APPENDIX K: Informational Special Study of Reduced Reliance on Aliso Canyon Storage – Assumptions, Study Results and Alternative Analysis

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K.1 Gas-fired Generation Curtailment

The list of gas-fired generation that was curtailed for the study was obtained from FTI Consulting (CPUC's consultant) study that is part of the CPUC Aliso Canyon OII Phase 3 (I.17-02-002)

- FTI Final Report Supporting Materials[1]
    - FTI Consulting provided individual generating units that were curtailed due to absence of Aliso Canyon in its study in the Excel spreadsheet titled "Summary Gas Demand Table with Curtailments – Final Shortfall Models – Prepared for the CPUC.xlsx"
    - From the table, the generators that were curtailed has a zero value in the "Supported per Hydraulic Models" column, but non-zero value in the "Requirements per PLEXOS Model" column.
    - Table K.1-1 provides a summary of the number of generating facilities as well as the total amount of capacity (in MW) that were curtailed.

Table K.1-1: Number of Generator Facilities and Total Curtailment Capacity

PTO Area	Number of Generation Facilities	Total Curtailment (MW)
SCE	41	3,083
SDG&E	15	645
Total	56	3,728

- FTI Consulting has determined approximately 56 generating facilities would be required to be curtailed in the absence of the Aliso Canyon gas storage.
- The estimated total curtailment is about 3,700 MW for generating facilities in the SCE and SDG&E service areas.
- A summary of the gas-fired generating facilities that are subject to curtailment in the absence of Aliso Canyon gas storage is included in Table K.1-2.

[1] https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/natural-gas/aliso-canyon/fti-phase-3-final-report-supporting-materials.zip

Table K.1-2: Gas-fired generating facilities that are subject to curtailment in the absence of Aliso Canyon gas storage

Area	Facility Name	Curtailed Capacity (MW)	EIA Plant Code
SCE	Att Van Nuys	0.9	62574
SCE	Walnut Creek Energy Park	500.5	57515
SCE	Glenarm	102	422
SCE	Ratkovich Alhambra	0.9	62458
SCE	Harbor Cogen	98	50541
SCE	Long Beach Generation, LLC	177.3	341
SCE	El Segundo Energy Center	526	57901
SCE	Oxnard Paper Mill	10.5	57585
SCE	Canyon Power	200	57027
SCE	Grapeland Hybrid	46	56472
SCE	Loma Linda University Cogen	1.2	10206
SCE	California Institute of Technology	2.2	10262
SCE	San Antonio Regional Hospital	0.4	50234
SCE	Oxnard	36.1	50464
SCE	Municipal Cogen Plant	1.1	50674
SCE	Biola University Hybrid	0.1	54296
SCE	Indigo Energy Center	135	55541
SCE	Century Generating Facility	40	55934
SCE	Drews Generating Facility	40	55935
SCE	Agua Mansa Power Plant	60.5	55951
SCE	H. Gonzalez	5.4	56039
SCE	Riverside Energy Resource Center	36.4	56143
SCE	Springs Generating Station	40	56144
SCE	Bear Valley Power Plant	7.4	56346
SCE	Clearwater Power Plant	32.5	56356
SCE	McGrath Peaker	49	56471
SCE	Sentinel Energy Center, LLC	800	57482
SCE	Cal State University San Bernadino FCO1	1.4	57544
SCE	MolsonCoors Irwindale Brewery	12.56	58056
SCE	Honda Torrance	0.3	58300
SCE	Houweling Nurseries	6.3	58432
SCE	MCAGCC Cogen Plant	0.6	58914
SCE	Starbucks - Evolution Fresh	0.4	59804
SCE	UCI Fuel Cell	1	60120
SCE	Stanton Energy Reliability Center Hybrid	98	60698
SCE	SunSelect1	4.8	61754

Area	Facility Name	Curtailed Capacity (MW)	EIA Plant Code
SCE	Disney Prospect	0.9	62571
SCE	ATT Kelvin	0.9	62573
SCE	Kaiser East La Palma Ave. Fuel Cell	3.3	62698
SCE	Equinix Douglas St. Fuel Cell	1.3	62704
SCE	Equinix Maple Ave. Fuel Cell	1.8	62705
SDGE	Childrens Hospital	4.4	10175
SDGE	Kyocera America Project	1.1	10720
SDGE	Naval Hospital Medical Center	5.3	50963
SDGE	CP Kelco San Diego Plant	7.2	52147
SDGE	NRG Energy San Diego	0.2	54337
SDGE	Goal Line LP	33.8	54749
SDGE	CalPeak Power Border Peaker Plant	49.8	55510
SDGE	Escondido Energy Center	49.8	55538
SDGE	Chula Vista Energy Center	44	55540
SDGE	Orange Grove Peaking Facility	99.8	56914
SDGE	El Cajon Energy Center	49	57001
SDGE	Pio Pico Energy Center	300	57555
SDGE	Watkins Manufacturing Co.	0.9	57715
SDGE	Life Technologies Carlsbad	0.1	58302
	Total	**3728**	

K.2 Study Results

The following is a summary of the information only reliability study results:

- Extensive thermal overloading concerns under critical contingencies in the LA Basin and San Diego areas under summer peak load conditions;
- Several IID transmission facilities are also impacted due to contingencies in the San Diego-Imperial Valley area;
- 2032 Winter peak load conditions did not result in transmission reliability concerns in the LA Basin and San Diego-Imperial Valley area, provided that the remaining gas-fired generation resources are available; and
- As transportation and building fuel substitution become more electrified in the future, the winter peak load is also increasing (winter peak load for 2035 increases 6% over the 2032 winter peak load (73% of summer peak vs. 67% summer peak).

A summary of the information only study results is provided in Table K.2-1.

Table K.2-1: Summary of Information Only Study Results

	Impacted Facilities	Contingencies	Area	Identified Reliability Concerns	Notes
1	Chino-Mira Loma 230kV line	P6 - Mira Loma AA Banks 500/230kV #1, then #2 bank	East LA Basin	Thermal overload	
2	Ellis-Johanna 230kV line	P6 - Ellis-Santiago 230kV, then Imperial Valley-N.Gila 500kV line	West LA Basin	Thermal overload	P6 involves one SCE-owned facility and one SDG&E-owned facility
3	Ellis-Santiago 230kV line	P6 – Ellis-Johanna 230kV, then Imperial Valley-N.Gila 500kV line	West LA Basin	Thermal overload	See above notes
4	Johanna-Santiago 230kV line	P6 – Ellis-Santiago 230kV, then Imperial Valley-N.Gila 500kV line	West LA Basin	Thermal overload	See above notes
5	La Fresa-Hinson 230kV line	P6 – La Fresa-Laguna Bell 230kV, then Mesa-Redondo 230kV line	West LA Basin	Thermal overload	
6	Laguna Bell-Mesa 230kV line	P6 – Lighthipe-Mesa 230kV, then Mesa-Redondo 230kV line	West LA Basin	Thermal overload	
7	Lighthipe-Mesa 230kV line	P6 – La Fresa-Laguna Bell 230kV, then Mesa-Redondo 230kV line	West LA Basin	Thermal overload	
8	Mesa-Redondo 230kV line	P6 – La Fresa-Laguna Bell 230kV, then Lighthipe-Mesa 230kV line	West LA Basin	Thermal overload	
9	Del Amo – Hinson 230kV line	P6 – La Fresa-Laguna Bell 230kV, then Lighthipe-Mesa 230kV line	West LA Basin	Thermal overload	

	Impacted Facilities	Contingencies	Area	Identified Reliability Concerns	Notes
11	Midway-Whirlwind 500kV segment 32 line	P6 – Midway-Vincent 500kV #1, then Midway-Vincent 500kV #2	North of LA Basin	Thermal overload	Current RAS needs to be checked for adequacy and applicability for future 10-year horizon
12	Midway-Whirlwind 500kV segment 31 - 32	P6 – Midway-Vincent 500kV #1, then Midway-Vincent 500kV #2	North of LA Basin	Thermal overload	See above notes
13	Devers – Red Bluff 500kV #1 500kV line	P6 – Devers – Red Bluff #2 500kV line, then IV – N.Gila 500kV line	East of LA Basin	Thermal overload	
14	Julian Hinds – Mirage 230kV line	P6 – Devers – Red Bluff #1 500kV, then Devers-Red Bluff #2 line	East of LA Basin	Thermal overload	Existing Blythe generation RAS tripping is adequate
15	Mira Loma AA Bank 500/230kV #1	P6 – Chino-Mira Loma #3 230kV line, then Mira Loma AA Bk #2	East LA Basin	Thermal overload	
16	Serrano AA Bank 500/230kV #2	P6 – Serrano AA Bank #1, then Serrano AA Bank #3	West LA Basin	Thermal overload	
17	Mesa AA Bank 500/230kV #3	P6 – Laguna-Mesa 230kV line, then Mesa AA Bank #4	West LA Basin	Thermal overload	
18	Otay Mesa-Tijuana 230kV line	P6 - Ocotillo-Suncrest 500kV, then ECO-Miguel 500kV line	SDG&E	Thermal overload	
19	Sycamore-Suncrest 230kV line #1	P6 - ECO-Miguel 500kV, then Sycamore-Suncrest line #2	SDG&E	Thermal overload	
20	Imperial Valley 230kV Phase Shifting Transformer	P6 - Ocotillo-Suncrest 500kV, then ECO-Miguel 500kV line	SDG&E	Thermal overload	
21	Miguel 500/230kV transformer #1	P6 - Ocotillo-Suncrest 500kV, then Miguel 500/230kV transformer #2	SDG&E	Thermal overload	
22	Suncrest 500/230kV transformer #2	P6 - ECO-Miguel 500kV, then Suncrest 500/230kV transformer #1	SDG&E	Thermal overload	
23	Pilot Knob-El Centro 161kV line	P3 - G-1 TDM, then Imperial Valley-N.Gila 500kV line	IID	Thermal overload	Impacted IID facility
24	Pilot Knob-Yucca 161kV line	P3 - G-1 TDM, then Imperial Valley-N.Gila 500kV line	IID	Thermal overload	See above notes
25	Yucca 161/69kV transformer	P3 - G-1 TDM, then Imperial Valley-N.Gila 500kV line	IID	Thermal overload	See above notes

K.3 Transmission Alternatives

Table K.3-1 provides a summary of potential transmission alternatives that were evaluated:

Table K.3-1: Potential Transmission Alternatives

Options	Description of Alternatives	Areas
1A	• Diablo South Multi-Terminal HVDC VSC Line (2000 MW at Diablo Canyon, 1000 MW at Alamitos and 1000 MW at Huntington Beach; • Additional upgrades in LA Basin (La Fresa-Hinson 230kV, South of Ellis 230kV lines); and • Imperial Valley-N.Gila #2 500kV line, Sycamore-Suncrest 230kV #3 line, Suncrest 500/230kV #3 transformer, Miguel 500/230kV #3 transformer.	Western LA Basin & San Diego
1B	• Diablo South Multi-Terminal HVDC VSC Line (same as in Option 1A); • Imperial Valley – N.Gila 500kV #2 line; and • Alberhill – Suncrest 500kV HVDC VSC line (1000 MW).	Western and Eastern LA Basin, San Diego
2A	• Diablo South Multi-Terminal HVDC VSC Line (2000 MW at Diablo Canyon, 1000 MW at Redondo Beach, 1000 MW at Encina).	Western LA Basin and San Diego
2B	• Diablo South (same as Option 2A); • Third Sycamore-Suncrest 230kV line; and • Fourth Serrano AA 500/230kV transformer.	Western LA Basin and San Diego
2C	• Diablo South (same as Option 2A); and • Alberhill-Suncrest HVDC VSC Line (1000 MW).	Western LA Basin and San Diego
3	• Diablo South (2000 MW at Diablo Canyon, 500 MW at Redondo Beach, 750 MW at Alamitos, 750 MW at San Onofre).	Western LA Basin and San Diego
4	• Vincent-Del Amo HVDC VSC line (1000 MW).	Western LA Basin
5	• Imperial Valley – Serrano HVDC VSC line (2000 MW).	San Diego, Western LA Basin
6	• Devers – La Fresa HVDC VSC line (1000 MW).	Eastern and Western LA Basin
7A	• Imperial Valley-Del Amo HVDC VSC line (2000 MW); and • Imperial Valley-N.Gila #2 500kV line.	San Diego Western LA Basin
7B	• Option 7A, plus the following upgrades: o Additional upgrades in the LA Basin (La Fresa-Hinson 230kV line, Lighthipe-Mesa 230kV line, Mesa-Redondo 230kV, Midway-Whirlwind (check for applicability and adequacy of Path 26 RAS); o Serrano AA 500kV Bank #4; o Additional Suncrest and Miguel 500/230kV transformer banks; and o Additional dynamic reactive support in San Diego.	Western LA Basin San Diego
8A	• Multi-terminal HVDC VSC (Imperial Valley (2000 MW)-Inland (normal flow at 1000 MW with converter capability up to 2000 MW for emergency condition)-Del Amo (1000 MW normal flow with converter capability up to 2000 MW for emergency condition)), plus the following upgrades: o Del Amo-Mesa 500kV line (new); o Del Amo-Serrano 500kV line (new); and o Del Amo new 500kV substation with 3 new AA-banks.	Western LA Basin San Diego

Options	Description of Alternatives	Areas
8B	• Multi-terminal HVDC VSC (Imperial Valley (2000 MW) – Sycamore Canyon (1000 MW normal flow with converter capability up to 2000 MW for emergency condition) - Del Amo (1000 MW normal flow with converter capability up to 2000 MW for emergency condition)), plus the following upgrades: o Del Amo-Mesa 500kV line (new); o Del Amo-Serrano 500kV line (new); and o Del Amo new 500kV substation with 3 new AA-banks.	Western LA Basin San Diego

Table K.3-2 provides a summary of each alternative's performance and its effectiveness in mitigating identified reliability concerns.

Table K.3-2: Summary of Transmission Alternative Assessments

Options	Alternative Descriptions	Summary of Performance Analysis	Effectiveness/Notes
1A	Diablo South HVDC VSC (Diablo, Alamitos, HB) and upgrades in SCE and SDG&E area, IV-NG #2 500kV line	• This option is effective for both LA Basin and San Diego areas.	High / Also provides relief for Path 26 line flow under contingency condition
1B	Diablo South HVDC VSC (see above), IV-NG #2 500kV, Alberhill-Suncrest HVDC VSC	• This option is not effective for the San Diego area.	Not effective
2A	Diablo South HVDC VSC (Diablo, Redondo, Encina)	• This option is not effective for both the LA Basin and San Diego areas.	Not effective
2B	Option 2A, plus Sycamore-Suncrest 230kV #3 and fourth Serrano AA Bank	• This option is effective for both LA Basin and San Diego areas.	High / Also provides relief for Path 26
2C	Option 2A, plus Alberhill-Suncrest HVDC VSC line	• This option is effective for both LA Basin and San Diego areas.	High / Also provides relief for Path 26
3	Diablo South HVDC VSC (Diablo, Redondo, Alamitos, San Onofre)	• This option is not effective for both LA Basin and San Diego areas: (a) does not mitigate Serrano AA bank loading issue; (b) does not mitigate various loading constraints in San Diego area.	Not effective
4	Vincent-Del Amo HVDC VSC line	• This option is not effective for both LA Basin and San Diego areas: identified reliability concerns still remain.	Not effective
5	Imperial Valley-Serrano 500kV line HVDC VSC	• This option is not effective for both LA Basin and San Diego areas: identified reliability concerns still remain.	Not effective
6	Devers-La Fresa HVDC VSC line	• This option is not effective for both LA Basin and San Diego areas: identified reliability concerns still remain.	Not effective

Options	Alternative Descriptions	Summary of Performance Analysis	Effectiveness/Notes
7A	IV-Del Amo HVDC VSC, IV-N.Gila #2 500kV line	• This option is not effective for both LA Basin and San Diego areas: identified reliability concerns still remain.	Not effective
7B	Option 7A, plus various 230kV upgrades in LA Basin, additional AA banks in LA Basin and San Diego	• This option is effective for both LA Basin and San Diego areas.	High / Also provides policy-driven benefits
8A	Imperial Valley-Inland-Del Amo HVDC VSC line, plus new 500kV lines and substation in the LA Basin	• This option still has some reliability concerns for both SCE and San Diego areas: (a) 230kV line overload in the LA Basin that will need operating procedure for operating the Imperial Valley-Inland-Del Amo multi-terminal DC line to mitigate line overload in the Western LA Basin; (b) line loading concern on the Path 26 lines in SCE area; and (c) voltage collapse condition occurs for the P6 of Eco-Miguel 500kV line, followed by Ocotillo-Suncrest 500kV line (this condition needs operating procedure to operate the DC line under contingency condition).	Partially effective; will need operating procedure to operate the DC line under contingency condition; will require feasibility assessment for Path 26 RAS for future
8B	Imperial Valley-Sycamore-Del Amo HVDC VSC line, plus new 500kV lines and substation in LA Basin	• This option is effective for both LA Basin and San Diego areas.	High / Also provides policy-driven benefits