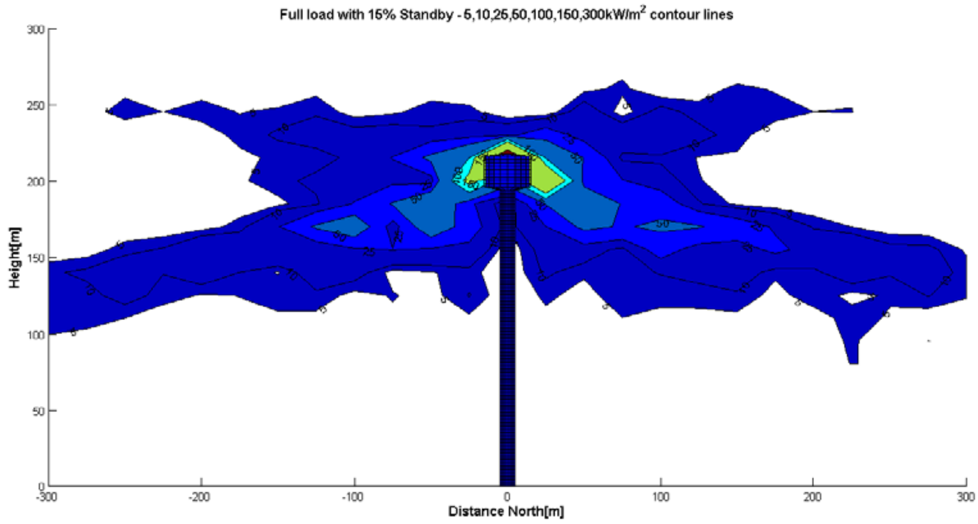



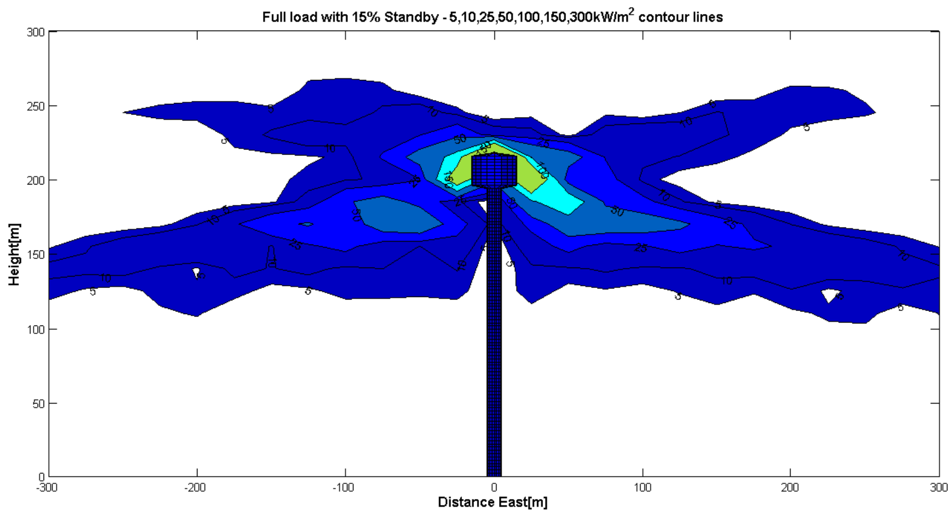

The above plan views show the maximal flux quantifier over the solar field at full load (no standby).

Top Image: Overview of the RMS site

Bottom Image: Enlargement of inner rectangle. Red circle represents the receiver location

Figure 3: Plan View of Flux at Full load with 0% standby over RMS 1 Solar Field



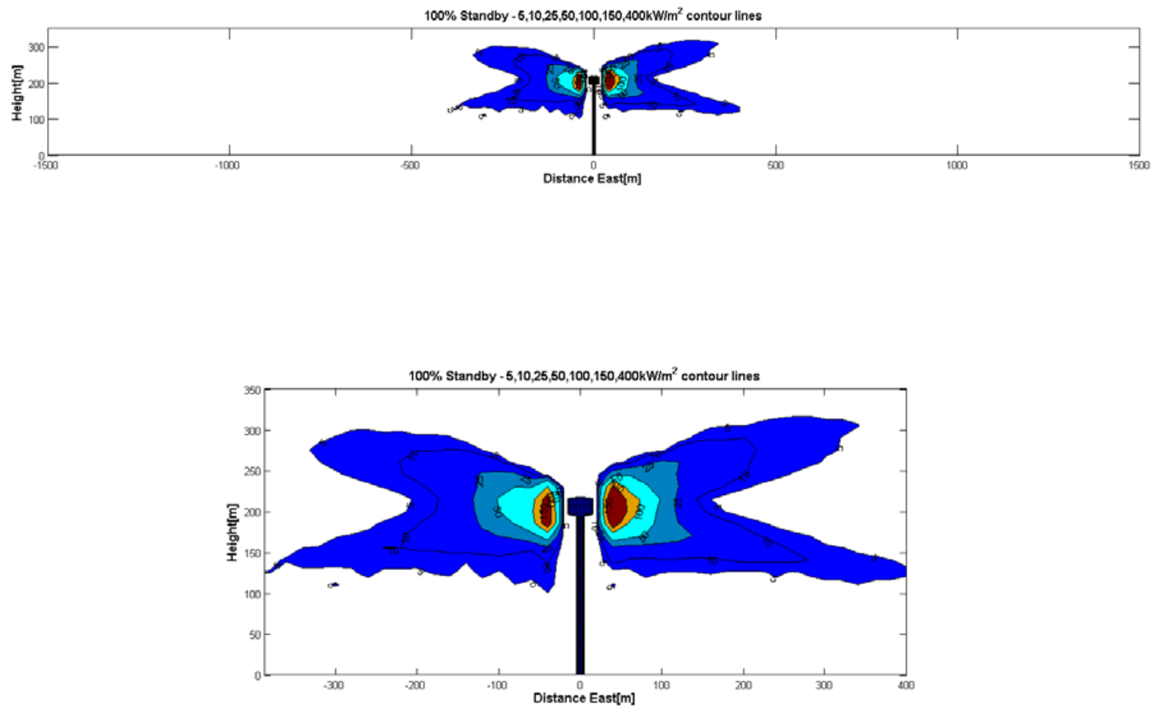




View of vertical cross section through the tower of maximal flux quantifier at full load with 15% of solar field at standby.

Top: view from east (25m resolution),

Bottom: view from south(25m resolution).

Figure 4: Full load with 15% standby




Side views of maximal flux quantifier vertical cross section plot at 20m resolution. Top: view from east; bottom:zoom in of view from east. Views from other direction are expected to be similar

Figure 5 Full Standby

**BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA**
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**APPLICATION FOR CERTIFICATION**
**FOR THE *RIO MESA SOLAR ELECTRIC GENERATING FACILITY***

DOCKET NO. 11-AFC-04
PROOF OF SERVICE
(Revised 7/11/12)


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## DECLARATION OF SERVICE

I, Michelle L. Farley, declare that on July 20, 2012, I served and filed a copy of the attached document Applicant's Response to Data Requests, Set 2A #159 Dated July 20, 2012. This document is accompanied by the most recent Proof of Service list, located on the web page for this project at: http://www.energy.ca.gov/sitingcases/riomesa/index.html.

The document has been sent to the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit or Chief Counsel, as appropriate, in the following manner:

(*Check all that Apply*)

For service to all other parties:

X — Served electronically to all e-mail addresses on the Proof of Service list;

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*AND*

For filing with the Docket Unit at the Energy Commission:

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*OR, if filing a Petition for Reconsideration of Decision or Order pursuant to Title 20, § 1720:*

____ Served by delivering on this date one electronic copy by e-mail, and an original paper copy to the Chief Counsel at the following address, either personally, or for mailing with the U.S. Postal Service with first class postage thereon fully prepaid:

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michael.levy@energy.ca.gov

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Michelle L. Farley



*indicates change