

APPENDIX J

Emissions Calculator and Supporting Documentation

Appendix J

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This appendix contains the output of the Emissions Calculator used to estimate the offset obligations from repowers of existing OTC generation and from new, greenfield generation. The data is organized by facility.

Sources with existing utility steam boiler capacity have the ability to access the SCAQMD internal offset bank for repower projects if they meet the criteria in Rule 1304(a)(2). For a qualifying boiler repower, the SCAQMD withdraws ERCs from the internal offset bank in an amount equal to the potential to emit (not the net emissions increase) of the new generating units replacing the existing boiler(s). Therefore, the offset estimates for both existing OTC boiler repowers and new, greenfield fossil generation will be based on potential to emit calculations multiplied by the applicable offset ratio for each pollutant. In SCAQMD, offsets are determined from maximum monthly emissions divided by 30 days to obtain an average daily potential to emit per pollutant.

Data for OTC boiler repower projects was extracted from OTC Implementation Plans submitted to the State Water Resources Control Board and Application for Certification data submitted to the California Energy Commission. Additional supporting data is summarized in the following tables and sub-appendices.

1) Appendix J-1. Assumed Emission Factors for OTC Repower Replacement Capacity

This section summarizes the data used to calculate lb/MWh emission factors based on monthly emission levels for a combined cycle and simple cycle power plant.

2) Table J-2. Summary of OTC Policy Implementation Plans for Generating Units in LA Basin

This table summarizes repowering plans and target schedules for the existing OTC power plants based on information submitted to the SWRCB.

Output from Emissions Calculator

AES Southland Facilities / ISO BAA

Alamitos	Unit	Type	Permitted Rating	
			(MW)	Retirement
	1	ST	175	2022
	2	ST	175	2022
	3	ST	320	2024
	4	ST	320	2024
	5	ST	480	2018
	6	ST	480	2018

OTC Treatments:	Capacity MW		Operation		NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)
	(Nameplate)	Type	(hr/mo)	Operation					
1. Repower Units 5 and 6	400	P	744	2018	1,418.56	2,172.48	416.64	615.04	19.84
	300	CC	744	2018	617.52	758.88	364.56	260.40	96.72
	300	CC	744	2018	617.52	758.88	364.56	260.40	96.72
	1000		Potential to Emit (tpd)		2,653.60	3,690.24	1,145.76	1,135.84	213.28
					1.33	1.85	0.57	0.57	0.11
2. Repower Units 3 and 4	300	CC	744	2024	617.52	758.88	364.56	260.40	96.72
	300	CC	744	2024	617.52	758.88	364.56	260.40	96.72
	100	P	744	2024	354.64	543.12	104.16	153.76	4.96
	700		Potential to Emit (tpd)		1,589.68	2,060.88	833.28	674.56	198.40
					0.79	1.03	0.42	0.34	0.10
3. Repower Units 1 and 2	300	P	744	2022	1,063.92	1,629.36	312.48	461.28	14.88
	100	CC	744	2022	205.84	252.96	121.52	86.80	32.24
	400		Potential to Emit (tpd)		1,269.76	1,882.32	434.00	548.08	47.12
					0.63	0.94	0.22	0.27	0.02

Huntington Beach	Unit	Type	Permitted Rating	
			(MW)	Retirement
	1	ST	215	2020
	2	ST	215	2020
	3	ST	225	2012
	4	ST	225	2012

OTC Treatments:	Capacity MW		Operation		NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)
	(Nameplate)	Type	(hr/yr)	Operation					
1. Shut down Units 3 and 4 (provide offsets for Walnut Creek)									
2. Repower Block 1 (Redondo Beach 6 and 8 capacity applied)	469.5	CC	744	2018	966.42	1,187.65	570.54	407.53	151.37
	469.5		Potential to Emit (tpd)		966.42	1,187.65	570.54	407.53	151.37
					0.48	0.59	0.29	0.20	0.08
Repower Block 2 (replace Units 1 and 2)	469.5	CC	744	2020	966.42	1,187.65	570.54	407.53	151.37
	469.5		Potential to Emit (tpd)		966.42	1,187.65	570.54	407.53	151.37
					0.48	0.59	0.29	0.20	0.08

Redondo Beach				
Unit	Type	Permitted Rating (MW)	Retirement	
5	ST	175	2019	
6	ST	175	2018	
7	ST	480	2019	
8	ST	480	2018	

OTC Treatments:	Capacity MW (Nameplate)	Type	Operation (hr/yr)	Operation	NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)
1. Repower Units 5 and 7	511	CC	744	2019	1,051.84	1,292.63	620.97	443.55	164.75
	511	CC	744	2019	0.00	0.00	0.00	0.00	0.00
	511		Potential to Emit (tpd)		1,051.84	1,292.63	620.97	443.55	164.75
					0.53	0.65	0.31	0.22	0.08

NRG Facilities / ISO BAA

El Segundo				
Unit	Type	Permitted Rating (MW)	Retirement	
1	ST		Retired	
2	ST		Retired	
3	ST	335	2013	
4	ST	335	2015	

OTC Treatments:	Capacity MW (Nameplate)	Type	Operation (hr/yr)	Operation	NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)
1. Repower Units 1, 2, and 3	560	CC	744	2013	1,152.70	1,416.58	680.51	486.08	180.54
	560		Potential to Emit (tpd)		1,152.70	1,416.58	680.51	486.08	180.54
					0.58	0.71	0.34	0.24	0.09
2. Repower Unit 4	435	CC	744	2018	895.40	1,100.38	528.61	377.58	140.24
	435		Potential to Emit (tpd)		895.40	1,100.38	528.61	377.58	140.24
					0.45	0.55	0.26	0.19	0.07

LADWP Facilities / LADWP BAA

Harbor				
Unit	Type	Permitted Rating (MW)		
1	CCCT	95.6	2026	
2	CCCT	95.6	2026	
5	CCST	86.25	2026	

OTC Treatments:	Capacity MW (Nameplate)	Type	Operation (hr/yr)	Operation	NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)	
1. Repower Units 1, 2, and 5	277.45	CC	744	2026	571.10	701.84	337.16	240.83	89.45	(At this time, LADWP has no plans to repower the gas turbines, only to replace the cooling systems, so these emissions will not be included in the offset totals)
	277.45		Potential to Emit (tpd)		0.29	0.35	0.17	0.12	0.04	

Haynes				
Unit	Type	Permitted Rating (MW)		
1	ST	230	2023	
2	ST	230	2023	
5	ST		2013	
6	ST		2013	
8	CCST	257	2029	
9	CCCT	169.9	2029	
10	CCCT	169.9	2029	

OTC Treatments:	Capacity MW (Nameplate)	Type	Operation (hr/yr)	Operation	NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)	
1. Repower Units 5 and 6	616.2	CC	744	2013	1,268.39	1,558.74	748.81	534.86	198.66	(Already permitted)
	616.2		Potential to Emit (tpd)		0.63	0.78	0.37	0.27	0.10	
2. Repower Units 1 and 2	444	CC	744	2023	913.93	1,123.14	539.55	385.39	143.15	
	444		Potential to Emit (tpd)		0.46	0.56	0.27	0.19	0.07	
3. Repower Units 8, 9, and 10	596.8	CC	744	2029	1,228.45	1,509.67	725.23	518.02	192.41	(At this time, LADWP has no plans to repower the gas turbines, only to replace the cooling systems, so these emissions will not be included in the offset totals)
	596.8		Potential to Emit (tpd)		0.61	0.75	0.36	0.26	0.10	

Scattergood				
Unit	Type	Permitted Rating (MW)		
1	ST	179	2020	
1	ST	secondary fuel		
2	ST	179	2020	
2	ST	secondary fuel		
3	ST	460	2015	

OTC Treatments:	Capacity MW (Nameplate)	Type	Operation (hr/yr)	Operation	NOx (lb/day)	CO (lb/day)	VOC (lb/day)	PM10 (lb/day)	SOx (lb/day)	
1. Repower Unit 3	318.3	CC	744	2015	655.19	805.17	386.80	276.28	102.62	
	206	P	744	2015	730.56	1,118.83	214.57	316.75	10.22	
	524.3		Potential to Emit (tpd)		0.69	0.96	0.30	0.30	0.06	(Permit to Construct for repower issued May 2013)
2. Repower Units 1 and 2	367	CC	744	2020	755.43	928.36	445.98	318.56	118.32	
	367		Potential to Emit (tpd)		0.38	0.46	0.22	0.16	0.06	

For HIGH BOOKEND, contribution from OTC repowers:						
Capacity, MW: 3,985	ISO HIGH BOOKEND, lb/day:	9,393.12	12,401.74	4,703.69	3,994.66	1,066.52 (uses all units except El Segundo 3 repower)
Capacity: 811	LADWP HIGH BOOKEND, lb/day:	3,055.11	3,975.50	1,586.89	1,296.98	374.30 (does not include Haynes 5/6 repower since permit to construct already issued; does not include Harbor units nor Haynes 8-10 as current plans are to only replace cooling systems)
		12,448.23	16,377.24	6,290.59	5,291.64	1,440.83
	tons/day:	6.22	8.19	3.15	2.65	0.72
	With applicable Offset Ratio, tons/day:	7.47	8.19	3.77	2.65	0.72 (ERCs from Internal Bank at 1.2:1 for NOx/VOC and 1.0:1 for others)

For HIGH BOOKEND, additional 450 MW of new generation to meet LCR + 165 MW*:						
	lb/day:	1265.916	1555.704	747.348	533.82	198.276 (assumes combined cycle and uses New Unit emission factors and assumed operating hours)
	tons/day:	0.63	0.78	0.37	0.27	0.10
	With 1.2:1 Offset Ratio, tons/day:	0.76	0.93	0.45	0.32	0.12 (no access to Internal Bank)

*The 165 MW is to correct the difference in repower capacity based on the OTC Implementation Plans, which is just short of the 4150 MW.

TOTAL HIGH BOOKEND, tons/day:	8.23	9.12	4.22	2.97	0.84
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For LOW BOOKEND, contribution from OTC repowers:						
	ISO LOW BOOKEND, lb/day:	8,341.28	11,109.11	4,082.72	3,551.11	901.78 (uses Alamitos, HB, and El Segundo 4)
	LADWP LOW BOOKEND, lb/day (same as high bookend):	3,055.11	3,975.50	1,586.89	1,296.98	374.30
		11,396.39	15,084.61	5,669.62	4,848.09	1,276.08
	tons/day:	5.70	7.54	2.83	2.42	0.64
TOTAL LOW BOOKEND, tons/day (with applicable Offset Ratio):	6.84	7.54	3.40	2.42	0.64 (ERCs from Internal Bank at 1.2:1 for NOx/VOC and 1.0:1 for others)	

Appendix J-1

Assumed Emission Factors for OTC Repower Replacement Capacity

For Repowers with Combined Cycle Generation

Source of emissions data is the Application for Certification for the Huntington Beach Energy Project submitted to the California Energy Commission:

Type of gas turbine: Mitsubishi 501DA
Data per power block:
 No. of gas turbines connected to steam turbine: 3
 Gas turbine maximum heat input: 1498 MMBtu/hr (HHV)
 Duct burner maximum heat rating: 509 MMBtu/hr (HHV)
 Power output for generator on gas turbine: 132.256 MW
 Power output for generator on steam turbine: 151 MW
 Power output, per generating unit: 183 MW

Energy output, single generating unit:
 Monthly energy output = 123,331 MWh

Note: If one steam turbine is shared by multiple gas turbines, then the steam turbine rating is divided by the number of gas turbines; this is consistent with data provided to the CEC in the AFC. Since emissions are based on maximum conditions, assume full load conditions during online operation and no energy output during startup and shutdown periods.

Operational Information

	Event Duration (min/event)	Duration (hours/action)	Potential Frequency			Hours per Day	Hours per Month	Hours per Year
			No. per Day	No. per Month	No. per Year			
Cold starts	90	1.50	1	5		1.50	7.50	0
Warm starts	32.5	0.54	2	25		1.08	13.54	0
Hot starts	32.5	0.654	0	60	624	0.00	32.50	338
Shutdown	10	0.17	3	90	624	0.50	15.00	104
Online operation						20.92	675.46	6200
Total hours of operation						24		

Note: Assume annual starts are hot/warm starts.

Monthly Emissions Data (including startup and shutdown)

Pollutant	Proposed BACT	Monthly Emissions @ 100% load, 186 hr DB on (lb/mo, per turbine)	EF, lb/MWh
NOx	2.0 ppmvd @ 15% O2	10,208	0.083
CO	2.0 ppmvd @ 15% O2	12,597	0.102
VOC	1.0 ppmvd @ 15% O2	6,043	0.049
PM10	Natural gas (4.5 lb/hr)	4,278	0.035
SOx	Natural gas (2.45 lb/hr)	1,592	0.013

For Repowers with Simple Cycle Generation

Source of emissions data is the Permit to Construct evaluation for the LA City DWP Haynes Generation Station by the SCAQMD (December 2010):

Type of gas turbine: GE LMS100
 Gas turbine maximum heat input: 906.6 MMBtu/hr (HHV)
 Power output for generator on gas turbine: 102.7 MW
 Energy output, single generating unit:
 Monthly energy output = 53,712 MWh

Note: Since emissions are based on maximum conditions, assume full load conditions during online operation and no energy output during startup and shutdown periods.

Operational Information

	Event Duration (min/event)	Duration (hours/action)	Potential Frequency			Hours per Day	Hours per Month	Hours per Year
			No. per Day	No. per Month	No. per Year			
Startup	25	0.42	6	150	1095	2.50	62.50	456.25
Shutdown	10	0.17	6	150	1095	1.00	25.00	182.50
Online operation						20.50	523	4524
Total hours of operation						24		

Monthly operation notes: 22 days continuous operation at full load, including 6 startups and shutdowns per day; 9 days operating for 8 hr/day with 2 startups and 2 shutdowns.

Monthly Emissions Data (including startup and shutdown)

Pollutant	Proposed BACT	Monthly Emissions (lb/mo, per turbine)	EF, lb/MWh
NOx	2.5 ppmvd @ 15% O2	7,681	0.143
CO	4 ppmvd @ 15% O2	11,755	0.219
VOC	2 ppmvd @ 15% O2	2,272	0.042
PM10	Natural gas (6.423 lb/MMscf or 5.80 lb/hr)	3,341	0.062
SOx	Natural gas (0.168 lb/MMscf or 0.15 lb/hr)	90	0.002

Table J-2. Summary of OTC Policy Implementation Plans for Generating Units in LA Basin

Facility	Owner	Unit	Type	Proposed Cooling Technology	Permit Size of Unit to Repower (MW)	Technology of Repower Unit	Output of New Unit	Old OTC Unit Offline / Shut down	OTC Policy Compliance Date	Generator OTC Implementation Plan Date ¹	Generator Projected Commercial Online Date for New Replacement Unit
Alamitos	AES	1	Boiler	ACC or closed cycle mechanical draft w/ reclaimed water	175	600 MW simple cycle, 470 MW combined cycle	700	Mar-Apr 2022 (Phase 2)	12/31/2020	2022	Phase 2 (retire 1/2): 300 MW (May 2022) and 400 MW (Dec 2022)
		2	Boiler		175				12/31/2020	2022	
		3	Boiler		320			Mar-Apr 2024 (Phase 3)	12/31/2020	2024	Phase 3 (retire 3/4): 370 MW (May 2024)
		4	Boiler		320				12/31/2020	2024	
		5	Boiler		480			2018 (Phase 1)	12/31/2020	2018-2019	Phase 1 (retire 5/6): 400 MW (June 2018), 300 MW (Oct 2018), 300 MW (Mar 2019)
		6	Boiler		480				12/31/2020	2018-2019	
					1950		2070				
Huntington Beach (Redondo Beach capacity transfer)	AES	1	Boiler	ACC	215	Block 2: combined cycle	469.5	Q4 2020	12/31/2020	2020	Q2 2020
		2	Boiler		215			Q4 2020	12/31/2020	2020	
		3	Boiler	N/A	(225)	Shut down and offsets transferred to Walnut Creek Energy Center	N/A	10/31/2012	12/31/2020	N/A	N/A
		4	Boiler	N/A	(225)		N/A	10/31/2012	12/31/2020	N/A	N/A
		6/8	Boiler	ACC	655	Block 1: combined cycle	469.5	Q2 2018	12/31/2020	2018	Q3 2018
					1085		939				
Redondo Beach	AES	5	Boiler	ACC	175	Combined cycle	511	Q1 2019	12/31/2020	2020	Q3 2019
		7	Boiler		480			Q1 2019	12/31/2020	2020	
		6	Boiler	See Huntington Beach	(175)	Use for Huntington Beach repower per Rule 1304	See Huntington Beach	Q2 2018	12/31/2020	2018	See Huntington Beach repower
		8	Boiler	See Huntington Beach	(480)			Q2 2018	12/31/2020	2018	See Huntington Beach repower
					655		511				
El Segundo	NRG	1	Boiler	ACC	175	2 combined cycle plants, 1x1 configuration (286.7 MW each), Units 5,6,7,8	573.4	Demolished	N/A	N/A	April 2013
		2	Boiler		175			Demolished	N/A	N/A	
		3	Boiler		335			W/in 90 days of commercial operation of Units 5,6,7,8 (June 2013)	12/31/2015	N/A	
		4	Boiler	ACC	335	Combination of air cooled combined cycle turbines and simple cycle peakers	435 ²	2015	12/31/2015	12/31/2015	2018-2019
					1020		1008.4				

¹ Includes any updates to original April 2011 Implementation Plan submitted to the State Water Resources Control Board.

² Uses additional remaining capacity from El Segundo Unit 1, 2, and 3 repower project.

Facility	Owner	Unit	Type	Proposed Cooling Technology	Permit Size of Unit to Repower (MW)	Technology of Repower Unit	Output of New Unit	Old OTC Unit Offline / Shut down	OTC Policy Compliance Date	Generator OTC Implementation Plan Date ¹	Generator Projected Commercial Online Date for New Replacement Unit
Scattergood	LADWP	1	Boiler	To be determined, wet or dry	179	To be determined	367	Existing units in service until new units online (2015-2020)	12/31/2024	12/31/2020	2015-2020
		2	Boiler		179				12/31/2024	12/31/2020	
		3	Boiler	ACC	460	Combined cycle and 2 simple cycle	524.3	Existing units in service until new units online (2015)	12/31/2015	12/31/2015	12/31/2015
					818		891.3				
Haynes	LADWP	1	Boiler	To be determined, wet or dry	230	To be determined	444	Existing units in service until new units online (2016-2023)	12/31/2029	12/31/2023	2016-2023
		2	Boiler		230				12/31/2029	12/31/2023	
		5	Boiler	Dry	343	6 simple cycle turbines (102.7 MW each), Units 11,12,13,14,15,16	616.2	Existing units in service until new units online (2013)	12/31/2013	6/1/2013	First unit in service by Jan 2013; all units by 6/1/2013
		6	Boiler	Dry	261				12/31/2013	6/1/2013	
		8	ST	To be determined, wet or dry	257	To be determined (served by Unit 8)	250	Existing units in service until new units online (2022-2029)	12/31/2029	12/31/2029	2022-2029
		9	CCGT		169.9				12/31/2029	12/31/2029	
		10	CCGT		169.9				12/31/2029	12/31/2029	
					1660.8		1650				
Harbor	LADWP	1	CCGT	To be determined, wet or dry	95.6	(served by Unit 5)	95.6	Existing units in service until new units online (2021-2026)	12/31/2029	12/31/2026	2021-2026
		2	CCGT		95.6	(served by Unit 5)	95.6		12/31/2029	12/31/2026	
		5	ST		86.25	To be determined	86.25		12/31/2029	12/31/2026	
					277.45		277.45				