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March 17, 2016

Ms. Vicky Lee
Air Quality Engineer
South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, CA 91765

Re: Alamitos Energy Center Supplemental Application for Certification Revisions (Facility ID 115394)

Dear Ms. Lee:

AES Alamitos, LLC (AES) is proposing to increase the number of cold start-ups for the combined-cycle turbines on a monthly and annual basis, which will affect the emissions estimates and associated modeling. Per correspondence with Jerry Salamy, these revisions will be presented to the South Coast Air Quality Management District (SCAQMD) via submission of updated Air Quality and Public Health sections of the air permit application. The revised air permit application sections, complete with revised and updated air quality modeling analysis and health risk assessment results, are anticipated to be submitted no later than March 30, 2016. In the interim, however, AES has prepared a summary of the changes for SCAQMD's consideration, as presented below.

Operating Profiles

The proposed operating profile for the combined-cycle turbines is presented in Table 1. The revisions provide additional operational flexibility to AES by allowing up to 15 cold starts per month and 80 cold starts per year. The warm and hot starts were adjusted downwards to maintain the total monthly and annual number of start-ups at 62 and 500, respectively. No changes are proposed for the simple-cycle turbine operating profile, which is also presented below.

TABLE 1
Combustion Turbine Operating Profile

	GE Frame 7FA.05		GE LMS-100	
Parameter	**Events**	**Hours**	**Events**	**Hours**
Total Annual Operating Hours (per turbine, including startup/shutdown hours)	--	4,640	--	2,358
Annual Cold Startup	80	80.0	0	--
Annual Warm Startup	88	44.0	0	--
Annual Hot Startup	332	166	500	250

TABLE 1
Combustion Turbine Operating Profile

Parameter	GE Frame 7FA.05		GE LMS-100	
	Events	Hours	Events	Hours
Annual Shutdown	500	250	500	108
Total Annual Startup/ Shutdown Hours	--	540	--	358
Total Monthly Operating Hours (per turbine, including startup/shutdown hours)	--	744	--	744
Monthly Cold Startup	15	15.0	0	--
Monthly Warm Startup	12	6.00	0	--
Monthly Hot Startup	35	17.5	62	31.0
Monthly Shutdown	62	31.0	62	13.4
Total Monthly Startup/ Shutdown Hours (per turbine)	--	69.5	--	44.4

Proposed changes to GE Frame 7FA.05 operating profile

The auxiliary boiler may operate 365 days per year with 24 cold starts, 48 warm starts, and 48 hot starts, and an annual fuel consumption of 189,155 million British thermal units (MMBtu). Monthly operation assumes 2 cold starts, 4 warm starts, 4 hot starts, and 16,055 MMBtu per month of fuel consumption. While the number of monthly and annual starts have not changed, the monthly and annual fuel consumption estimates have been reduced.

Emissions Estimates

Start-up and Shutdown Events

The expected start-up and shutdown emissions on a per event basis have not changed for either the combined-cycle or simple-cycle turbines. However, for completeness, Table 2 presents the expected start-up and shutdown emissions.

TABLE 2
Startup/Shutdown Emission Rates

	Emission Rates (lb/event/turbine)					
	NO_x	CO	VOC	SO_2 [a, b]	PM_{10} [b]	$PM_{2.5}$ [b]
Combined-cycle Turbine [c]						
Cold Start-up	61.0	325	36.0	4.86	8.50	8.50
Warm Start-up	17.0	137	25.0	2.43	4.25	4.25
Hot Start-up	17.0	137	25.0	2.43	4.25	4.25
Shutdown	10.0	133	32.0	2.43	4.25	4.25
Simple-cycle Turbine [d]						
Start-up	16.6	15.4	2.80	0.82	3.12	3.12
Shutdown	3.12	28.1	3.06	0.35	1.35	1.35

TABLE 2
Startup/Shutdown Emission Rates

	Emission Rates (lb/event/turbine)					
	NO_x	**CO**	**VOC**	**SO_2 [a, b]**	**PM_{10} [b]**	**$PM_{2.5}$ [b]**

[a] The maximum SO_2 hourly emission rate is based on a fuel sulfur concentration of 0.75 grain of sulfur per 100 dry standard cubic feet of natural gas.

[b] SO_2, PM_{10}, and $PM_{2.5}$ emission rates were derived from the maximum hourly emission rates during baseload operation and start-up/shutdown durations.

[c] Maximum emission rates were based on an ambient temperature of 20°F.

[d] Maximum emission rates were provided by the manufacturer.

Notes:

°F = degrees Fahrenheit

CO = carbon monoxide

lb/event/turbine = pound(s) per event per turbine

NO_X = oxides of nitrogen

$PM_{2.5}$ = particulate matter with aerodynamic diameter less than or equal to 2.5 microns

PM_{10} = particulate matter with aerodynamic diameter less than or equal to 10 microns

SO_2 = sulfur dioxide

VOC = volatile organic compounds

For the auxiliary boiler, the expected start-up oxides of nitrogen (NO_X), carbon monoxide (CO), and volatile organic compound (VOC) emissions on a per event basis have not changed. However, particulate matter with aerodynamic diameter less than or equal to 10 microns (PM_{10}) and sulfur dioxide (SO_2) start-up emissions for the auxiliary boiler have been estimated on a per event basis using SCAQMD's default Annual Emission Reporting emission factors. The auxiliary boiler's start-up emissions for all pollutants are presented in Table 3.

TABLE 3
Auxiliary Boiler Start-up Emissions

	Cold Start, 170 minutes	**Warm Start, 85 minutes**	**Hot Start, 25 minutes**
Pollutant	**lb/event**	**lb/event**	**lb/event**
NO_X	4.22	2.11	0.62
CO	4.34	2.17	0.64
VOC	4.69	2.34	0.69
PM_{10}	0.84	0.42	0.12
SO_2	0.24	0.12	0.035

Note:

lb/event = pound(s) per event

Proposed new auxiliary boiler start-up emissions

Hourly, Daily, Monthly, and Annual Emissions

There are no proposed changes to the maximum hourly emission rates for combined-cycle turbine operation. However, the daily, monthly, and annual emissions have increased based on the revised operating profile shown in Table 1. The hourly, daily, monthly, and annual emissions are presented in Table 4, and include all relevant revisions.

TABLE 4
Combined-cycle Turbine Emissions [a]

Pollutant	Average Annual Emissions (tpy)	Maximum Monthly Emissions (lb/month)	Average Daily Emissions (lb/day)	Maximum Hourly Emissions (lb/hr)
NO_X	82.6	26,911	897	16.5
CO	174	52,663	1,755	10.0
VOC	51.2	15,154	505	5.75
SO_2	7.44	7,236	241	4.86
PM_{10}	39.4	12,648	422	8.50
$PM_{2.5}$	39.4	12,648	422	8.50

[a] Annual, monthly, and daily emissions account for operation of two GE 7FA.05 combined-cycle turbines.

Notes:

lb/day = pound(s) per day

lb/hr = pound(s) per hour

lb/month = pound(s) per month

tpy = ton(s) per year

Proposed revisions to combined-cycle turbine emissions

The maximum hourly emission rates for simple-cycle turbine operation have been revised slightly. The daily, monthly, and annual emissions have been revised accordingly. The hourly, daily, monthly, and annual emissions are presented in Table 5, and include all relevant revisions.

TABLE 5
Simple-cycle Turbine Emissions [a]

Pollutant	Average Annual Emissions (tpy)	Maximum Monthly Emissions (lb/month)	Average Daily Emissions (lb/day)	Maximum Hourly Emissions (lb/hr) [b]
NO_X	52.5	27,910	930	8.23
CO	75.4	33,213	1,107	8.01
VOC	15.0	7,876	263	2.30
SO_2	3.82	4,835	161	1.62
PM_{10}	29.4	18,550	618	6.23
$PM_{2.5}$	29.4	18,550	618	6.23

[a] Annual, monthly, and daily emissions account for operation of four LMS-100PB simple-cycle turbines.

[b] Maximum hourly emission rates reflect performance at historic ambient conditions for low, average, and high ambient temperatures.

Proposed revisions to simple-cycle turbine emissions

The hourly emissions for the auxiliary boiler have been revised based on SCAQMD's Annual Emission Reporting default emission factors. The daily, monthly, and annual emissions have been adjusted accordingly and also account for the reduced fuel consumption estimates noted previously. The auxiliary boiler emissions are presented in Table 6.

TABLE 6
Auxiliary Boiler Emissions

Period	NO_X	CO	VOC	SO_2 [a]	PM_{10}	$PM_{2.5}$	Fuel Use (MMBtu)
Hourly Emissions (lb/hr) [b]	0.42	2.83	0.47	0.14	0.51	0.51	70.8
Daily Emissions (lb/day) [c]	3.75	21.4	4.17	1.09	3.82	3.82	535
Monthly Emissions (lb/month) [d]	112	641	125	32.8	115	115	16,055
Annual Emissions (lb/yr) [e]	1,328	7,547	1,476	137	1,351	1,351	189,155
Annual Emissions (tpy) [f]	0.66	3.77	0.74	0.069	0.68	0.68	--

[a] Hourly, daily, and monthly SO_2 emission rates assume a maximum fuel sulfur level of 0.75 grain per 100 dscf. Annual SO_2 emission rates assume an average fuel sulfur level of 0.25 grain per 100 dscf.

[b] Hourly emissions are based on the maximum hourly firing rate.

[c] Daily emissions are the monthly emissions averaged over 30 days.

[d] Monthly emissions assume two cold starts, four warm starts, four hot starts, and 16,055 MMBtu of fuel consumption per month.

[e] Annual emissions assume 24 cold starts, 48 warm starts, 48 hot starts, and 189,155 MMBtu of fuel consumption per year.

Note:

lb/yr = pound(s) per year

Proposed revisions to auxiliary boiler emissions

Greenhouse Gas Emissions

The proposed changes to the combined-cycle turbine operating profile have increased the annual average fuel consumption. Together with the revised auxiliary boiler fuel consumption previously noted, the facility greenhouse gas (GHG) emissions estimates have been revised. Table 7 presents the revised fuel consumption estimates for each combustion source and Table 8 presents the revised GHG emissions.

TABLE 7
Fuel Consumption

Fuel Consumption	Combined-cycle Turbine (per unit)	Simple-cycle Turbine (per unit)	Auxiliary Boiler	Total
Fuel Consumption per Hour (MMBtu)	2,275	879	70.8	8,137
Fuel Consumption per Day (MMBtu) [a]	54,604	21,094	535	194,117
Fuel Consumption per Year (MMBtu)	10,437,686	2,064,775	189,155	29,323,625

[a] Daily fuel consumption for the turbines is based on the maximum rated heat capacity multiplied by 24 hours per day. Daily fuel consumption for the auxiliary boiler is the monthly fuel consumption averaged over 30 days.

Proposed changes to fuel consumption estimates

TABLE 8
GHG Emissions

	CO_2	CH_4	N_2O	CO_2e [a]
AEC, MT/yr	1,555,912	29.3	2.93	1,557,654

[a] Value includes SF_6 emissions associated with 12 circuit breakers with an assumed annual leak rate of 1 percent, as allowed by 17 California Code of Regulations 95350 – 95359.

Notes:

MT/yr = metric ton(s) per year

CH_4 = methane

CO_2 = carbon dioxide

CO_2e = carbon dioxide equivalent

N_2O = nitrous oxide

SF_6 = sulfur hexafluoride

Proposed changes to facility GHG emissions

Toxic Air Contaminant Emissions

Based on the proposed changes to the combined-cycle turbine operating profile shown in Table 1, the annual toxic air contaminant (TAC) emissions have been revised. The hourly and annual TAC emissions are presented in Table 9, and include all relevant revisions.

TABLE 9
Combined-cycle Turbine Air Toxics Emissions

Compound	Emission Factors		Emissions (per Turbine)			Emissions (Facility Total)		
	lb/MMcf [a]	lb/MMBtu [a]	lb/hr [b]	lb/yr [c]	tpy	lb/hr	lb/yr	tpy
Ammonia [d]	5 ppm	--	15.3	70,004	35.0	30.5	140,008	70.0
1,3-Butadiene	4.39E-04	4.18E-07	0.0010	4.36	0.0022	0.0019	8.73	0.0044
Acetaldehyde [e]	1.80E-01	1.71E-04	0.39	1,789	0.89	0.78	3,579	1.79
Acrolein [e]	3.69E-03	3.51E-06	0.0080	36.7	0.018	0.016	73.4	0.037
Benzene [e]	3.33E-03	3.17E-06	0.0072	33.1	0.017	0.014	66.2	0.033
Ethylbenzene	3.26E-02	3.10E-05	0.071	324	0.16	0.14	648	0.32
Formaldehyde [e]	3.67E-01	3.50E-04	0.80	3,648	1.82	1.59	7,296	3.65
Naphthalene	1.33E-03	1.27E-06	0.0029	13.2	0.0066	0.0058	26.4	0.013
PAHs [f]	9.18E-04	8.74E-07	0.0010	4.56	0.0023	0.0020	9.13	0.0046
Propylene Oxide	2.92E-02	2.78E-05	0.063	290	0.15	0.13	581	0.29
Toluene	1.33E-01	1.27E-04	0.29	1,322	0.66	0.58	2,644	1.32
Xylene	6.53E-02	6.22E-05	0.14	649	0.32	0.28	1,298	0.65

TABLE 9
Combined-cycle Turbine Air Toxics Emissions

Compound	Emission Factors		Emissions (per Turbine)			Emissions (Facility Total)		
	lb/MMcf [a]	lb/MMBtu [a]	lb/hr [b]	lb/yr [c]	tpy	lb/hr	lb/yr	tpy
TOTAL HAPs				**8,115**	**4.06**		**16,230**	**8.12**
TOTAL TACs				**3,686**	**1.84**		**7,371**	**3.69**

[a] Provided by SCAQMD via e-mail correspondence on November 3, 2015, with the exception of ammonia. Units of lb/MMBtu calculated by dividing lb/MMcf by the gas heat content of 1,050 Btu/cf.

[b] Hourly per turbine emissions calculated by multiplying the emission factor by 2,275 MMBtu/hr, HHV.

[c] Annual per turbine emissions calculated by multiplying the emission factor by 2,250 MMBtu/hr, HHV and 4,640 hours per year.

[d] Based on the operating exhaust ammonia limit of 5 ppmvd at 15 percent O_2 and an F-factor of 8,710.

[e] Emission factors account for the use of an oxidation catalyst, as provided by SCAQMD via e-mail correspondence on November 3, 2015.

[f] Per Section 3.1.4.3 of *AP-42*[1], PAH emissions were assumed to be controlled up to 50 percent through the use of an oxidation catalyst.

Notes:

Btu/cf = British thermal unit(s) per cubic foot

EPA = U.S. Environmental Protection Agency

HAP = hazardous air pollutant

HHV = higher heating value

lb/MMBtu = pound(s) per million British thermal unit

lb/MMcf = pound(s) per million cubic foot

MMBtu/hr = million British thermal unit(s) per hour

O_2 = oxygen

PAH = polycyclic aromatic hydrocarbon

ppmvd = parts per million by volume, dry

Proposed changes to combined-cycle turbine TAC emissions

Although no changes have been proposed for the simple-cycle turbine TAC emissions, they have been presented in Table 10 for completeness.

[1] U.S. Environmental Protection Agency (EPA). 2000. *AP-42, Fifth Edition, Volume I.* Chapter 3, Section 3.1, Stationary Gas Turbines. April.

TABLE 10
Simple-cycle Turbine Air Toxics Emissions

	Emission Factors		Emissions (per Turbine)			Emissions (Facility Total)		
Compound	**lb/MMcf [a]**	**lb/MMBtu [a]**	**lb/hr [b]**	**lb/yr [c]**	**tpy**	**lb/hr**	**lb/yr**	**tpy**
Ammonia [d]	5 ppm	--	6.09	14,309	7.15	24.4	57,235	28.6
1,3-Butadiene	4.39E-04	4.18E-07	0.00037	0.86	0.00043	0.0015	3.45	0.0017
Acetaldehyde [e]	1.80E-01	1.71E-04	0.15	354	0.18	0.60	1,416	0.71
Acrolein [e]	3.69E-03	3.51E-06	0.0031	7.26	0.0036	0.012	29.0	0.015
Benzene [e]	3.33E-03	3.17E-06	0.0028	6.55	0.0033	0.011	26.2	0.013
Ethylbenzene	3.26E-02	3.10E-05	0.027	64.1	0.032	0.11	256	0.13
Formaldehyde [e]	3.67E-01	3.50E-04	0.31	722	0.36	1.23	2,887	1.44
Naphthalene	1.33E-03	1.27E-06	0.0011	2.62	0.0013	0.0045	10.5	0.0052
PAHs [f]	9.18E-04	8.74E-07	0.00038	0.90	0.00045	0.0015	3.61	0.0018
Propylene Oxide	2.96E-02	2.82E-05	0.025	58.2	0.029	0.10	233	0.12
Toluene	1.33E-01	1.27E-04	0.11	262	0.13	0.45	1,046	0.52
Xylene	6.53E-02	6.22E-05	0.055	128	0.064	0.22	514	0.26
TOTAL HAPs				**1,606**	**0.80**		**6,424**	**3.21**
TOTAL TACs				**729**	**0.36**		**2,916**	**1.46**

[a] Provided by SCAQMD via e-mail correspondence on November 3, 2015, with the exception of ammonia. Units of lb/MMBtu calculated by dividing lb/MMcf by the gas heat content of 1,050 Btu/cf.

[b] Hourly per turbine emissions calculated by multiplying the emission factor by 879 MMBtu/hr, HHV.

[c] Annual per turbine emissions calculated by multiplying the emission factor by 876 MMBtu/hr, HHV and 2,358 hours per year.

[d] Based on the operating exhaust ammonia limit of 5 ppmvd at 15 percent O_2 and an F-factor of 8,710.

[e] Emission factors account for the use of an oxidation catalyst, as provided by SCAQMD via e-mail correspondence on November 3, 2015.

[f] Per Section 3.1.4.3 of *AP-42*[2], PAH emissions were assumed to be controlled up to 50 percent through the use of an oxidation catalyst.

Based on the reduced auxiliary boiler annual fuel consumption noted previously, the annual TAC emissions for the auxiliary boiler have been revised. The hourly and annual TAC emissions are presented in Table 11, and include all relevant revisions.

[2] EPA. 2000. *AP-42, Fifth Edition, Volume I.* Chapter 3, Section 3.1, Stationary Gas Turbines. April.

TABLE 11
Auxiliary Boiler Air Toxics Emissions

Compound	Emission Factors		Emissions		
	lb/MMcf [a]	lb/MMBtu [a]	lb/hr [b]	lb/yr [c]	tpy
Ammonia [d]	5 ppm	--	1.59E-01	4.09E+02	2.12E-01
Benzene	5.80E-03	5.52E-06	3.91E-04	1.04E+00	5.22E-04
Formaldehyde	1.23E-02	1.17E-05	8.29E-04	2.22E+00	1.11E-03
PAHs	1.00E-04	9.52E-08	6.74E-06	1.80E-02	9.01E-06
Naphthalene	3.00E-04	2.86E-07	2.02E-05	5.40E-02	2.70E-05
Acetaldehyde	3.10E-03	2.95E-06	2.09E-04	5.58E-01	2.79E-04
Acrolein	2.70E-03	2.57E-06	1.82E-04	4.86E-01	2.43E-04
Propylene	5.30E-01	5.05E-04	3.57E-02	9.55E+01	4.77E-02
Toluene	2.65E-02	2.52E-05	1.79E-03	4.77E+00	2.39E-03
Xylene	1.97E-02	1.88E-05	1.33E-03	3.55E+00	1.77E-03
Ethylbenzene	6.90E-03	6.57E-06	4.65E-04	1.24E+00	6.22E-04
Hexane	4.60E-03	4.38E-06	3.10E-04	8.29E-01	4.14E-04
TOTAL HAPs				**14.8**	**0.0074**
TOTAL TACs				**4.09**	**0.0020**

[a] Provided by SCAQMD via e-mail correspondence on November 3, 2015. Units of lb/MMBtu calculated by dividing lb/MMcf by the gas heat content of 1,050 Btu/cf.

[b] Hourly emissions calculated by multiplying the emission factor by 71 MMBtu/hr, HHV.

[c] Annual emissions calculated by multiplying the emission factor by 189,155 MMBtu/year, HHV, which accounts for two cold starts, four warm starts, and four hot starts per month.

[d] Based on the operating exhaust ammonia limit of 5 ppmvd at 15 percent O_2 and an F-factor of 8,710.

Proposed changes to auxiliary boiler TAC emissions

Air Quality and Public Health Impacts

As a result of the emission changes described above, the maximum annual predicted ambient air quality and TAC concentrations will change; however, these changes are minimal and the overall impacts to air quality and public health and conclusions from the air quality modeling and health risk assessment are not affected. Specifically, modeling for annual nitrogen dioxide (NO_2), 8-hour CO, SO_2, annual PM_{10}, and annual $PM_{2.5}$ impacts are expected to be slightly modified as a result of these changes. The modeled scenarios affected by the above changes are listed below:

- Commissioning
    - Combined-cycle turbine commissioning, because the annual impacts include routine operation of the combined-cycle turbines and auxiliary boiler
    - Simple-cycle turbine commissioning, because the annual impacts include routine operation of the combined-cycle turbines and auxiliary boiler
- Operation

  - AEC operation, although the operational load resulting in the highest modeled impact is not expected to change
  - SCAQMD Rule 2005, consistent with the revised AEC operation impacts
  - Prevention of Significant Deterioration (PSD) Class II Standards, consistent with the revised AEC operation impacts
  - PSD Class I Standards, consistent with the revised AEC operation impacts
  - PSD Class I Air Quality-Related Values
  - Class II Visibility, consistent with the revised annual facility emissions
- Public Health
  - Acute, chronic, and cancer risks for the facility
  - Acute, chronic, and cancer risks for each individual unit
  - Cancer burden estimate for the facility

As noted above, the revised air permit application sections will be submitted no later than March 30, 2016.

Please let me or Jerry Salamy know if you have any additional questions.

Sincerely,

Stephen O'Kane
Vice-President
AES Southland Development, LLC
AES Alamitos, LLC
AES Alamitos Energy, LLC

cc: Jennifer Didlo/AES
Jeff Harris/ESH
Jerry Salamy/CH2M
Keith Winstead/CEC