DOCKETED	
Docket Number:	19-SB-100
Project Title:	SB 100 Joint Agency Report: Charting a path to a 100% Clean Energy Future
TN #:	229644
Document Title:	Californians for Green Nuclear Power, Inc. Comment DIablo Canyon Decommissioning Documents
Description:	CPUC Intervenor Californians for Green Nuclear Power, Inc. (CGNP) submits this CPUC filing in R.16-02-007 as one of eight exhibits supporting the continued safe operation of Diablo Canyon Power Plant (DCPP) beyond 2025 as an essential component of California's Path to a 100% Clean Energy Future. Diablo Canyon's pair of safe, reliable, cost-effective, and zero-emissions power reactors are California's largest generation plant by far, producing about 9% of California's in-state generation - the equivalent of more than 5 (five) Hoover Dams annually. In 2010, the California Energy Commission (CEC) commissioned the California Science and Technology Commission (CSTC) to prepare a pair of reports regarding the path to a 100% Clean Energy Future. The CSTC's report conclusions were clear. The safe and cost-effective solution was a dramatic expansion beyond the four commercial nuclear power reactors then in operation. The eminent CSTC scientists and engineers concluded California would require about 30 such reactors
Filer:	Gene Nelson, Ph.D.
Organization:	Californians for Green Nuclear Power, Inc.
Submitter Role:	Intervenor
Submission Date:	9/3/2019 10:47:45 PM
Docketed Date:	9/3/2019

Labor	Material	Equipment	Disposal	Other	Contingency	Redactions
43.579%	3.839%	5.474%	0.459%	14.511%	10.229%	21.908%

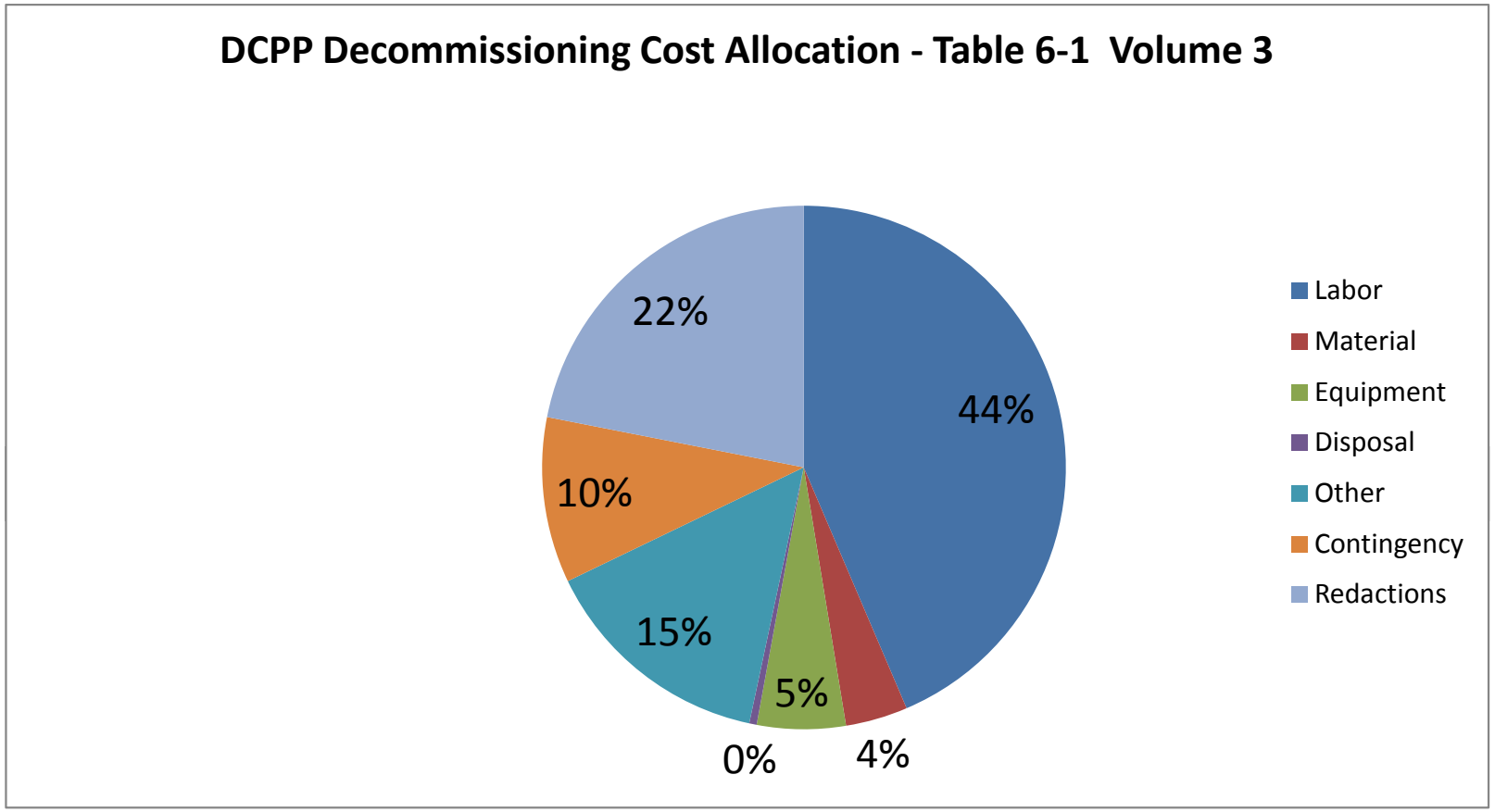

Chart by Gene A. Nelson, Ph.D. 07/25/19

Table 6-1: DCPP Decommissioning Milestones - Spreadsheets on Pages 464-470 of 486 **(Pages 481-487 of 525 in Volume 3)**

Unassigned Cost Milestones **Values are thousands of dollars.**

	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Redactions	Grand Total
1	Program Management, Oversight, and Fees	$895,127	$21,837	$10,047		$358,212	$176,823		$1,462,046
2	Security Operations	$476,576	$9,358			$1,620	$73,133		$560,687
3	Waste/Transportation/Material Management (Excluding: Breakwater, RPV/RVI Segmentation, & Large Component Removal)	$115,347	$10,166	$19,103	Redacted	Redacted	Redacted	$710,595	$855,211
4	Power Block Modifications	$47,104	$14,749	$3,972		$4,355	$10,527		$80,707
5	Site Infrastructure	$75,661	$31,751	$10,043		$5,129	$18,388		$140,972
6	Large Component Removal (including waste/transportation)	$34,575	$4,971	$21,955	Redacted	Redacted	Redacted	$104,869	$166,370
7	Reactor/Internals Segmentation	$56,203	$28,427	$11,082	Redacted	Redacted	Redacted	$236,629	$332,341
8	Spent Fuel Transfer to ISFSI	$35,482	$822	$9,643		$158,872	$30,723		$235,541
9	Turbine Building	$36,525	$4,763	$6,190		$3,069	$18,121		$68,667
10	Auxiliary Building	$51,112	$9,086	$8,984		$5,414	$17,526		$92,122
11	Containment	$64,428	$10,639	$12,742		$9,711	$23,492		$121,012
12	Fuel Handling Building	$25,274	$6,420	$4,460		$2,965	$9,509		$48,627
14	Balance of Site	$43,332	$6,633	$16,680		$1,296	$12,760		$80,702
15	Intake Structure	$14,893	$3,410	$11,391		$5,079	$6,880		$41,654
16	Discharge Structure	$6,060	$1,606	$3,660		$1,520	$2,275		$15,122
17	Breakwaters	$14,922	$1,899	$91,621	$14,533	$106,086	$57,265		$286,326
18	Non-ISFSI Site Restoration	$62,568	$10,618	$14,269		$25,962	$21,658		$135,075
19	Spent Fuel Transfer to DOE	$10,542			$7,517	$3,035	$3,164		$24,258
20	ISFSI Demolition and Site Restoration	$27,114	$7,216	$7,057		$4,562	$9,007		$54,956
	GRAND TOTAL	$2,092,845	$184,370	$262,899					$4,802,395
	Percent of $4.802 Billion	43.579%	3.839%	5.474%	0.459%	14.511%	10.229%	21.908%	100.000%

Application: 18-12-
(U 39 E)
Exhibit No.:
Date: December 13, 2018
Witness(es): Various

http://docs.cpuc.ca.gov/PublishedDocs/SupDoc/A1812008/1842/250896150.pdf
Archived 07 24 19 by Gene A. Nelson, Ph.D.
Table 6-1 Decommissioning Milestones for an estimated $4.8 billion decommissioning cost are found on page 464-470 of 465 (pagination shown on pages in volume.)
(This is actually Pages 481-487 in Volume 3)

PACIFIC GAS AND ELECTRIC COMPANY

2018 NUCLEAR DECOMMISSIONING COST TRIENNIAL PROCEEDING

PREPARED TESTIMONY
ATTACHMENTS SUPPORTING CHAPTER 4

VOLUME 3

Table 6-1: DCPP Decommissioning Milestones

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
Unassigned Cost Milestones								
1	**Program Management, Oversight, and Fees**	**$895,127**	**$21,837**	**$10,047**		**$358,212**	**$176,823**	**$1,462,045**
1.01	Staffing	629,462				8,135	85,960	723,557
1.02	Severance	135,155					20,273	155,429
1.03	Energy					59,601	8,940	68,541
1.04	Insurance					25,393	2,539	27,932
1.05	Property Tax					36,556	3,656	40,211
1.06	NRC Fees / Reviews	28,474				34,666	4,956	68,096
1.07	Association/Industry Fees					7,323	732	8,055
1.08	Facility Maintenance	13,579				5,251	2,824	21,654
1.09	Water Management	9,647	3,055	8,569		41,976	9,487	72,734
1.10	Permits	21,395				31,467	5,011	57,872
1.11	Future Land Use	11,654	37				669	12,361
1.12	Spent Fuel Management Plan	25,890				26,345	7,827	60,062
1.13	License Termination Plan	10,760	456			150	2,841	14,207
1.14	Site Characterization	6,058	6	1,373		4,111	3,464	15,013
1.15	Emergency Planning - Senate Bill 1090					38,668	5,800	44,468
1.16	Emergency Planning	2,621				21,303	3,589	27,513

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
1.17	Consumables	431	18,283	105		11,748	7,642	38,209
1.18	Public Outreach & Stakeholder Engagement					5,520	611	6,131
2	**Security Operations**	**$476,576**	**$9,358**			**$1,620**	**$73,133**	**$560,686**
2.01	Security Staffing	471,360					70,704	542,064
2.02	Other Security Related Costs	5,216	9,358			1,620	2,429	18,622
3	**Waste/Transportation/Material Management (Excluding: Breakwater, RPV/RVI Segmentation, & Large Component Removal)**	**$115,347**	**$10,166**	**$19,103**	[redacted]			**$855,211**
3.01	Waste & Transportation Management	87,325	7,774	11,374				
3.02	Transportation		155	3,444				
3.03	Disposal							
3.04	Material Management	28,022	2,238	4,285				
3.05	Asset Recovery							
3.06	GTCC Disposal				30,000		7,500	37,500
Discrete Cost Milestones								
4	**Power Block Modifications**	**$47,104**	**$14,749**	**$3,972**		**$4,355**	**$10,527**	**$80,707**
4.01	U1 Spent Fuel Pool Island	4,270	817	94		627	871	6,680
4.02	U2 Spent Fuel Pool Island	3,569	1,019	101		606	794	6,090
4.03	Install 230kV Baywood Feed	10,830	2,329	1,917			2,261	17,338

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
4.04	U1 Cold and Dark	9,470	4,687	549		1,548	2,438	18,692
4.05	U2 Cold and Dark	9,470	4,687	549		1,548	2,438	18,692
4.06	Security Modifications	9,495	1,210	762		26	1,724	13,216
5	**Site Infrastructure**	**$75,661**	**$31,751**	**$10,043**		**$5,129**	**$18,388**	**$140,972**
5.01	Offsite Infrastructure	11,029	9,330	4,277		938	3,836	29,411
5.02	Road Improvements	7,088	5,160	1,785		353	2,158	16,543
5.03	Facility Construction	14,437	7,647	2,038		871	3,749	28,742
5.04	Existing Building and Structure Modifications	9,789	4,470	1,224		2,326	2,671	20,481
5.05	ISFSI Security Building Construction	6,921	4,540	314		530	1,846	14,151
5.06	ISFSI Pad Expansion for GTCC Storage	11,259	604	405		110	1,857	14,235
5.07	Project Oversight and Support	15,139					2,271	17,410
6	**Large Component Removal (including waste/transportation)**	**$34,575**	**$4,971**	**$21,955**	[redacted]			**$166,370**
6.01	Legacy Steam Generators	4,598	314	3,345				45,872
6.02	Legacy Rx Heads	1,004	107	21				3,592
6.03	Steam Generators	16,741	1,167	15,692				78,506
6.04	Reactor Heads	468	353	528				4,614
6.05	Reactor Coolant Pumps	2,016	219	832				9,361
6.06	Pressurizers	503	310	539				4,215
6.07	Manipulators	224	84	512				1,024
6.08	Generators and Exciters	341	61	72				592
6.09	Main Turbines	986	154	167				1,633
6.10	Diesel Generators	296	255	31				728

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
6.11	Other Turbine Building Components	2,542	1,586	182	[redacted]			5,387
6.12	Large Access Penetrations	88	141	35				329
6.13	Project Oversight and Support	4,769	219					10,517
7	**Reactor/Internals Segmentation**	**$56,203**	**$28,427**	**$11,082**				**$332,341**
7.01	U1 Internals Segmentation	7,358	3,007					17,308
7.02	U1 Reactor Segmentation	4,025	2,111	11				10,165
7.03	U2 Internals Segmentation	6,247	4,335	4				17,136
7.04	U2 Reactor Segmentation	3,338	1,457	11				8,353
7.05	Waste & Transportation	432		4,791				191,129
7.06	Project Oversight and Support	18,092	1,751	1,588				36,417
7.07	Specialty Equipment	16,710	15,766	4,676				51,833
8	**Spent Fuel Transfer to ISFSI**	**$35,482**	**$822**	**$9,643**		**$158,872**	**$30,723**	**$235,541**
8.01	SNF and GTCC Cask Procurement	963	572	1,278		154,612	23,614	181,039
8.02	U1 Spent Fuel Transfer to ISFSI	17,542	155	4,403		1,859	3,594	27,552
8.03	U2 Spent Fuel Transfer to ISFSI	13,898	76	2,641		1,647	2,739	21,003
8.04	U1 GTCC Transfer to ISFSI	1,697	9	792		608	466	3,574
8.05	U2 GTCC Transfer to ISFSI	1,381	9	528		145	310	2,374
9	**Turbine Building**	**$36,525**	**$4,763**	**$6,190**		**$3,069**	**$18,121**	**$68,667**
9.01	U1 Decontamination	12,037	658	957		15	6,833	20,500
9.02	U1 System & Area Closure	2,995	1,329	672		399	1,349	6,744
9.03	U1 Demolition	2,221	316	1,358		1,006	735	5,635
9.04	U2 Decontamination	10,791	658	957		15	6,210	18,630
9.05	U2 System & Area Closure	6,115	1,401	663		518	2,174	10,871

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
9.06	U2 Demolition	2,366	401	1,584		1,116	820	6,287
10	**Auxiliary Building**	**$51,112**	**$9,086**	**$8,984**		**$5,414**	**$17,526**	**$92,122**
10.01	U1 Decontamination	1,773	139	66		1	990	2,969
10.02	U1 System & Area Closure	20,902	3,483	1,927		886	6,800	33,998
10.03	U1 Demolition	4,117	1,390	2,263		1,994	1,464	11,228
10.04	U2 Decontamination	1,075	139	66		1	640	1,921
10.05	U2 System & Area Closure	18,707	3,533	1,947		574	6,190	30,951
10.06	U2 Demolition	4,538	403	2,715		1,957	1,442	11,055
11	**Containment**	**$64,428**	**10,639**	**$12,742**		**$9,711**	**$23,492**	**$121,012**
11.01	U1 Decontamination	4,413	347	547		277	2,792	8,375
11.02	U1 System & Area Closure	20,772	3,508	1,312		1,133	6,681	33,407
11.03	U1 Demolition	7,427	1,382	4,525		3,434	2,515	19,283
11.04	U2 Decontamination	3,197	343	547		274	2,180	6,540
11.05	U2 System & Area Closure	21,064	3,630	1,286		1,129	6,778	33,888
11.06	U2 Demolition	7,556	1,428	4,525		3,464	2,546	19,519
12	**Fuel Handling Building**	**$25,274**	**$6,420**	**$4,460**		**$2,965**	**$9,509**	**$48,627**
12.01	U1 Decontamination	1,014	78	247		2	671	2,013
12.02	U1 System & Area Closure	8,399	2,201	849		475	2,981	14,905
12.03	U1 Demolition	2,103	1,373	1,358		1,237	911	6,982
12.04	U2 Decontamination	976	77	247		2	651	1,953
12.05	U2 System & Area Closure	11,479	2,305	854		594	3,808	19,040
12.06	U2 Demolition	1,302	386	905		655	487	3,735

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
14	**Balance of Site**	**$43,332**	**$6,633**	**$16,680**		**$1,296**	**$12,760**	**$80,702**
14.01	Decontamination	7,148	115	75		2	3,670	11,011
14.02	System & Area Closure	8,292	2,448	755		821	1,847	14,163
14.03	Demolition	27,892	4,070	15,850		473	7,243	55,528
15	**Intake Structure**	**$14,893**	**$3,410**	**$11,391**		**$5,079**	**$6,880**	**$41,654**
15.01	System Area Closure	3,920	595	296		830	846	6,486
15.02	Coffer Dam	3,308	1,498	6,872		812	1,874	14,364
15.03	Demolition	7,665	1,317	4,223		3,437	4,161	20,804
16	**Discharge Structure**	**$6,060**	**$1,606**	**$3,660**		**$1,520**	**$2,275**	**$15,122**
16.01	Discharge Piping Decontamination	283	62	35			190	570
16.02	Coffer Dam	2,246	836	2,870		361	947	7,261
16.03	Demolition	950	245	515		446	539	2,696
16.04	System Area Closure	2,581	463	239		713	599	4,595
17	**Breakwaters**	**$14,922**	**$1,899**	**$91,621**	**$14,533**	**$106,086**	**$57,265**	**$286,326**
17.01	Demolition	14,922	1,899	91,621		2,687	27,782	138,910
17.02	Transportation					103,400	25,850	129,249
17.03	Disposal Cost				14,533		3,633	18,166
18	**Non-ISFSI Site Restoration**	**$62,568**	**$10,618**	**$14,269**		**$25,962**	**$21,658**	**$135,075**
18.01	Utilities and Structures Demo	7,656	850	3,626		15,302	4,115	31,549
18.02	Soil Remediation	2,193	172	667		573	541	4,145
18.03	Final Site Survey	25,061				5,911	9,291	40,263
18.04	Grading and Landscaping	27,658	9,596	9,976		4,176	7,711	59,118

ID	Scope Description	Labor	Material	Equipment	Disposal	Other	Contingency	Grand Total
		(in thousands)						
19	**Spent Fuel Transfer to DOE**	**$10,542**			**$7,517**	**$3,035**	**$3,164**	**$24,258**
19.01	U1 Spent Fuel Transfer to DOE	4,574				1,416	899	6,889
19.02	U2 Spent Fuel Transfer to DOE	5,308			7,517	1,416	2,136	16,376
19.03	GTCC Transfer to Offsite Facility	660				204	130	993
20	**ISFSI Demolition and Site Restoration**	**$27,114**	**$7,216**	**$7,057**		**$4,562**	**$9,007**	**$54,956**
20.01	Utilities and Structures Demo	12,190	713	3,491		2,543	4,734	23,671
20.02	Soil Remediation	1,347	47	206		180	267	2,048
20.03	Final Site Survey	1,073				400	442	1,915
20.04	Grading and Landscaping	12,505	6,455	3,359		1,439	3,564	27,322
	GRAND TOTAL	**$2,092,845**	**$184,370**	**$262,899**				**$4,802,395**

Figure 4-1 Decommissioning versus Operating Staffing Levels During Transition

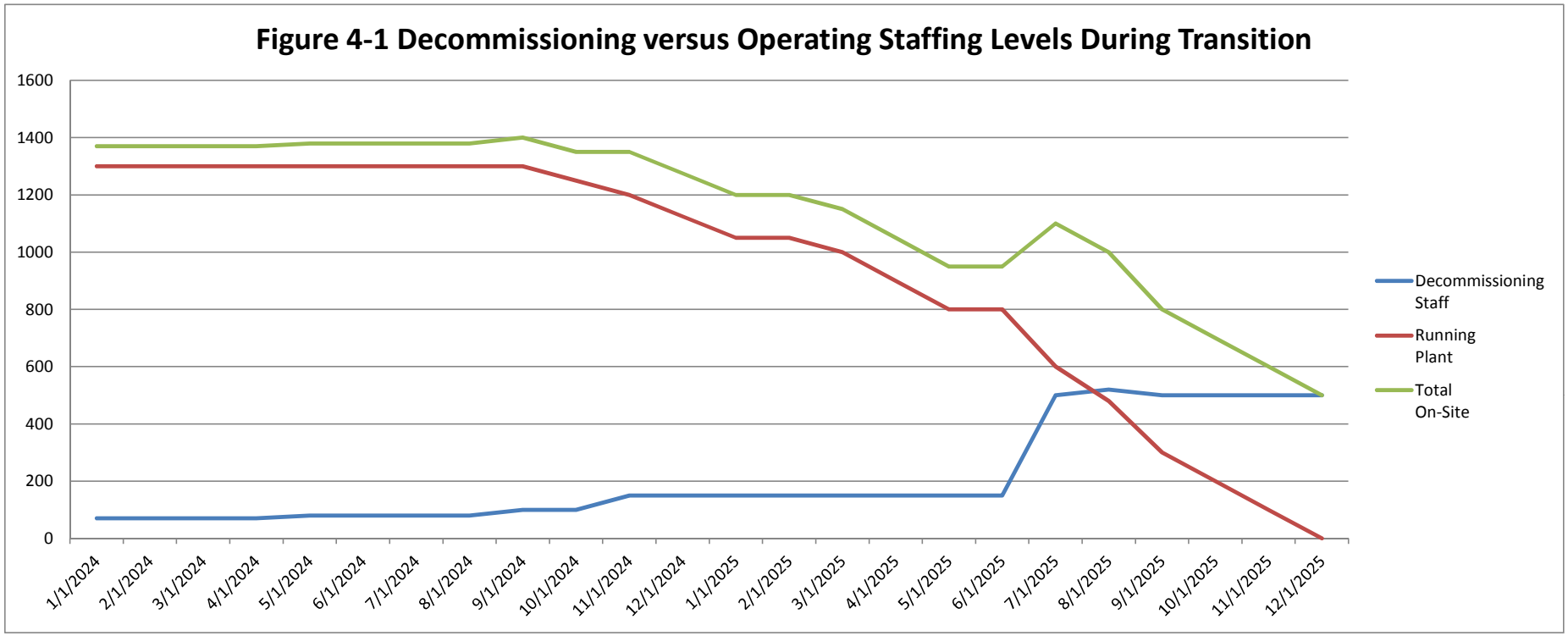

Figure 4-1 DCPP Decommissioning versus Operating Staffing Levels

	Decommissioning Staff	Running Plant	Total On-Site
1/1/2024	70	1300	1370
2/1/2024	70	1300	1370
3/1/2024	70	1300	1370
4/1/2024	70	1300	1370
5/1/2024	80	1300	1380
6/1/2024	80	1300	1380
7/1/2024	80	1300	1380
8/1/2024	80	1300	1380
9/1/2024	100	1300	1400
10/1/2024	100	1250	1350
11/1/2024	150	1200	1350
12/1/2024	150	1125	1275
1/1/2025	150	1050	1200
2/1/2025	150	1050	1200
3/1/2025	150	1000	1150
4/1/2025	150	900	1050
5/1/2025	150	800	950
6/1/2025	150	800	950
7/1/2025	500	600	1100
8/1/2025	520	480	1000
9/1/2025	500	300	800
10/1/2025	500	200	700
11/1/2025	500	100	600
12/1/2025	500	0	500

Values Estimated from graph on page 112 of 486 (Page 129 of 525 i
(PG&E apparently did not provide this tabular data.)
Gene Nelson, Ph.D. July 25, 2019

Social Cost of Carbon from Closing Diablo Canyon Power Plant in 2024-2025

An omission in Berkeley's Economic Impact Assessment is the Social Cost of Carbon (SC-CO2) for replacing Diablo Canyon with any electricity source, or combination thereof, which emits CO_2, SO_2, or NO_X pollution. The SC-CO2 is meant to be a comprehensive estimate of climate change damages and includes changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. For example: In 2017, California generated an average of 4.6 megawatthours of electricity for each short ton of CO_2e[1] it emitted[2]. Replacing Diablo Canyon with sources emitting greenhouse gases at California's average rate will thus increase California emissions by a minimum of 3.91 million short tons/year.

The U.S. EPA has calculated a social cost of carbon at $42/ton of CO_2 in 2024 and $46 per ton in 2025, increasing to a maximum of $69/ton by 2050. Diablo Canyon should be re-licensed to operate for a additional 20-year period.[3] The loss of Diablo Canyon Power Plant would **increase California carbon emissions by 80.155 million short tons** during these two decades. These increased carbon emissions will cause environmental, health, and other societal damages of **$4.248 billion** through 2045.

DCPP Carbon Avoidance, 2025-2045

Period	DCPP Avoidance, Tons CO_2e	Social Cost / Ton CO_2e	Est. Cost[1]
2024 (one reactor shuts down in June)	977,500	$42	$41,055,000
2025 (second reactor shuts down in June)	2,932,500	$46	$134,895,000
2026-2029	15,640,000	$46	$719,440,000
2030-2034	19,550,000	$50	$977,500,000
2035-2089	19,550,000	$55	$1,075,250,000
2040-2044	19,550,000	$60	$1,173,000,000
2045 (to July 1)	1,955,000	$65	$127,075,000
20-year Totals	**80,155,000**		**$4,248,215,000**

Note: DCPP's typical annual production taken to be 18 million MWh/year.
Thus CO2 Avoidance = 18 million MWh/4.6 Tons/MWh = 3,910,000 Tons CO2
[1] Complete calendar year.

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[1] "CO_2e", or CO_2 equivalent, is a combined cost representing greenhouse gases CO_2, SO_2, and NO_X in proportion to their cumulative effect on climate.

[2] The Social Cost of Carbon: Estimating the Benefits of Greenhouse Gas Reduction https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

[3] 2017 California State Emissions: https://www.eia.gov/electricity/state/california/