ATTACHMENT 2

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Energy Answers Arecibo, LLC

PSD Air Quality Modeling Analysis (Revised $PM_{10}/PM_{2.5}$ Analysis)

For the proposed

Arecibo Renewable Energy Project
Arecibo, Puerto Rico

Barrio Cambalache, Arecibo, Puerto Rico

Revision Submitted October 2011

6.0 Model Results for Evaluating Significance

Following USEPA guidance (USEPA, 1990), a preliminary analysis was conducted to determine if the emissions from the proposed Facility resulted in a significant impact on ambient air quality. For each of the criteria pollutants subject to PSD review (NO_X, SO_2, CO, PM_{10} and $PM_{2.5}$), the proposed Facility's emissions were modeled using AERMOD. The maximum pollutant-specific impact for each applicable averaging period from the year of site-specific meteorological data was used to compare to the respective SIL. The three operating loads (110%, 100%, and 80%) were modeled. . Table 6-1 lists the maximum modeled ambient air concentration for CO, $PM_{2.5}$, PM_{10}, NO_2, and SO_2 in comparison with the PSD Class II SILs. This air quality modeling also presents the air quality modeling results of the analyses for comparison to the interim 1-hour SILs for NO_2 and SO_2. An interim SIL of 7.8 $\mu g/m^3$ was used for SO_2 and an interim SIL of 7.5 $\mu g/m^3$ was used for NO_2.

Modeling was completed for two potential startup and shutdown scenarios: The first is modeling startup and shutdown of one boiler while the second boiler continues to operate; the second is both boilers undergoing startup or shutdown simultaneously. Tables 6-2 and 6-3 provide results for startup under two scenarios; one where both boilers are started simultaneously, and a second where one boiler is started while the second is operating at 80%, 100%, and 110% load scenarios. Tables 6-4 and 6-5 summarize the model results during shutdown periods. Two possible scenarios were modeled; one where both units shut down simultaneously, and a second with one unit undergoing shutdown while the second remains active (80%, 100%, and 110% load scenarios are each analyzed). Results in Tables 6-2 through 6-5 for startup and shutdown periods are limited to the 1-hour CO, 3-hour SO_2, 24-hour SO_2, 24-hour PM_{10}, and 24-hour $PM_{2.5}$ due to the relatively short period that the boilers undergo startup and shutdown. Per the approved protocol, Energy Answers did not model 1-hour NO_2 and SO_2 impacts during startup and shutdown periods due to the statistical form of these standards and the intermittency of startup and shutdown conditions.

Table 6-1: Model Results - Significant Impact Levels Evaluation – Normal Operations

Parameter	Operating Level	Averaging Period	Class II SIL (μg/m³)	Maximum Concentration (μg/m³)	UTM Northing (meters)	UTM Easting (meters)
CO	110%	1	2000	113.3	742678.99	2043000.41
	110%	8	500	33.6	742658.29	2042987.81
	100%	1	2000	111.3	742678.99	2043000.41
	100%	8	500	34.5	742658.29	2042987.81
	80%	1	2000	116.5	742616.89	2042962.60
	80%	8	500	33.7	742658.29	2042987.81
PM_{10}	110%	24	5	2.65[b, c]	742402.13	2042601.0
	110%	Annual	1	—(a)	—(a)	—(a)
	100%	24	5	2.65[b, c]	742402.13	2042601.0
	100%	Annual	1	0.89[b, c]	742452.13	2042526.00
	80%	24	5	2.65[b, c]	742402.13	2042601.0
	80%	Annual	1	0.89[b, c]	742452.13	2042526.00
$PM_{2.5}$	110%	24	1.2	1.90[b] (1.40[c])	742658.29	2042987.81
	110%	Annual	0.3	—(a)	—(a)	—(a)
	100%	24	1.2	1.95[b] (1.40[c])	742658.29	2042987.81
	100%	Annual	0.3	0.18[b] (0.17[c])	742452.13	2042526.00
	80%	24	1.2	1.90[b] (1.40[c])	742658.29	2042987.81
	80%	Annual	0.3	0.18[b] (0.18[c])	742452.13	2042526.00
SO_2	110%	1	7.8	41.5	742678.99	2043000.41
	110%	3	25	21.58	742102.13	2042851.00
	110%	24	5	4.01	742658.29	2042987.81
	110%	Annual	1	—(a)	—(a)	—(a)
	100%	1	7.8	40.7	742678.99	2043000.41
	100%	3	25	22.03	742685.29	2042987.81
	100%	24	5	4.11	742658.29	2042987.81
	100%	Annual	1	0.29	742429.61	2043518.25
	80%	1	7.8	42.65	742616.89	2042962.60
	80%	3	25	23.24	742602.13	2043051.00
	80%	24	5	4.02	742658.29	2042987.81
	80%	Annual	1	0.31	742429.61	2043518.25
NO_2 [a]	110%	1	7.5	55.84	742678.99	2043000.41
	110%	Annual	1	—(a)	—(a)	—(a)
	100%	1	7.5	54.83	742678.99	2043000.41
	100%	Annual	1	0.80	742427.89	2042551.00
	80%	1	7.5	57.38	742616.89	2042962.60
	80%	Annual	1	0.801	742427.13	2042551.00

(a) Potential annual impacts for the 110% load scenario are not reported due to the impracticality of operating the boilers at 110% load continuously for a year.
(b) Predicted impacts using estimated $PM_{10}/PM_{2.5}$ emissions based on 24/22 mg/dscm.
(c) Predicted impacts using estimated $PM_{10}/PM_{2.5}$ emissions based on 30 mg/dscm.

Table 6-2: Model Results - Startup Both Boilers Simultaneously

Parameter	Averaging Period	Class II SIL (µg/m³)	Maximum Concentration (µg/m³)	UTM Northing (meters)	UTM Easting (meters)
CO	1	2000	44.81	742405.05	2042746.64
	8	500	18.55	742477.13	2042501.00
SO_2	1	7.8	—(a)	—(a)	—(a)
	3	25	0.63	742602.13	2040351.00
	24	5	0.106	742658.29	2042987.81
PM_{10}	24	5	2.65	742402.13	2042601.00
$PM_{2.5}$	24	1.2	0.79	742658.29	2042987.81

(a) Per the approved modeling protocol 1-hour SO2 and NO2 were not evaluated for startup or shutdown periods.

Table 6-3: Model Results - Startup of 1 Boiler While Second Boiler is Active

Parameter	Operating Level for "Other" Boiler	Averaging Period	Class II SIL (µg/m³)	Maximum Concentration (µg/m³)	UTM Northing (meters)	UTM Easting (meters)
CO	110%	1	2000	118.5	742616.89	2042962.60
	110%	8	500	32.5	742658.29	2042987.81
	100%	1	2000	117.0	742616.89	2042962.60
	100%	8	500	32.0	742658.29	2042987.81
	80%	1	2000	110.1	742616.89	2042962.60
	80%	8	500	30.4	742575.48	2042937.39
SO_2	110%	1	7.8	—(a)	—(a)	—(a)
	110%	3	25	20.4	742602.13	2043051.00
	110%	24	5	3.30	742658.29	2042987.81
	100%	1	7.8	—(a)	—(a)	—(a)
	100%	3	25	20.1	742602.13	2043051.00
	100%	24	5	3.23	742658.29	2042987.81
	80%	1	7.8	—(a)	—(a)	—(a)
	80%	3	25	19.35	742596.19	2042949.99
	80%	24	5	3.04	742596.19	2042949.99
PM_{10}	110%	24	5	2.65	742402.13	2042601.00
	100%	24	5	2.65	742402.13	2042601.00
	80%	24	5	2.65	742402.13	2042601.00
$PM_{2.5}$	110%	24	1.2	1.68	742658.29	2042987.81
	100%	24	1.2	1.66	742658.29	2042987.81
	80%	24	1.2	1.61	742575.48	2042937.39

(a) Per the approved modeling protocol 1-hour SO_2 and NO_2 were not evaluated for startup or shutdown periods.

Table 6-4: Model Results - Shutdown Both Boilers Simultaneously

Parameter	Averaging Period	Class II SIL (µg/m^3)	Maximum Concentration (µg/m^3)	UTM Northing (meters)	UTM Easting (meters)
CO	1 hour	2000	43.81	742405.05	2042746.64
	8	500	18.55	742477.13	2042501.00
SO_2	1	7.8	—(a)	—(a)	—(a)
	3	25	0.152	742492.68	2042886.97
	24	5	0.0255	742502.13	2042951.00
PM_{10}	24	5	2.65	742402.13	2042601.00
$PM_{2.5}$	24	1.2	0.471	742477.13	2042501.00

(a) Per the approved modeling protocol 1-hour SO2 and NO2 were not modeled for startup or shutdown periods.

Table 6-5: Shutdown of One Boiler while Second Boiler is Active

Parameter	Operating Level for "Other" Boiler	Averaging Period	Class II SIL (µg/m^3)	Maximum Concentration (µg/m^3)	UTM Northing (meters)	UTM Easting (meters)
CO	110%	1	2000	101.2	742616.89	2042962.60
	110%	8	500	27.9	742658.29	2042987.81
	100%	1	2000	99.7	742616.89	2042962.60
	100%	8	500	27.4	742658.29	2042987.81
	80%	1	2000	92.7	742616.89	2042962.60
	80%	8	500	25.7	742596.19	2042949.99
SO_2	110%	1	7.8	—(a)	—(a)	—(a)
	110%	3	25	20.0	742602.13	2043051.00
	110%	24	5	3.24	742658.29	2042987.81
	100%	1	7.8	—(a)	—(a)	—(a)
	100%	3	25	19.7	742602.13	2043051.00
	100%	24	5	3.17	742658.29	2042987.81
	80%	1	7.8	—(a)	—(a)	—(a)
	80%	3	25	18.9	742596.19	2042949.99
	80%	24	5	2.98	742696.19	2042949.99
PM_{10}	110%	24	5	2.65	742402.13	2042601.00
	100%	24	5	2.65	742402.13	2042601.00
	80%	24	5	2.65	742402.13	2042601.00
$PM_{2.5}$	110%	24	1.2	1.12	7425596.19	2042949.99
	100%	24	1.2	1.18	742658.29	2042987.81
	80%	24	1.2	1.199	742658.29	2042987.81

(a) Per the approved modeling protocol 1-hour SO_2 and NO_2 were not evaluated for startup or shutdown periods.

Except for the 1-hour NO_2 and SO_2, and the 24-hour $PM_{2.5}$, all other pollutants modeled had impacts below their respective SILs under the three boiler load conditions. Since the maximum impacts for CO, and PM_{10} under the three load conditions are below significance for all averaging times including startup and shutdown, no further analysis was necessary. (Note that the 110% load scenario is not evaluated on an annual basis due to the impracticality of operating the boilers at this level continuously for an entire year.) In addition, the annual NO_2 and the 3-hour, 24-hour, and annual SO_2 impacts are below their respective SILs. Therefore, these emissions from the proposed AREP are not considered to cause or contribute to an exceedance of an ambient air quality standard or PSD increment, and a full, cumulative, multisource analysis is not required for these pollutants and averaging periods. An additional full impact multi-source analysis is required only for the 1-hour NO_2, 1-hour SO_2, and 24-hour $PM_{2.5}$ emissions. The full impact analysis for these is discussed in the following sections.

6.1 *Identifying the Significant Impact Area (SIA)*

Since the proposed AREP is using one year of site-specific meteorological data, the radius of the SIA was conservatively based on the maximum, or highest first-high, 1-hour or 24-hour impacts from the worst-case load scenario as determined from the preliminary impact analysis. The SIA radius for the 1-hour NO_2 impacts was determined to be approximately 4.5 kilometers. Figures 6-2, 6-3, and 6-4 show the isopleth plots for the 80%, 100%, and 110% load scenarios, respectively, for the 1-hour NO_2 results from which the SIA was derived. The preliminary analysis for the 1-hour SO_2 impacts indicated that the SIA distance is approximately 3.6 kilometers. Figures 6-5, 6-6, and 6-7 show the isopleth plots for the 80%, 100%, and 110% load scenarios, respectively, for the 1-hour SO_2 results. The preliminary impact analysis for $PM_{2.5}$ indicated an SIA distance of approximately 1.5 kilometers as shown in Figures 6-8, 6-9, and 6-10, respectively, for the for the 80%, 100%, and 110% load scenarios.

6.2 *Full (Cumulative) Impact Analysis*

A cumulative air modeling analysis was completed in accordance with EPA's Guideline on Air Quality Models (40 CFR 51 Appendix W) to demonstrate compliance with the 1-hour NAAQS for NO_2 and SO_2 as well as for the 24-hr $PM_{2.5}$ averaging period. This 1-hour cumulative modeling analysis is required following the SIL evaluation described above in which potential concentrations of NO_2 and SO_2 were found to exceed the respective interim SIL on the 1-hour averaging period as shown in Table 6-1. In addition, Table 6-1 shows that a 24-hour cumulative modeling analysis for $PM_{2.5}$ is required since the maximum predicted impacts were found to exceed the SIL, including the startup scenarios where only one boiler is undergoing startup. In the cumulative modeling analysis, emissions from existing off-site sources and representative background concentrations are included to assess the ambient impact at the receptor location within the SIA. The 8th highest daily 1-hour maximum concentration at each receptor (98th percentile) was used for comparing the impacts to the 1-hour NO_2 NAAQS. The 4th highest daily 1-hour maximum concentration at each receptor (99th percentile) was used for comparing the impacts to the 1-hour SO_2 NAAQS. For $PM_{2.5}$, both the annual and 24-averaging periods must be evaluated in the NAAQS and PSD increment multisource analysis. The maximum predicted concentrations were used for comparing the cumulative impacts (including background) with the 24-hour and annual NAAQS. The highest second high concentration for the 24-hour averaging period and the maximum annual impacts were used to compare with the PSD increments. With respect to the startup and shutdown operations and PM2.5, it is shown that the 24-hour maximum impacts are below those predicted during normal operations with both units active. Therefore, for the purposes of this demonstration, the multisource $PM_{2.5}$ analysis is completed for the worst-case scenario which is when both boilers are operating. Startup and shutdown emissions are not included in the multisource PM2.5 analysis considering that startup and shutdown occurs intermittently, requires less than 24 hours to complete, and results in lower impacts than both units fully operational as shown in Tables 6-1 through 6-5 above.

For the 1-hour NO_2 and SO_2 full impact analysis the receptor are limited to those where predicted maximum concentrations equaled or exceeded the SIL. This approach is consistent with recommendations in recent USEPA (USEPA 2011) guidance and will allow for identification of any potential exceedances caused by or contributed to by the proposed facility. For the $PM_{2.5}$ full impact analysis, however, all receptors within the SIA are included.

If the full impact analysis indicates a potential modeled exceedance, the determination as to whether the proposed facility may potentially cause or contribute to this modeled exceedance may be based on both spatial (at locations where the SIL is exceeded) and temporal (at the time of a potential modeled exceedances in terms of year, month, day, and hour) conditions. This is demonstrated (if necessary) by using the MAXDCONT report generated by AERMOD.

6.2.1 Background Air Quality

Background air monitoring data must also be evaluated for the purposes of conducting a cumulative (full) impact analysis for demonstrating that potential emissions do not result in an exceedance of the NAAQS. Per USEPA recommendation and the approved modeling protocol, the most recent three years of background data is referenced in the updated analysis for the 1-hour NO_2 and SO_2 impacts. For the purposes of this analysis, a tiered approach was followed in accordance with the recommendations made in the March 1, 2011 guidance memorandum (USEPA 2011). The following tiers[1] were used for developing a conservative representation of background concentrations for conducting the cumulative 1-hour assessments (as described in the modeling protocol approved by EPA):

Tier 1: Maximum 1-hour value in recent 3 years;

Tier 2: 3 year average of the maximum 1-hour values in each year of the most recent 3 years;

Tier 3: 3 year average of the 98th percentile of the daily maximum 1-hour concentrations of NO_2, and the 3-year average of the 99th percentile of the daily maximum 1-hour concentrations of SO_2.

The tiered approach provides a mechanism for progressively evaluating ambient concentrations using a simple conservative assumption (Tier 1) to a more data intensive statistical computation (Tier 3). For this analysis, a background value of 65.2 µg/m3 is used for NO_2 calculated from the most recent 3 year period (2005-07) from the monitor in Catano (Monitor ID 72-033-0008) according to the Tier 2 approach. The Tier 3 approach was used for the SO_2 analysis (66.44 µg/m^3), calculated from the monitor data collected in Barceloneta (Monitor ID 72-017-0003). A copy of the background monitoring data is provided in Appendix C.

In addition, since the revised modeling analysis for $PM_{2.5}$ SILs indicates that a cumulative analysis was necessary, ambient $PM_{2.5}$ background monitoring data was necessary for the cumulative impact comparison to the NAAQS. Per USEPA direction, the most recent three years of background data will be necessary for the NAAQS analysis. Per PREQB recommendation, the monitoring location for $PM_{2.5}$ in Barceloneta (Monitor ID 72-017-0003) was used as representative of the Arecibo area. The monitor is located 13.2 kilometers from the proposed Energy Answers facility. The Barceloneta monitor is located along a main thoroughfare (PR-20) and likely will

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[1] The modeling protocol included an additional tier, but based on comments in the EPA approval letter of July 5,2011, only three tiers are included.

capture particulate matter from the transportation sector in the area. In addition, the monitor is situated in an area that will capture emissions from the existing nearby industrial facilities. As discussed in the emission inventory section, some of these nearby source emissions captured by the $PM_{2.5}$ monitor will also be included in the multisource modeling and thus provide a conservative estimate to the total air quality for the area. Like the area south of Arecibo, the location and land use for the Barceloneta monitor are classified as residential and rural, respectively.

The Barceloneta monitor (TEOM Gravimetric 50 degree C) has available continuous hourly $PM_{2.5}$ ambient monitoring values for the 2007 to 2009 period. Energy Answers processed this available raw data to determine the 3-year average of the 24-hour 98th percentile concentration as well as the 3-year average of the annual concentration. EPA guidance (USEPA. 2010b) states that the representative monitored $PM_{2.5}$ design value, rather than the overall maximum monitored background concentration, should be used for the cumulative analysis. The $PM_{2.5}$ design value for the 24-hour averaging period is based on the 3-year average of the 98th percentile 24-hour average $PM_{2.5}$ concentrations for the daily standard. The annual design value is based on the 3-year average of the annual average $PM_{2.5}$ concentrations. The individual years of monitoring data and 3-year averages are presented in Table 6-5.

Table 6-5. Background $PM_{2.5}$ Monitoring Data

Averaging Period	Monitoring Location & ID	98th%tile Monitored Concentration ($\mu g/m^3$)[(a)]			
		2007	2008	2009	3-Year Avg.
24-Hour	Barceloneta (Monitor ID 72-017-0003)	20.1	10.6	17.3	16.0
Annual	Barceloneta (Monitor ID 72-017-0003)	6.5	4.9	5.0	5.5

(a.)

Based on this data, the 3-year average of the 98th percentile concentration for the 24-hour averaging period is 16.0 $\mu g/m^3$ and the design value for the annual averaging period is 5.5 $\mu g/m^3$.

Actual background monitoring data were obtained from EPA databases and are summarized in Appendix C.

6.2.2 Off-Site Source Inventory

Per the EPA's Draft New Source Review Workshop Manual (October 1990), the scope of the off-site sources that must include in a cumulative impact analysis, starts by defining the SIA. This was done in the process of completing the SIL evaluation described above. Initial air dispersion modeling indicates that the predicted maximum impacts for SO_2 that are equal to and greater than the interim 1-hour SIL occurred out to a distance of approximately 3.6 km from the site. Similarly, the distance where the maximum predicted impacts for NO_2 equal to or greater than the interim 1-hour SIL was found to extend approximately 4.5 km from the site. And the preliminary modeling analysis indicates that the maximum predicted impacts for $PM_{2.5}$ equal to or greater than the 24-hour SIL extends out approximately 1.5 km from the site. As a result, major and minor facilities within this distance from the site must be identified and incorporated in the full impact analysis, and the major sources that are located within an additional 50 km past the pollutant-specific SIA distance must be evaluated.

The process of identifying potential sources that must be included in this analysis started by consulting the PREQB Air Quality Division and USEPA Region 2. Energy Answers reviewed permit files, including copies of the air permits and permit applications. Energy Answers also coordinated with PREQB on obtaining necessary modeling input data directly from some of the sources via data requests made by PREQB. In addition to these efforts, the EPA's Air Facility System and National Emissions Inventory databases were searched for major sources in the modeling inventory area. Tables provided in Appendix D list the specific model input parameters used for the cumulative analysis collected from these efforts. For $PM_{2.5}$, ARCADIS used permit limits for particulate matter if provided in the air permit as well as any available information for the specific equipment or process found in the most recent versions of EPA's AP-42, FIRE and Speciate databases.

6.2.3 Terrain Limitations to Plume Interactions from Sources Located on the South Coast

Puerto Rico has a central mountain range that extends approximately 85 km in the East-West direction, from the western shoreline of the island to the area just south of San Juan. Ground elevations in this area range between 700 m (~2300 feet) and 1500 m (>4900 feet) above sea level. Before conducting the cumulative modeling analysis, it is first important to evaluate whether a plume originating from sources located on the south side of the mountain range would be properly represented by AERMOD in the SIA on the north side of the mountain range. The question is raised after reviewing

EPA's *AERMOD: Description of Model Formulation*, EPA-454/R-03-004, Section 5.1 which provides the technical description of how AERMOD models a plume as:

> A combination of a horizontal plume (terrain impacting) and a terrain-following plume. Therefore, for all situations, the total concentration, at a receptor, is bounded by the concentration predictions from these states. In flat terrain the two states are equivalent. By incorporating the concept of the dividing streamline height, in elevated terrain, AERMOD's total concentration is calculated as a weighted sum of the concentrations associated with these two limiting cases or plume states.

Although AERMOD is capable of predicting impacts at receptor locations in complex terrain, the model is limited such that it is not able to account for the blocking effects that the elevated terrain located between a stack and a receptor point could have on the plume. This is particularly important when evaluating short-term (1-hour and 24-hour) impacts. Figure 6-1 illustrates how the plume concentrations predicted by AERMOD at receptors located on the leeward side of a mountain would be biased toward the horizontal plume state. This representation, in effect, simulates dispersion as if the mountain top is not present.

Considering this in the context of modeling sources located on the south coast of Puerto Rico, where the plume would have to encounter the extensive mountain range before reaching the SIA for this project, it is evident that including sources on the south side of the mountain range would produce erroneous results.

Since AERMOD outputs concentrations determined by the weighted sum of concentrations determined from the horizontal plume algorithm and the terrain-following plume, as described above, the predicted impacts from sources located on the windward side of the mountain range at receptors in the SIA for this project, located on the leeward side of the mountain range, would be biased toward the horizontal plume computation. In effect, this prediction ignores the potential effects of the elevated terrain in the region between the stacks and the receptors. Due to the impracticality behind this limitation in AERMOD, and considering the variation in meteorological parameters that a plume would actually encounter at higher elevations in the mountainous region (ambient temperature, wind speed, wind direction, turbulence effects), when compared with the parameters in the meteorological data set used for this analysis which were recorded a lower elevations, the sources located on the windward side of the mountain range were excluded from the cumulative modeling analysis for this project.

6.2.4 AERSCREEN Concentration Gradient Evaluation for Sources to the South

The USEPA AERSCREEN model was executed for each of the major sources listed by PREQB located on the south side of the central mountain range on the island. This was done per the recommendation of EPA to provide further evidence supporting the conclusion that the major sources located to the south of the central mountain range do not have the potential to produce plumes with significant concentration gradients within the SIA and, therefore, do not need to be included in the cumulative modeling analysis. AERSCREEN uses a conservative set of meteorological conditions, actual stack parameters and geographical location, and actual terrain elevation data surrounding the source to approximate the plume characteristics. Stack data used for AERSCREEN were collected as part of the off-site inventory data collection efforts. Based on historical average temperature records for Puerto Rico, the minimum and maximum temperatures used for AERSCREEN are 69 °F (294 K) and 88 °F (304 K). AERSCREEN input and output files are included on the DVD disc in Appendix E.

AERSURFACE was used to estimate the surface roughness coefficients, albedo, and Bowen ratio around each source for input to AERSCREEN based on available NED data for the island. (Although AERSURFACE was not used for the AERMOD demonstration for the PSD ambient impact analysis due to the age of the available surface data, it is sufficiently accurate for the purposes of this screening analysis.)

AERSCREEN was used to estimate the distance out from each of the sources that the maximum air impact occurs and give a conservative indication to the general trend of plume dispersion with distance. Unit emission rates were used at each source; therefore, the resultant concentrations reported are relative values rather than absolute values.

Table 6-6 below lists the distances of the maximum impact concentrations obtained from AERSCREEN. This data indicates that the facilities to the south do not have the potential to produce a plume with a significant concentration gradient affecting the SIA of the proposed AREP. Figures in Appendix D illustrate the change in plume maximum concentration with distance for each of the major sources identified to the south of the central mountain range on the island. For each of these four facilities evaluated, the maximum concentrations are estimated to essentially "level out" before reaching the project study area. Thus, it is reasonable to conclude that any measureable impact associated with these facilities is captured within the background monitoring data or is insignificant.

Table 6-6: AERSCREEN Model Results for Sources Located to the South of the Central Mountain Range

Source	Location	Distance to Maximum Concentration (m)	Approximate Distance to Project Area (m)
Cemex de Puerto Rico, Inc.	Ponce	477	49,000
Destilleria Serralles	Ponce	1,376	51,200
Ecoelectrica LP	Penuelas	6,550	53,600
PREPA Costa Sur	Guayanilla	3,780	51,200

6.2.5 AERSCREEN Concentration Gradient Evaluation for Distant $PM_{2.5}$ Sources

The USEPA AERSCREEN model was executed for ESSROC, Inc., a major source of particulate matter, to determine if the facility would have the potential to produce a plume with a significant concentration gradient affecting the SIA of the proposed AREP. A concentration-versus-distance plot is given in Appendix D illustrates the change in plume maximum concentration with distance for ESSROC which is located greater than 40 kilometers to the east of the proposed AREP facility. The facility-wide emissions were modeled using AERSCREEN and the analysis showed that the maximum predicted concentrations are estimated to essentially “level out” before reaching the project study area. Thus, it is reasonable to conclude that any measureable impact associated with this facility is captured within the background monitoring data or is insignificant within the SIA. Therefore, ESSROC sources were not included in the final multisource analysis for $PM_{2.5}$.

Table 6-7: AERSCREEN Model Results for Distant $PM_{2.5}$ Sources

Source	Location	Distance to Maximum Concentration (m)	Approximate Distance to Project Area (m)
ESSROC.	Dorado	75	43,500

6.3 *Evaluating 1-hour NO_2 Cumulative Impacts*

The approach for evaluating the cumulative 1-hour NO_2 impacts begins with first identifying the receptors within the SIA where the maximum modeled 1-hour NO_2 impact from the proposed AREP is predicted to be equal to or greater than the interim SIL of 7.5 $\mu g/m^3$. Further analysis is limited to these receptors per the EPA March 1 guidance memorandum since impacts below the SIL are not considered to cause or contribute to a significant impact to ambient air quality. These receptors were identified in AERMOD using the MAXIFILE output table generated in the screening model runs.

Multisource modeling was then completed for the receptors where the proposed AREP is significant to determine whether the proposed AREP is a significant contributor (i.e. contributing 7.5 $\mu g/m^3$ or more) to the cumulative impact at the times and locations of predicted exceedances. The 8^{th} highest value is taken, adjusted by a factor of 0.8 per the Tier 2 Ambient Ratio Method, and then added to the background concentration. As discussed in Section 6.2.1, the background value is taken as the 3-year average of the maximum 1-hour values measured between 2005-2007 at the monitor in Catano, PR. This demonstrates that there are no modeled exceedances of the standard at the receptors where the potential AREP impacts are significant. Table 6-8 presents the 8^{th} highest daily maximum predicted 1-hour NO_2 concentration for each operating scenario modeled.

Table 6-8: Multisource Model Results - 1-hour NO_2 NAAQS

Boiler Operating Scenario	8th Highest Maximum 1-hour NO_2 Impact Over SIA ($\mu g/m^3$)	Tier 2 1-hour NO_2 Impact ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Total NO_2 Impact ($\mu g/m^3$)	1-hour NO_2 NAAQS ($\mu g/m^3$)
80% Load	106.9	85.5	65.2	150.7	188
100% Load	106.9	85.5	65.2	150.7	188
110% Load	106.9	85.5	65.2	150.7	188

a) Reported combined source inventory maximum impacts located where the proposed AREP is predicted to be significant (i.e. greater than the proposed 1-hour NO_2 SIL.)
b) Background NO_2 concentration reported is the 3-year average of the maximum 1-hour values from 2005-07 recorded at the Catano monitoring location.

All model input and output files are provided on DVD in Appendix E.

It should be noted that the results reported here differ from those submitted in the initial PSD application due to the use of the newest release of AERMOD that was made available after the initial PSD for the proposed AREP was submitted in February 2011. This newer version of AERMOD includes post-processing routines designed for addressing the 1-hour statistical standards for NO_2 and SO_2. Differences in the results can also be attributed to the use of the 3 year average of ambient background concentration of NO_2 from the Catano monitor rather than a 1 year maximum value obtained from the Cambalache monitor. Both changes in the model and ambient background values were implemented per EPA comments received on March 31, 2011.

6.4 *Evaluating 1-hour SO2 Cumulative Impacts*

Consistent with the approach used for the 1-hour NO_2 analysis, the cumulative SO_2 impact analysis begins by identifying the receptor locations for the full 1-hour SO_2 impact analysis were those receptor locations located within the SIA where the maximum, or highest first-highest, 1-hour SO_2 impact from the proposed AREP was equal to or greater than the interim SIL. An interim SIL of 7.8 $\mu g/m^3$ was used for this analysis. Further analysis is limited to these receptors per the EPA March 1 guidance memorandum since emissions below the SIL are not considered to cause or contribute a significant impact to ambient air quality. These receptors were identified in AERMOD using the MAXIFILE output table generated in the screening model runs.

Multisource modeling was conducted to predict the 4th highest value over these receptors. This value is then and added to the background concentration. As discussed in Section 6.2.1, the background value is taken as the 3-year average of the 99th percentile of the daily maximum 1-hour values measured at the Barceloneta monitoring station for 2003-05. Table 6-9 presents the 4th highest daily maximum predicted 1-hour SO_2 concentration from the full cumulative impact analysis. This demonstrates that there are no exceedances of the 1-hour SO2 standard at any receptor where the proposed AREP has predicted impacts that are above the SIL.

Table 6-9: Multisource Model Results - 1-hour SO_2 NAAQS

Boiler Operating Scenario	4th Highest Maximum 1-hour SO_2 Impact Over SIA [a] ($\mu g/m^3$)	Background SO_2 [b] ($\mu g/m^3$)	Total SO_2 Impact ($\mu g/m^3$)	1-hour SO_2 NAAQS ($\mu g/m^3$)
80% Load	94.05	66.44	160.49	196
100% Load	94.23	66.44	160.67	196
110% Load	94.23	66.44	160.67	196

a) Reported combined source inventory maximum impacts located where the proposed AREP is predicted to be significant (i.e. greater than the proposed 1-hour SO_2 SIL.)
b) Background SO_2 concentration reported is the 3-year average of the 99th percentile of maximum 1-hour values recorded at the Barceloneta monitoring station for 2003-05.

All model input and output files are provided on DVD in Appendix E.

It is noted that the results reported here differ from those submitted in the initial PSD application due to the use of the newest release of AERMOD, including the post-processing routines designed for addressing the 1-hour statistical standards for NO_2 and SO_2. Differences in the results may also be attributed to the use of the 3 year average background concentration of SO_2 from the Barceloneta monitor rather than the time of day maximum values obtained for 2005 that were used in the previous analysis. Both changes in the model used and the different background values were implemented per comments received from EPA on March 31, 2011.

6.5 *Evaluating 24-hour and Annual $PM_{2.5}$ Cumulative Impacts*

As stated above, if the modeled ambient air concentration from the proposed project equal or exceed the SIL for either the 24-hour or the annual averaging period, a cumulative impact assessment needs to be conducted. Initially, the significant impact area (SIA) is determined for the averaging period(s) that equals or exceeds the SIL. The full impact NAAQS analysis accounts for the combined impact of the proposed Energy Answers facility, emissions from other nearby sources, and representative background concentrations. All receptors within the SIA radius are included in the cumulative analysis. The cumulative impacts are then compared to the NAAQS to determine whether the proposed Energy Answers facility will cause or contribute to a violation of the 24-hour or annual $PM_{2.5}$ NAAQS. The full impact PSD increment analysis will include the proposed Energy Answers facility and $PM_{2.5}$ emissions from other nearby sources. Based on the preliminary analysis for the revised $PM_{2.5}$ emissions from the boilers, a cumulative impact analysis was required. Nearby facilities which were evaluated for inclusion in the $PM_{2.5}$ multi-source analysis are presented in Table 6-10 and shown in Figure 6-2. The emission rates and stack parameters are provided in Appendix D. The approach for evaluating the cumulative impacts for the NAAQS and PSD increment analyses are described in the following sections.

Table 6-10. List of Nearby Facilities Included in $PM_{2.5}$ Multisource Analysis

Facility	Distance (km)	Minor/Major
ABB (Abraxis Bioscience Manufacturing)	14.7	Major
Abbott Laboratories	14.0	Major
Battery Recycling Company	1.2	Minor
Bristol Holding Pharma	24.7	Major
Merck, Sharp & Dohme	16.8	Major
PREPA Cambalache	1.3	Major
PREPA Vega Baja	32.8	Major
Safetech Corp	4.3	Major

The PREPA Cambalache and the Battery Recycling Company facilities are located within the SIA. To ensure that the worst-case predicted impacts within the SIA are captured by the air dispersion modeling, building downwash parameters developed from available structure data from these facilities along with the emissions data were incorporated in the NAAQS modeling.

6.5.1 $PM_{2.5}$ NAAQS Analysis

The cumulative impact analysis for NAAQS accounts for the combined impact of the proposed Energy Answers facility, emissions from other nearby sources, and representative background concentration. The cumulative impacts are then compared to the NAAQS values presented in Table 3-2 to determine whether the proposed Energy Answers facility will cause or contribute to a violation of the 24-hour or annual $PM_{2.5}$ NAAQS.

For the 24-hour NAAQS analysis, the maximum (first highest) modeled 24-hour concentration within the SIA was combined with the 3-year average of the 98th percentile (8th highest) concentrations derived from each year on the available monitoring data (USEPA. 2010b). The SIA grid used in the multisource modeling analysis is presented in Figure 6-3. The combined impacts were compared to the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$. For the annual averaging period, the maximum predicted concentration from the year of site specific meteorological data was combined with the 3-year average of the annual $PM_{2.5}$ monitor concentration and then compared to the annual NAAQS of 15 $\mu g/m^3$. The results of the NAAQS analysis are present in Tables 6-11 and 6-12. Predicted cumulative impacts for both potential $PM_{2.5}$ emission rates (22 mg/dscm and 30 mg/dscm) are shown below.

Table 6-11: Model Results for 24-hour $PM_{2.5}$ NAAQS

Boiler Operating Scenario	Maximum 24-hour $PM_{2.5}$ Impact ($\mu g/m^3$)	24-Hour Background $PM_{2.5}$ (a) ($\mu g/m^3$)	Total $PM_{2.5}$ Impact ($\mu g/m^3$)	24-hour $PM_{2.5}$ NAAQS ($\mu g/m^3$)	Less than NAAQS
Based on 22 mg/dscm					
80% Load	9.25	16	25.3	35	Yes
100% Load	9.25		25.3		Yes
110% Load	9.25		25.3		Yes
Based on 30 mg/dscm					
80% Load	9.25	16	25.3	35	Yes
100% Load	9.25		25.3		Yes
110% Load	9.25		25.3		Yes

a. Background $PM_{2.5}$ concentration reported is the 3-year average of the 98th percentile of the 24-hour values recorded at the Barceloneta monitoring station for 2007-09.

Table 6-12: Model Results for Annual $PM_{2.5}$ NAAQS

Boiler Operating Scenario	Maximum Annual $PM_{2.5}$ Impact ($\mu g/m^3$)	Annual Background $PM_{2.5}$ [(a)] ($\mu g/m^3$)	Total $PM_{2.5}$ Impact ($\mu g/m^3$)	Annual $PM_{2.5}$ NAAQS ($\mu g/m^3$)	Less than NAAQS
Based on 22 mg/dscm					
80% Load	2.03	5.5	7.5	15	Yes
100% Load	2.03		7.5		Yes
110% Load	2.03		7.5		Yes
Based on 30 mg/dscm					
80% Load	2.03	5.5	7.5	15	Yes
100% Load	2.03		7.5		Yes
110% Load	2.03		7.5		Yes

a. Background $PM_{2.5}$ concentration reported is the 3-year average of the annual values recorded at the Barceloneta monitoring station for 2007-09.

6.5.2 $PM_{2.5}$ PSD Increment Analysis

Under PSD, the facility under review must demonstrate that the proposed emissions will not cause or contribute to air pollution in excess of any maximum allowable increase or maximum allowable concentration for any pollutant. The maximum allowable increase of an air pollutant that is allowed to occur above the applicable baseline concentration is known as the PSD increment. The major and minor source baseline date for $PM_{2.5}$ was set at October 20, 2010, the date of publication of the final rule on $PM_{2.5}$. As with the NAAQS analysis described in the previous section, the cumulative impacts from the PSD increment analysis are compared to the established increments to determine whether the proposed Energy Answers facility will cause or contribute to a violation of the 24-hour or annual $PM_{2.5}$ increments. The PSD increment analysis should include all nearby sources that started operation or have a change of emissions due to an equipment or permit modification after the baseline date for $PM_{2.5}$ and will thus consume the available increment for the area. No other inventory source is believed to have undergone a permit modification after the baseline date and therefore, only the proposed Energy Answers' emissions sources will be modeled to determine compliance with the 24-hour and annual PSD increment.

For the 24-hour averaging period, the highest second high predicted concentration was compared to the 24-hour increment value (see Table 3-2). For the annual, the highest concentration was compared to the annual increment. The modeling results of the increment analysis for both $PM_{2.5}$ emission rates and the three operating loads are present in Tables 6-13 and 6-14.

Table 6-13: Model Results for 24-hour $PM_{2.5}$ PSD Increments

Boiler Operating Scenario	Highest-2nd High 24-hour $PM_{2.5}$ Impact ($\mu g/m^3$)	24-hour $PM_{2.5}$ Increment ($\mu g/m^3$)	Less than Increment
Based on 22 mg/dscm			
80% Load	1.06	9	Yes
100% Load	1.11		Yes
110% Load	1.14		Yes
Based on 30 mg/dscm			
80% Load	1.45	9	Yes
100% Load	1.52		Yes
110% Load	1.55		Yes

Table 6-14: Model Results for Annual $PM_{2.5}$ PSD Increments

Boiler Operating Scenario	Maximum-Annual $PM_{2.5}$ Impact ($\mu g/m^3$)	Annual $PM_{2.5}$ Increment ($\mu g/m^3$)	Less than Increment
Based on 22 mg/dscm			
80% Load	0.17	4	Yes
100% Load	0.17		Yes
110% Load	0.17		Yes
Based on 30 mg/dscm			
80% Load	0.17	4	Yes
100% Load	0.17		Yes
110% Load	0.17		Yes

The results from the modeling analysis for $PM_{2.5}$ show that the proposed AREP will not cause or contribute to an exceedance of the 24-hour or annual NAAQS or PSD increment. In addition, the modeling analysis for SO_2 and NO_2 show that the proposed AREP also will not cause or contribute to an exceedance of the 1-hour NAAQS. All model input and output files are provided on DVD in Appendix E.

7.0 PSD Class I Area Considerations

PSD Class I areas are designed in 40 CFR Part 81 and are areas of special national or regional value from a natural, scenic, recreational or historic perspective. The PSD Class I areas that are most proximate to the project site are mandatory Federal Class I areas, which include the following areas in existence on August 7, 1977:

- International parks;
- National wilderness areas which exceed 5,000 acres in size;
- National memorial parks which exceed 5,000 acres in size; and
- National parks which exceed 6,000 acres in size.

These areas are administered by the National Park Service, U.S. Fish and Wildlife Service, or the U.S. Forest Service. These Federal Land Managers (FLMs) are responsible for evaluating proposed projects' air quality impacts in the Class I areas and may make recommendations to the permitting agency to approve or deny permit applications.

The closest designated PSD Class I area is Virgin Islands National Park, located on the island of St. John, approximately 170 km east of the proposed site. Class I area impact analyses consist of:

- An air quality impact analysis;
- A visibility impairment analysis; and
- An analysis of impacts on other air quality related values (AQRVs) such as impacts to flora and fauna, water, and cultural resources.

Based on the distances from the project site and the quantity of project emissions, it is expected that the FLMs will not require Class I modeling analyses for the project. However, the approach detailed in the 2008 Federal Land Managers' Air Quality Related Values Work Group (FLAG 2008) guidance document will be used to confirm whether or not Class I modeling analyses are required. The FLAG 2008 guidance proposes setting a threshold ratio of emissions to distance, below which AQRV review is not required (10 D Rule):

$$Q\ (tpy)/d\ (km) < 10, \text{ no AQRV analysis required}$$

where,

Q is the combined project emissions increase in tons per year (tpy)
d is the nearest distance to a Class I Area in kilometers (km).

The Q/D for regulated air pollutants from the proposed AREP are below 10. (Q/D: 801/170 = 4.7) Therefore, no further analysis of potential impacts to the Virgin Island National Park is expected.

8.0 Additional Impacts Analyses

Per the requirements of 40 CFR Part 52.21(o), Energy Answers completed an analysis of potential impairment to visibility, soils and vegetation that could occur as a result of the proposed source. Energy Answers also evaluated the potential air quality impact as a result of general commercial, residential, industrial and other growth associated with the proposed facility. This evaluation was conducted per the 1990 Draft USEPA NSR Workshop Manual Guidance.

8.1 *Visibility Impairment Analysis*

A visibility impairment analysis is required in “Class II floor areas”. Class II floor areas include the following areas in existence on August 7, 1977, that exceed 10,000 acres in size:

- National monuments;
- National primitive areas;
- National preserves;
- National recreational areas;
- National wild and scenic rivers;
- National wildlife refuges; and
- National lakeshores and seashores.

These Class II floor areas also include the following areas established after August 7, 1977 that exceed 10,000 acres in size:

- National parks; and
- National wilderness areas.

No areas meeting these Class II floor criteria were identified within 80 km (50 miles) of the project site. Therefore, a quantitative visibility analysis is not required or provided herein.

No visibility impairment at the local level is expected due to the types and quantities of emissions projected from the Facility sources. The opacity of combustion exhausts from the Facility will be low and will typically be at or approaching zero. Emissions of primary particulates and sulfur oxides due to combustion will also be low due to the installation of advanced controls. The contribution of emissions of VOC to the potential for haze formation in the area will be minimal given the low VOC emission rate from the plant. Emissions of NO_x will be controlled using state-of-the-art control technology so that any potential for visibility impairment associated with NO_x will be minimized.

8.2 *Plume Visibility Analysis*

A visibility analysis of the potential plume from the boiler stacks was conducted using VISCREEN. VISCREEN is an USEPA-approved atmospheric plume visibility model which calculates the potential impact of a plume of specified emissions for specific transport and dispersion conditions. VISCREEN is a conservative tool for estimating visual impacts in accordance with the Workbook for Plume Visual Impact Screening and Analysis (Revised) (USEPA 1992). Details for the VISCREEN analysis are provided in the February 2011 PSD application. The analysis was conducted to evaluate whether the plume would be visible especially from nearby protected areas, including the Camabalache Forest and Rio Abajo Forest. The findings of the VISCREEN analysis incorporating the revised particulate matter emissions indicate that the plume from the proposed AREP will be below the visibility screening criteria for these areas. Class II Plume Visibility Analysis

8.3 *Impacts on Soils, Vegetation, and Wildlife*

The potential impact of the proposed facility on local soils, vegetation and wildlife is deemed acceptable based on several studies and analyses. These include the following:

- The Puerto Rico Department of Natural and Environmental Resources (DNER) acknowledged the adequacy of the Environmental Indicators Study (EIS) completed for the proposed Energy Answers Renewable Energy Project submitted to the Puerto Rico DNRE in December of 2010 (CSA 2010). The EIS concluded there are no endangered species at or near the proposed facility and that emissions from the facility are not expected to adversely impact local flora, fauna or the environment. The following studies were included in the EIS and supported this conclusion.

  - A Terrestrial Flora and Fauna Study, completed by CSA (2010), is included in the approved EIS. No species of special concern to the DNER and the U.S. Fish and Wildlife Service were identified.

  - A screening level ecological risk assessment (SLERA) completed by ARCADIS estimated constituent concentrations in soil, surface water and sediment and compared these levels to conservative screening levels. Estimated concentrations were orders-of-magnitude lower than the screening levels used as benchmarks in the study. The SLERA concluded there was a low potential for ecological risk is expected for habitat areas within 10 km of the Site.

- A Joint Permit Application to address impacts on jurisdictional areas (existing drainage canals) at the Energy Answer site was filed last December with the Puerto Rico DNER (Central receiving agency), the US Army Corps of Engineers, Fish and Wildlife Service, and other agencies. The application is currently under review by the US Army Corps of Engineers.

8.3.1 Screening Level Ecological Risk Assessment

ARCADIS prepared a SLERA to evaluate potential ecological risks associated with emissions from the proposed AREP. The SLERA focused on evaluation of potential adverse effects to ecological receptors (wildlife) within a 10-kilometer (km) radius of the proposed facility from predicted constituent concentrations in environmental matrices (i.e., soil, surface water and sediment) as a result of Facility air emissions.

Constituents evaluated in the assessment, constituents of potential concern (COPCs), were initially identified based recommendations provided in USEPA guidance (USEPA 2005, 1997, 1998, and 2003), and on stack test data generated from a RRF with a similar design to the proposed facility ("SEMASS Unit 3") located in Massachusetts. Emission rates estimates were also based on SEMASS Unit 3 data and limits established in the PSD permit prepared for that facility.

Air dispersion and deposition modeling combined source emission rates and facility information (i.e., source parameters and building profile, etc.) with physical data from the area surrounding the proposed facility (i.e., meteorology, terrain, and land use information) to estimate unitized ambient air concentrations and deposition fluxes. Potential emissions were modeled for risk assessment purposes using AERMOD, version 6.7.1 (EPA AERMOD 09292). AERMOD is the recommended model for air quality analysis in USEPA's *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W). The modeling was performed with a commercial version of AERMOD (Lakes' version 6.7.1). Since COPCs emitted from the combustion unit flues are dispersed and deposited as either vapors or particulates (i.e., particles or particle bound), AERMOD was run to generate estimates of air concentrations and deposition fluxes for vapor phase, particle phase and particle bound COPCs. Fate and transport models recommended by USEPA (USEPA 2005) were used to estimate COPC concentrations in environmental media (e.g., soil, surface water) and other components of the environment that may contribute to exposure.

Potential impacts to land and surface water within a 10 km radius of the proposed AREP was evaluated. The SLERA integrated the four components of an ecological risk assessment (USEPA 1997, 1998) as described below:

1. Problem Formulation: This first step in the SLERA process describes the Site setting, the conceptual site model (CSM), and assessment and measurement endpoints (USEPA, 1998).

2. Exposure Assessment: Involves the process of estimating the magnitude of chemical exposure, and includes the identification of potentially exposed ecological receptors and the evaluation of potentially complete exposure pathways. The process considers various site-related conditions, such as air dispersion and deposition modeling results, proximity to environmentally-sensitive areas (ESAs), and receptor-specific activity patterns. For this SLERA, exposure-point concentrations are calculated based on the results of air dispersion and deposition modeling.

3. Effects Assessment: Involves comparison of the calculated exposure-point concentrations of chemicals of potential ecological concern (COPEC) in various media (i.e., soil, surface water, and sediment) at receptor locations to ecologically-based screening levels (EBSLs) for different classes of receptor organisms. The purpose of this comparison is to identify the potential for adverse effects to receptor populations.

4. Risk Characterization: The level of potential risk is estimated for ecological receptors with potentially complete exposure pathways identified in the Problem Formulation and Ecological Exposure Assessment steps of the SLERA. Risks are estimated by comparing maximum detected concentrations in each modeled medium to the EBSLs identified in the Effects Evaluation.

Based on the information above, the SLERA examined the potential coincidence of ESAs, COPEC, and complete exposure pathways at ecological habitat areas or ESAs within 10 km of the RRF. The risk characterization step of the SLERA integrated and evaluated the results of the data screening and nature of ecological exposures to provide a characterization of potential ecological risk based on site-specific conditions.

The following conclusions were reached regarding potential ecological risk associated with the Site:

- Exposure pathways for wildlife to site-related COPEC are present within the 10 km radius, but are expected to be limited to habitat areas such as the State Forests to the southwest and southeast and the conservation areas to the northeast due to their distance from the emissions source and/or being positioned away from the area of greatest dispersion and deposition.

- Comparison of the worst-case maximum COPC results for soil to EBSLs showed concentrations of COPEC to be at least several orders-of-magnitude less than the soil EBSLs. As a result, the potential for risk to ecological receptors exposed to soil is anticipated to be negligible.

- Comparison of the worst-case maximum COPC results for surface water (Cienaga Tiburones area) to EBSLs showed concentrations of COPEC to typically be at least one order-of-magnitude less than the surface water EBSLs and 3 orders-of-magnitude less than the sediment EBSLs. As a result, the potential for risk to ecological receptors exposed to surface water and sediment is anticipated to be negligible.

- Comparison of the worst-case maximum COPC results for sediment (Cienga Tiburones area) to EBSLs showed concentrations of COPEC to be at least 3 orders-of-magnitude less than the sediment EBSLs. As a result, the potential for risk to ecological receptors exposed to sediment is anticipated to be negligible.

The evaluation presented in the report is considered to be conservative and the potential risks to ecological receptors are likely lower than those discussed above based on the uncertainties as discussed n the report.

Due to COPEC concentrations in soil, surface water and sediment that are orders-of-magnitude less than the conservative ecological screening levels, a low potential for ecological risk is expected for habitat areas within 10 km of the Site. As a result, additional evaluation of potential ecological exposures at the Site is unwarranted.

8.3.2 Flora and Fauna Study

CSA completed a Terrestrial Flora and Fauna Study for the proposed AREP 2010. The study included a Terrestrial Flora and Fauna Survey, discussed details regarding the natural resources in the area of the proposed facility and evaluated the general flora and fauna in the different ecological media present in and near the proposed facility. Special attention was given to species deemed critical, threatened or endangered.

The proposed AREP condition is typical of abandoned industrial areas in which herbaceous plant species, mostly grasses and vines, the semi woody invasive shrub Mimosa pigra and Ricinus communis dominate the landscape. Woody species are present as small clusters throughout the property, especially along the southern and western borders of the site and along the Rio Grande de Arecibo River and other man-made abandoned ditches. In total 113 plant species were identified, all common species of widespread distribution in the island, which are associated to abandoned fields near large rivers and none are considered as critical elements, threatened or endangered. A complete list of the plant species is included in the full report included in the EIS.

The fauna is also composed of common species with wide distribution in the island of Puerto Rico. Fifty six (56) species have been recorded in the area of which forty-four (44) are birds. Among the most common bird species in the study area are the Bananaquit Coereba flaveola), Greater Antillean Grackle (Quiscalus niger), Rock Pigeon (Columba livia), Common Ground-dove (Columbina passerina), Mockingbird (Mimus polyglottos), Gray Kingbird (Tyrannus dominicensis), Smooth-billed Ani (Crotophaga ani), Black-faced Grassquit (Tiaris bicolor) and Orange-cheeked Waxbill (Estrilda melpoda). Other vertebrate groups include two (2) mammals, ten (10) amphibians and reptiles. Among these found are the small Indian mongoose (Herpestes auropunctatus), and several species of tree frogs (Eletherodactylus spp.) and anoline lizards (Anolis spp.).

None of these species are of any special concern to the Department of Natural and Environmental Resources and the U.S. Fish and Wildlife Service. The faunal species were listed in the EIS.

No jurisdictional wetland areas were identified at or near the proposed AREP, but parcels A and C include a system of unused canals that are connected to the Río

Grande de Arecibo River and are likely to be considered by the U.S. Army Corps of Engineers as Waters of U.S. These canals were part of the water system associated to the manufacturing process and to manage stormwater discharge.

The construction of the proposed facility will have short and long term impacts to the nearby terrestrial flora and fauna during the construction and operation phases of the project. Associated impacts include earth movement, tree removal and loss of vegetated areas. Several measures are presented in this study which can be implemented to minimize such impacts and promote the continued existence of desirable species and their habitats in the area.

The proposed activities are not expected to adversely impact threatened or endangered species.

8.3.3 Acidification

At the national level, the primary NAAQS have been established to protect the public health, while the secondary NAAQS have been established to protect the public welfare, property, vegetation, and other ecological systems from any known or anticipated detrimental effects. Ambient concentrations of the criteria pollutants at levels below the NAAQS would not be expected to harm most types of soils or vegetation and, therefore, wildlife. Predicted maximum concentrations as a result of operation of the proposed facility are well below the NAAQS; therefore, no adverse effects to soils, vegetation and wildlife are expected from these constituents.

Most impacts to wildlife due to emissions from combustion facilities are indirect. For instance, increased acidification to soils and water due to high levels of SO_2 affects amphibians due to absorption through skin, as well as impacting breeding success, particularly those that breed in vernal pools and acidified ponds. Possibly the greatest impact to wildlife, as a whole, is degradation of the composition, structure, and habitat value of on-site and nearby plant communities. However, given the Facility's location and relatively low emissions of pollutants known to stress vegetation, potential impacts are below known thresholds of injury. Therefore, no impacts to wildlife due to operation of the proposed AREP are expected.

8.3.4 Soils and Vegetation Modeling Analysis

In addition to the above studies, an analysis of the potential air impacts to soil and vegetation species in the area was conducted with particular emphasis on species with recreational or commercial value (USEPA, 1990) using ambient air quality screening levels for soils and vegetation given in USEPA guidance <u>A Screening Procedure for the</u>

Impacts of Air Pollution Sources on Plants, Soils and Animals (USEPA, 1980). AERMOD was used for this analysis in accordance with the approved modeling protocol. Table 8-1 summarizes the relevant screening levels. USEPA has not published screening values for PM_{10} or $PM_{2.5}$.

Table 8-1 Soils and Vegetation Screening Modeling

Parameter	Averaging Period	USEPA Screening Level (µg/m³)	MAX AREP Model Results (µg/m³)		
			80% Load	100% Load	110% Load
SO_2	1-hour	917	42.64	40.68	41.5
	3-hour	786	23.24	22.03	21.58
	Annual	18	0.310	0.287	—(a)
NO_2	4-hour	3,760	26.59	28.47	28.83
	8-hour	3,760	16.31	16.73	16.29
	1-month	564	1.15	1.15	1.13
	Annual	94	0.431	0.403	—(a)

a) Annual analysis for 110% is not applicable due to the expected short-term duration of this scenario.

Based on the results shown here, impacts to soils and vegetation can be considered negligible. Copies of the AERMOD input and output files are provided on DVD in Appendix E.

8.3.5 Lead Modeling Analysis

In addition, Energy Answers evaluated potential air quality impacts of lead from the proposed AREP for reference in considering the new 2008 NAAQS for lead. Although the potential emissions of lead from the proposed AREP are below the significant emission rate that triggers a PSD review and, therefore, an air modeling impact analysis for lead is not technically required, Energy Answers went ahead and modeled its maximum potential emissions of lead using AERMOD and the methodology described in the approved protocol. Since the new lead standard is in the form of a 3-month rolling average, the AERMOD model results for lead were processed using the LEADPOST (Version 11096) program to read the monthly concentrations and calculate the 3 month rolling averages. It should be noted that, for the purposes of modeling lead, the emission rates were amplified by a factor of 1000. This was necessary in order for LEADPOST to produce a non-zero output.

Results of this analysis indicate that the maximum predicted concentration of lead is 0.00056 ug/m3, which is well below the 0.15 ug/m3 NAAQS (3-month average). Therefore, the project will not cause a significant increase in the lead concentrations anywhere in the surrounding area. The model input and output files are provided on DVD in Appendix E.

8.3.6 Conclusion

Based upon the types of soils, vegetation, and wildlife on-site and in the vicinity of the site, as well as the controlled emission levels associated with plant operation, estimated impacts to soils, surface water, vegetation, and wildlife in the vicinity of the facility are not expected to pose a threat to the local flora, fauna or the environment.

At the national level, the primary NAAQS have been established to protect the public health, while the secondary NAAQS have been established to protect the public welfare, property, vegetation, and other ecological systems from any known or anticipated detrimental effects. Ambient concentrations of the criteria pollutants at levels below the secondary NAAQS would not be expected to harm most types of soils or vegetation and, therefore, wildlife. Predicted maximum concentrations as a result of operation of the proposed facility are well below the secondary NAAQS; therefore, no adverse effects to soils, vegetation and wildlife are expected.

8.4 *Growth Impact Analysis*

The purpose of the growth impact analysis is to quantify growth resulting from the construction and operation of the proposed project and to assess air quality impacts that would result from that growth. Impacts associated with construction of the facility will be minor and temporary. While not readily quantifiable, the temporary increase in vehicle miles traveled in the area would be insignificant, as would any temporary increase in vehicular emissions.

The existing infrastructure should be adequate to accommodate the proposed facility. The Facility will be constructed to meet general area electric power demands and, therefore, no significant secondary growth effects are anticipated. Subsequently, no air quality impacts due to associated industrial or commercial growth is expected. Furthermore, any significant industrial development resulting from the establishment of

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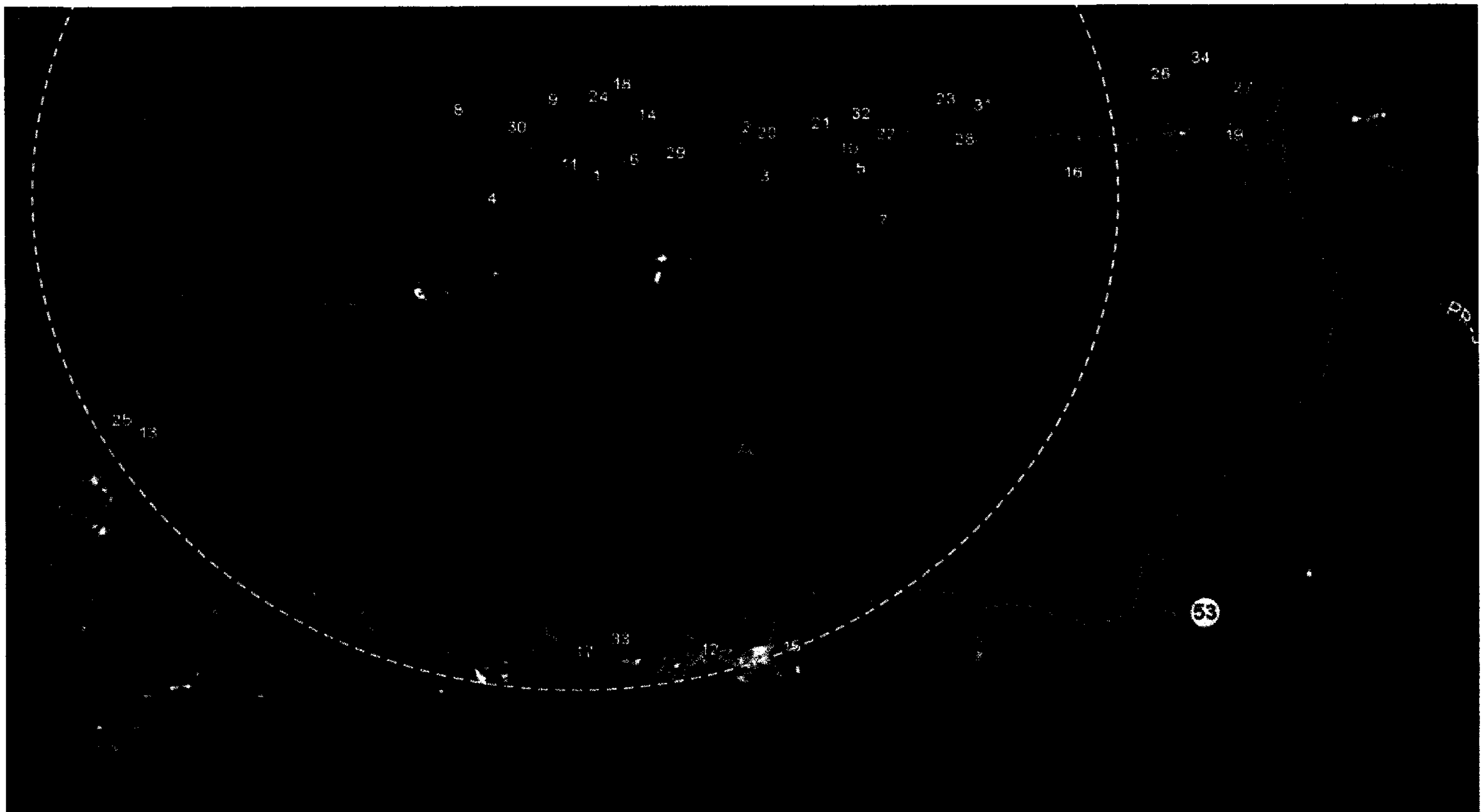
Appendix D

Offsite Source Inventory



1	Energy Answers proposed AREP
2	ABB Abraxis Pharmaceutical Manufacturing LLC
3	Abbott Laboratories
4	Alco Corp
5	BASF Agricultural
6	Battery Recycling
7	Betteroads Manati
8	Borinquen Container
9	Bright Dry Cleaning
10	Bristol Holding Pharma
11	Cantera Green
12	Cemex de Puerto Rico
13	Cerveceria India
14	Cutler Hammer Electrical Company
15	Destileria Serralles
16	Essroc
17	Eco Electrica LP
18	Ganaderos Alvarado
19	Goya (Tradewind Foods)
20	Merck Sharp and Dohme
21	Ortho Pharmaceutical
22	Patheon Mova
23	Pfizer Vega Baja
24	PREPA Cambalache
25	PREPA Mayaguez
26	PREPA Palo Seco
27	PREPA San Juan
28	PREPA Vega Baja
29	Safetech Corp
30	Thermoking
31	V'Soske
32	Warner Chilcott
33	PREPA South Coast
34	Barcardi

NO SCALE

57 KM RADIUS

ENERGY ANSWERS INTERNATIONAL, INC.
ARECIBO, PUERTO RICO

OFFSITE SOURCE INVENTORY FOR MULTISOURCE MODELING ANALYSIS

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FIGURE