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Diablo Canyon Power Plant Operations Assessment Report – 2026 Update

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California Energy Commission

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ABSTRACT

The Diablo Canyon Power Plant Operation Assessment report addresses a requirement in Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) for the California Energy Commission, in coordination with the California Public Utilities Commission and the California Independent System Operator, to publish an assessment of the operation of the Diablo Canyon Power Plant, on or before July 1, 2023, and on July 1 of each year thereafter until 2031. The assessment includes outage information, power plant operation costs, average revenues from electricity sales, worker attrition, and the contribution of the power plant to resource adequacy requirements. This report serves as the July 2026 update.

Keywords: Diablo Canyon, operations assessment, Senate Bill No. 846, outage, refueling, operational costs, worker attrition, resource adequacy

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EXECUTIVE SUMMARY

The Diablo Canyon Power Plant (DCPP) in San Luis Obispo County is owned and operated by Pacific Gas and Electric Company (PG&E) and, since 2012, is the last operating nuclear power plant in California. The DCPP consists of two nuclear reactors (Units 1 and 2) that began operation in May 1985 and March 1986, respectively. The DCPP produces about 18,000 gigawatt-hours of electricity annually, which is nearly nine percent of California's total electricity supply. The DCPP's original operating licenses issued by the United States Nuclear Regulatory Commission (NRC) expired in November 2024 for Unit 1 and August 2025 for Unit 2. The two units continued to operate past their original termination dates under an NRC exemption while the NRC considered PG&E's license renewal application (LRA). On April 2, 2026, the NRC approved PG&E's LRA for extended operations at DCPP through November 2, 2044, for Unit 1, and August 26, 2045, for Unit 2.

The 100 Percent Clean Energy Act of 2018 (Senate Bill (SB) 100, De León, Chapter 312, Statutes of 2018) establishes a target for renewable and zero-carbon resources to supply 100 percent of retail sales, as well as electricity procured to serve all state agencies, by 2045. Actions to achieve the goals of SB 100 are resulting in the unprecedented buildout of clean energy resources, primarily solar and energy storage at utility scale. Risks to the timely buildout of these resources at the scale required include supply chain issues and delays in interconnection and permitting.

Because the DCPP provides reliable power, roughly 2,280 megawatts of capacity at peak and net-peak times, and due to the potential challenges in developing new clean energy projects to ensure adequate resource availability during extreme weather situations, SB 846 (Dodd, Chapter 239, Statutes of 2022) was passed to provide a path to extend DCPP operations beyond 2025 if it is needed to support grid reliability.

Based on a thorough analysis, the California Energy Commission (CEC) determined that it was prudent for the state to pursue extension of the DCPP operating license. This determination was driven by the risk that sufficient clean electricity resources may not be built in time to reach the ordered procurement and to address potential grid demands during extreme heat events.

In December 2023, the California Public Utilities Commission (CPUC) voted to conditionally approve an extension of the DCPP operating license (Decision 23-12-036). This decision directs and authorizes extended operations at DCPP until October 31, 2029, for Unit 1, and October 31, 2030, for Unit 2.

While the NRC operating licenses provide a 20-year extension to DCPP through November 2044 for Unit 1 and August 2045 for Unit 2, SB 846, as well as the CPUC's conditional approval, only provide a path for a five-year extension for DCPP through October 2029 for Unit 1 and October 2030 for Unit 2.

The Diablo Canyon Power Plant Operation Assessment Report, published by the CEC in July 2023, addressed a requirement in SB 846 for the CEC, in coordination with the CPUC and the California Independent System Operator, to publish an assessment of the operation of the DCPP that includes outage information, power plant operational costs, average revenues from electricity sales, worker attrition, and the contribution of the power plant to resource adequacy requirements.

SB 846 also requires the CEC to publish an update to the original 2023 report on July 1 of each year thereafter until 2031. This report serves as the July 2026 update.

CHAPTER 1:

Introduction

The Diablo Canyon Power Plant (DCPP) near San Luis Obispo is owned and operated by Pacific Gas and Electric Company (PG&E). DCPP produces about 18,000 gigawatt-hours (GWh) of electricity annually, which is nearly nine percent of California's total electricity supply. The two reactor units were originally licensed by the United States Nuclear Regulatory Commission (NRC) to operate until November 2, 2024, for Unit 1, and August 26, 2025, for Unit 2.¹ The NRC granted permission for Units 1 and 2 to operate past their original termination dates while the NRC considered PG&E's license renewal application (LRA) which was granted on April 2, 2026.²

Additionally, due to DCPP providing roughly 2,280 megawatts (MW) of capacity at peak and net-peak times and the various challenges in developing new clean energy projects, Senate Bill (SB) 846 (Dodd, Chapter 239, Statutes of 2022) was passed to provide a path to extend DCPP operations beyond 2025 if it is needed to support grid reliability.

Based on a thorough analysis, the California Energy Commission (CEC) determined that it was prudent for the state to pursue extension of the DCPP operating license. This determination was driven by the risk that sufficient clean electricity resources may not be built in time to reach the ordered procurement and address potential grid demands during extreme heat events.

In December 2023, the California Public Utilities Commission (CPUC) voted to approve an extension of DCPP's license (Decision (D.) 23-12-036).³ This decision directs and authorizes extended operations at DCPP until October 31, 2029, for Unit 1, and October 31, 2030, for Unit 2. The approval in this decision is subject to the following conditions:

- The NRC authorizes DCPP to continue to operate under its current licenses past their expiration dates.
- The \$1.4 billion loan agreement authorized by SB 846 is not terminated.
- CPUC does not make a future determination that DCPP extended operations are imprudent or unreasonable.

SB 846 provides a path for only a five-year operational extension for DCPP Units 1 and 2. NRC's April 2026 license extension of twenty years does not alter the authority of SB 846. Consistent with SB 846, the CPUC's December 2023 conditional authorization of a five-year extension explicitly states that operations are authorized only through October 31, 2029, for

1 California Energy Commission staff. 2023. [Final Commission Report, Diablo Canyon Power Plant Extension, CEC Analysis of Need to Support Reliability](https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-ESR-01). Publication Number: CEC-200-2023-004, <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-ESR-01>.

2 United States Nuclear Regulatory Commission. March 2, 2023. [NRC Grants "Timely Renewal" Exemption to Allow Continued Operation of Diablo Canyon Nuclear Power Plant](https://www.nrc.gov/cdn/doc-collection-news/2023/23-015.pdf), <https://www.nrc.gov/cdn/doc-collection-news/2023/23-015.pdf>

3 California Public Utilities Commission. 2023. [Decision Conditionally Approving Extended Operations At Diablo Canyon Nuclear Power Plant Pursuant to Senate Bill 846](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M521/K424/521424048.pdf), <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M521/K424/521424048.pdf>

Unit 1, and October 31, 2030, for Unit 2. Therefore, although NRC has approved PG&E's license renewal application, any operations beyond those dates would still require additional authorization from the California Legislature.

According to PG&E, its pursuance of a 20-year extension was a cost-saving measure, as NRC's standard license extension process is for a 20-year extension. NRC's review system is set up to evaluate license extension applications based on a 20-year time frame and, according to PG&E, any deviation from that would likely require the development of updated criteria and a special exemption from the NRC. Therefore, PG&E stated that it pursued a 20-year extension because it was less expensive and less complicated than pursuing a 5-year extension.

As part of the LRA, the NRC issued a Safety Evaluation Report (SER)⁴ and a Final Supplemental Environmental Impact Statement (SEIS)⁵ in June 2025. The California Coastal Commission issued a Coastal Zone Management Act Federal Consistency Certification (Consistency Certification No. CC-0003-23) and Coastal Development Permit (Application No. 9-25-0739) at its meeting held on December 11, 2025, for the extended operations at DCPD and associated development. The Central Coast Regional Water Quality Control Board issued a National Pollutant Discharge Elimination System Permit (Order R3-2026-000) and a Federal Clean Water Act Section 401 Water Quality Certification (Order 34024WQ31) to DCPD on February 26, 2026. On April 2, 2026, the NRC approved PG&E's license renewal application for extended operations at DCPD through November 2, 2044, for Unit 1, and August 26, 2045, for Unit 2.⁶

Operations Assessment Report Update

SB 846 added Section 25233.2(d) of the Public Resources Code, which requires an annual assessment by the CEC, in coordination with the CPUC and California Independent System Operator (California ISO), of the operations at DCPD, including outage information, power plant operation costs, average revenues from electricity sales, worker attrition, and the contribution of the power plant to resource adequacy requirements

This annual update provides an assessment of DCPD operations occurring since the publication of the first DCPD Operation Assessment Report (CEC-700-2023-005),⁷ in July 2023, and since the subsequent annual updates starting in July 2024, including new information from the calendar year 2025.⁸

4 United States Nuclear Regulatory Commission staff. 2025. [Safety Evaluation Related to the License Renewal of Diablo Canyon Nuclear Power Plant, Units 1 and 2](https://www.nrc.gov/docs/ML2515/ML25153A508.pdf). <https://www.nrc.gov/docs/ML2515/ML25153A508.pdf>

5 United States Nuclear Regulatory Commission staff. 2025. [NUREG-1437, Supplement 62, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding License Renewal of Diablo Canyon Nuclear Power Plant, Units 1 and 2, Final Report."](https://www.nrc.gov/docs/ML2515/ML25156A357.pdf) <https://www.nrc.gov/docs/ML2515/ML25156A357.pdf>

6 United States Nuclear Regulatory Commission staff. 2026. [RECORD OF DECISION U.S. NUCLEAR REGULATORY COMMISSION DOCKET NUMBERS 50-275 AND 50-323 LICENSE RENEWAL APPLICATION FOR DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2](https://www.nrc.gov/docs/ML2602/ML26022A077.pdf). <https://www.nrc.gov/docs/ML2602/ML26022A077.pdf>

7 California Energy Commission staff. 2023. [Diablo Canyon Power Plant Operations Assessment Report](https://www.energy.ca.gov/publications/2023/diablo-canyon-power-plant-operations-assessment-report). Publication Number: CEC-700-2023-005, <https://www.energy.ca.gov/publications/2023/diablo-canyon-power-plant-operations-assessment-report>.

8 California Energy Commission staff. 2026. [Diablo Canyon](https://www.energy.ca.gov/data-reports/california-energy-planning-library/reliability/diablo-canyon). <https://www.energy.ca.gov/data-reports/california-energy-planning-library/reliability/diablo-canyon>

CHAPTER 2:

Diablo Canyon Power Plant Operations Assessment

Outage Information

DCPP schedules outages to permit refueling of the reactors, along with maintenance, inspections, and modifications. However, on occasion, a forced outage, also known as a manual maintenance outage, is required when a system is operating outside acceptable limits.

Refueling Outages

Refueling outage 1R25 occurred for Unit 1 between April 13 and May 18, 2025, the results of which were presented at the Diablo Canyon Independent Safety Committee (DCISC) public meeting on June 10 and 11, 2025. Refueling outage 2R25 occurred for Unit 2 between October 5 to November 4, 2025, the results of which were presented at the DCISC public meeting on February 18 and 19, 2026.

Maintenance and Forced Outages

Maintenance of the reactor systems are typically planned to occur during refueling outages to minimize the time the reactors are offline. On occasion, a forced outage is required when a system is operating outside acceptable limits and may require a curtailment (reduction) in power production. Curtailments may also be associated with planned maintenance events.

DCISC's thirty-fifth annual report⁹ for plant operating period July 1, 2024, through June 30, 2025, provides information regarding refueling, maintenance, and forced outages and is summarized in **Table 1**.

Table 1: Power Generation-Impacting Events July 2024 – June 2025

Unit	Date	Type	Reduced to Power Level	Event
1	8/31/24 – 9/2/24	Maintenance - Pick and Dredge	50%	Main condenser pick and dredge of marine growth due to high sea swells
1	9/14/24 – 9/16/24	Maintenance - Pick and Dredge	50%	Main condenser pick and dredge of marine growth due to high sea swells

⁹ Diablo Canyon Independent Safety Committee staff. 2025. [Thirty-Fifth Annual Report on the Safety of Diablo Canyon Nuclear Power Plant Operations](https://www.dcisc.org/download/library/annual-reports/35th-annual-report-93.pdf), <https://www.dcisc.org/download/library/annual-reports/35th-annual-report-93.pdf>.

Unit	Date	Type	Reduced to Power Level	Event
1	9/28/24 – 9/30/24	Maintenance - Pick and Dredge	50%	Main condenser pick and dredge of marine growth due to high sea swells
1	10/5/24 – 10/8/24	Maintenance - Pick and Dredge	50%	Main condenser pick and dredge of marine growth due to high sea swells
1	4/13/25 – 5/18/25	Refueling Outage	0%	1R25 Refueling outage
2	3/10/25 – 3/15/25	Maintenance - Curtailment	52%	Main condenser pick and dredge of marine growth due to high sea swells

Source: DCISC's thirty-fifth annual report, *Diablo Canyon Independent Safety Committee Thirty-Fifth Annual Report on the Safety of Diablo Canyon Nuclear Power Plant Operations July 1, 2024—June 30, 2025*

Outage Filings With the NRC

PG&E files outage reports with the NRC. The outage reports include descriptions of violations and associated corrective actions reported and taken by PG&E related to outages. NRC-identified, self-revealed, and licensee-identified findings and violations can be found on the *Inspection Reports for Operating Power Reactors* section of the NRC website.¹⁰ The following definitions are provided from the NRC Inspection Manual, Chapter 0612, Issue Screening, effective date May 28, 2025:¹¹

- Licensee-identified — Licensee-identified findings and violations are (1) identified as a result of deliberate observation by licensee personnel and (2) entered into the licensee corrective action program.
- Self-revealed — Self-revealed findings or violations are those identified as a result of a condition that (1) becomes apparent through a readily detectable degradation in material condition, capability, or functionality of equipment or plant operations and (2) does not meet the definition of licensee-identified or NRC-identified.
- NRC-identified — NRC-identified findings or violations are found by NRC inspectors, of which the licensee was not previously aware or had not been previously documented in the licensee's corrective action program. NRC-identified findings or violations also

¹⁰ United States Nuclear Regulatory Commission staff. 2025. ["Inspection Reports for Operating Power Reactors."](https://www.nrc.gov/reactors/operating/oversight/listofrpts-body.html#diab)
https://www.nrc.gov/reactors/operating/oversight/listofrpts-body.html#diab.

¹¹ United States Nuclear Regulatory Commission staff. 2025. [NRC Inspection Manual, Chapter 0612, Issue Screening, Effective Date May 28, 2025](https://www.nrc.gov/docs/ML2508/ML25086A248.pdf), https://www.nrc.gov/docs/ML2508/ML25086A248.pdf.

include issues initially identified by the licensee to which the inspector has identified inadequacies in the licensee's characterization or evaluation of the issue of concern.

There were no findings and violations during the scheduled refueling outages in 2025. PG&E tracks NRC-identified, self-revealed, and licensee-identified findings and violations in its corrective action program in accordance with NRC regulations until the findings and violations have been corrected.

Operational Costs

The historical operating costs of the DCPD as percentages of total annual expenses are summarized in **Table 2**. The operational costs subcategories listed in **Table 2** were developed by PG&E and intended to align with those used by the Electric Utility Cost Group (EUCG).

The EUCG provides a professional working forum for the electric utility industry to share information to help companies improve their operating, maintenance, and construction performance.

Table 2: Operating Costs as Percentages of Total Expenses

Operational Subcategory	2020	2021	2022	2023	2024	2025
Engineering (%)	11.7	10.3	10.9	7.9	8.3	7.2
Fuel Management (%)	0.1	0.2	0.2	0.5	0.1	2.3
Loss Prevention (%)	19.7	18.9	19.0	12.7	11.4	12.8
Materials and Services (%)	1.2	1.3	1.9	1.3	0.9	0.8
Operations (%)	17.8	18.6	18.7	12.9	14.9	13.8
Support Services (%)	20.0	21.1	20.6	34.4	33.6	37.8
Work Management (%)	26.6	27.2	26.5	26.7	28.4	23.5
Training — Develop and Conduct (%)	2.9	2.4	2.2	3.6	2.5	1.8

Source: Pacific Gas and Electric Company staff, 2023, 2024, 2025, and 2026

The operational expenses of the DCPD are summarized in **Table 3**. The operational expenses listed in **Table 3** were provided by PG&E and account for costs as approved by the CPUC in general rate cases (GRC) and in annual rate cases to support DCPD extended operations, along with any adjustments to previous years. GRCs are proceedings used to address the costs of operating and maintaining the utility system and the allocation of those costs among customer classes.

CPUC reviews detailed cost data for various areas of utility operations and approves a budget for the first year (test year) of the GRC cycle. For Years 2, 3, and 4 (post-test years), the GRC

decision prescribes how to adjust the test year budget for inflation and other factors that may affect costs, such as additional capital projects between test years.¹²

The DCPD incurred extended operations costs starting in 2023.¹³ The CPUC approved D.25-12-007 to support DCPD extended operations for the period of January 1 through December 31, 2026. Starting with the 2027 GRC, there will be no DCPD costs in the GRC. Instead, PG&E made a proposal to the CPUC that would address all DCPD extended operations costs (such as operational costs, nuclear fuel procurement costs, and the employee retention program) in its DCPD extended operations revenue requirement proposal. On March 27, 2026, PG&E filed with the CPUC application 26-03-031 to support DCPD extended operations for the period of January 1 through December 31, 2027. The CPUC is reviewing PG&E’s application throughout 2026, and the schedule specifies a CPUC decision in December 2026.

Table 3: Operating Expenses (Thousands of USD)

2020	2021	2022	2023	2024	2025
\$1,094,915	\$1,078,665	\$1,068,689	\$1,212,462	\$1,236,147	\$1,248,581

Note 1: Adjustments to amounts reflect outcomes from the approved regulatory decisions.

Source: Pacific Gas and Electric Company staff, 2023, 2024, 2025, and 2026

Revenues From Electricity Sales

DCPD earns revenue from electricity sales into organized markets, like the California ISO market. Sales into organized markets are wholesale, and the electricity can be sold in California ISO markets or another balancing authority’s markets. These revenues have been forecasted in PG&E’s DCPD extended operations revenue requirement proposal with the CPUC. **Table 4** summarizes the annual revenues from 2022 through 2025 for DCPD’s electricity sales into the California ISO market. The dollar amounts per megawatt-hour (\$/MWh) represent the average price of DCPD electricity sold into the California ISO wholesale market.

Separately, the total value of DCPD’s resource adequacy (RA) capacity is estimated based on a market price benchmark developed by the CPUC.¹⁴ **Table 4** summarizes DCPD’s RA capacity values from 2022 through 2025. The dollar amounts per kilowatt-year (\$/kW-yr) are derived from CPUC’s System RA market price benchmark.

12 California Public Utilities Commission staff. 2023. *What is a General Rate Case (GRC)?* <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-rates/general-rate-case>.

13 DCPD extended operations employee retention costs began on September 1, 2023. DCPD extended operations costs began on November 3, 2024, for Unit 1, and August 27, 2025, for Unit 2.

14 California Public Utilities Commission staff. 2026. *Power Charge Indifference Adjustment (PCIA)*. <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/power-charge-indifference-adjustment>

Table 4: Annual Revenues from DCP

	2022	2023	2024	2025
Electricity Sales into Organized Markets	\$1,485,696,233	\$980,840,452	\$640,100,651	\$602,870,000
\$/MWh	\$84.38	\$55.29	\$34.79	\$33.74
Total Value of RA Capacity	\$221,889,600	\$393,163,200	\$718,473,600	\$306,705,600
\$/kW-yr	\$97.32	\$172.44	\$315.12	\$134.52
Gross Revenue Requirement	\$1,180,812,000	\$1,331,209,000	\$1,391,461,000	\$1,313,168,000

Note 1: Adjustments to amounts reflect outcomes from the approved regulatory decisions.

Note 2: To determine the net cost to electric retail customers, subtract amounts in row "Electricity Sales into Organized Markets" from amounts in row "Gross Revenue Requirement."

Source: Pacific Gas and Electric Company staff, 2023, 2024, 2025, and 2026

Worker Attrition Through Continued Operation

The employee retention program authorized by CPUC D.18-01-022 expired at the end of 2023. However, SB 846 in Public Utilities Code (PUC) Section 712.8(f)(2) directs the CPUC to fund an extended program to support worker retention.

"The commission shall continue to fund the employee retention program approved in Decision 18-11-024 (December 2, 2018) Decision Implementing Senate Bill 1090 and Modifying Decision 18-01-22, as modified to incorporate 2024, 2025, and additional years of extended operations, on an ongoing basis until the end of operations of both units with program costs tracked under subdivision (e) and fully recovered in rates. Any additional funding for the employee retention program beyond what was already approved in commission Decision 18-11-024 shall be submitted by the operator in an application for review by the commission."

On September 12, 2024, the CPUC approved D.24-09-002 regarding the DCP employee retention program for the period from September 1, 2023, through November 1, 2030. The goal of this program is to retain the experienced and qualified DCP workforce to ensure safe and reliable operations during the extended DCP operation period. The DCP employee retention program has been funded through PG&E's DCP extended operations revenue requirement proposal with the CPUC since September 2023 and annually thereafter.

The Contribution of Diablo Canyon to Resource Adequacy

DCP provides nearly nine percent of California's total electricity supply and accounts for 2,280 MW total (1,140 MW per unit) of system RA. Each unit at DCP undergoes a planned refueling outage roughly every eighteen months. The planned outages for each unit are staggered such that only one unit is in a planned outage at a time.

In addition to refueling, DCPD undergoes planned curtailments to clean the intake tunnels of the plants. During planned refueling and tunnel cleaning outages, PG&E is obligated to ensure that adequate replacement RA resources are available to meet PG&E's RA obligations during the outage period. As planned outage timing and duration are scheduled far in advance, PG&E plans its portfolio so that it continues to meet its RA obligations and appropriately contributes to overall grid reliability during planned outages.

CPUC's Energy Division establishes RA obligations applicable to all load serving entities (LSEs) within the CPUC's jurisdiction and evaluates LSE filings annually and monthly. During the extended operations at DCPD, LSEs use DCPD's RA capacity attributes towards their respective RA program compliance requirements. In total, DCPD counts for 2,280 MW of RA capacity, which is allocated to all LSEs based on their share of system load. LSEs receive their allocations of DCPD's RA capacity from the CPUC's Energy Division via the Cost Allocation Mechanism. Because DCPD is a baseload resource, DCPD contributes to RA requirements under the CPUC's hourly Slice of Day framework in all twenty-four hours.

SB 846 in Public Utilities Code Section 454.52(f)(2) disallows LSEs from including DCPD in their integrated resource plans beyond November 1, 2024, for Unit 1, and August 26, 2025, for Unit 2. Additionally, CPUC Decision 23-12-036 instructed LSEs to procure future resources, as extended operations at DCPD cannot be considered for the integrated resource plan process.

CHAPTER 3:

Conclusions

This annual update provides an assessment of DCPD operations occurring since the initial *DCPD Operation Assessment Report* (CEC-700-2023-005) was published in July 2023, and since the last annual update in July 2025. This annual update includes new information from the calendar year 2025 related to:

- Outage information.
- Power plant operational costs.
- Revenues from electricity sales.
- Worker attrition.
- Contribution to resource adequacy.

CEC staff prepared this update of the operations assessment report to provide the state Legislature with an understanding of the current conditions of operations at DCPD. An operations assessment report update will be submitted to the Legislature on July 1 of each year until 2031 and will include updated analyses and assessments of DCPD operations.

GLOSSARY

CLIMATE CHANGE — Also referred to as 'global climate change'. The term 'climate change' is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, 'climate change' has been used synonymously with the term, 'global warming'; scientists however, tend to use the term in the wider sense to also include natural changes in climate.

RESOURCE ADEQUACY — The Resource Adequacy (RA) program, implemented by CPUC, ensures that adequate physical generating capacity dedicated to serving all load requirements is available to meet peak demand and planning and operating reserves, at or deliverable to locations and at times as may be necessary to ensure local area reliability and system reliability.

APPENDIX A:

Acronyms and Abbreviations

AEC — Atomic Energy Commission
California ISO — California Independent System Operator
CEC — California Energy Commission
CFR — Code of Federal Regulations
CPUC — California Public Utilities Commission
DCISC — Diablo Canyon Independent Safety Committee
DCPP — Diablo Canyon Power Plant
GRC – general rate cases
GWh — gigawatt-hour
HBPP — Humboldt Bay Nuclear Power Plant
ISFSI — Independent Spent Fuel Storage Installation
LRA – license renewal application
MW – megawatt
MWe – megawatts equivalent
MWh – megawatt-hour
NRC — Nuclear Regulatory Commission
PG&E — Pacific Gas and Electric Company
PWR — pressurized water reactor
PUC – Public Utilities Code
RA — resource adequacy
SB — Senate Bill

APPENDIX B:

Nuclear Energy in the United States and California

United States

Atomic Energy Commission

Before NRC was created, nuclear regulation was the responsibility of the Atomic Energy Commission (AEC), which Congress established in the Atomic Energy Act of 1946. Eight years later, Congress amended that law with the Atomic Energy Act of 1954, which allowed the development of commercial nuclear power. The act assigned the AEC the functions of promoting the use of nuclear power and regulating the safety of nuclear power. The AEC sought to ensure public health and safety from the hazards of nuclear power without imposing excessive requirements that would inhibit the growth of the industry. This was a difficult balance to achieve and within a short time the AEC stirred considerable controversy. An increasing number of critics during the 1960s charged that the AEC regulations were insufficiently rigorous in several important areas, including radiation protection standards, reactor safety, plant siting, and environmental protection.¹⁵

Nuclear Regulatory Commission

By 1974, the AEC's regulatory programs had come under such strong attack that Congress decided to abolish the agency. Supporters and critics of nuclear power agreed that the promotional and regulatory duties of the AEC should be assigned to different agencies. The Energy Reorganization Act of 1974 placed the AEC's weapons and energy development programs under the jurisdiction of an agency that later became the U.S. Department of Energy. Congress created the NRC to regulate the civilian nuclear power industry. NRC began operations on January 19, 1975. NRC focused its attention on several broad issues that were essential to protecting public health and safety. These issues included radiation protection, reactor safety, and regulation of nuclear materials.¹⁶

Radiation Protection

The primary danger of the use of nuclear materials for electrical power production, as well as a variety of industrial, medical, and research applications, is that workers or the public could be exposed to hazardous levels of radiation. The AEC and NRC published standards that were intended to provide an ample margin of safety from radiation generated by the activities of its licensees. These radiation standards were based on available scientific information and the judgment of leading authorities in the field at the time.¹⁷

¹⁵ United States Nuclear Regulatory Commission. 2021. *About the NRC*. <https://www.nrc.gov/about-nrc.html>

¹⁶ *Ibid.*

¹⁷ *Ibid.*

Radiation standards are continually updated as new data emerges. NRC ensures that users of radioactive materials keep radiation exposures within the agency's specified dose limits and as low as reasonably achievable. Users of radioactive materials must obtain a license from NRC and be inspected to ensure that they are following the agency's latest regulations and safety practices. Nuclear power plants emit minute quantities of radioactive gases and liquids to the environment under controlled and monitored conditions during normal plant operations. Because these radioactive discharges can have environmental impacts on humans and the environment, NRC requires licensees to monitor the discharges and analyze nearby environmental samples to ensure that the impacts of plant operations are minimized.¹⁸

NRC assists states expressing interest in establishing programs to assume NRC regulatory authority under the Atomic Energy Act of 1954, as amended. The Atomic Energy Act, Section 274 provides a statutory basis under which NRC relinquishes to the states portions of its regulatory authority to license and regulate byproduct materials (radioisotopes), source materials (uranium and thorium), and certain quantities of special nuclear materials. Additional details about the NRC Agreement State Program can be found on the NRC website.¹⁹ California is an Agreement State with the California Department of Public Health Division of Radiation Safety and Environmental Management serving as the state regulator.

Reactor Safety

The focus of the AEC and NRC regulatory programs was to prevent a major reactor accident from occurring that would threaten public health and safety. Both agencies issued a series of requirements designed to ensure that a power reactor would not release a massive amount of radiation. As the number and size of nuclear power plants being built rapidly increased during the late 1960s and early 1970s, reactor safety became a hotly debated and enormously complex public policy issue. Often bitter debates over the reliability of emergency core cooling systems, pressure vessel integrity, quality assurance, the probability of a major accident, and other questions received a great deal of attention from the AEC, the NRC, Congress, the nuclear industry, environmentalists, and the news media.

On March 28, 1979, the debate over nuclear power safety moved from the hypothetical to reality. An accident at Unit 2 of the Three Mile Island plant in Pennsylvania melted about half of the reactor core and generated fear that widespread radioactive contamination would result. The crisis ended without a major release of radiation or a need to order a general evacuation, but it underscored that new approaches to nuclear regulation were essential. The accident demonstrated that even a seemingly small equipment failure could lead to a serious nuclear incident and highlighted the importance of operator training, emergency planning, and other “human factors” in ensuring the safe operation of nuclear power plants.²⁰

Regulation of Nuclear Materials

18 United States Nuclear Regulatory Commission. 2022. *How the NRC Protects You*. <https://www.nrc.gov/about-nrc/radiation/protects-you.html>

19 United States Nuclear Regulatory Commission. 2022. *Agreement State Program*. <https://www.nrc.gov/about-nrc/state-tribal/agreement-states.html>

20 United States Nuclear Regulatory Commission. 2022. *About the NRC*. <https://www.nrc.gov/about-nrc.html>

NRC devotes substantial resources to a variety of complex questions in nuclear materials safety. One such issue was the protection of nuclear materials from theft or diversion. This issue became a prominent question after the 1970s in response to growing concern that nuclear materials could be obtained by terrorists or nations seeking to build atomic weapons. NRC devotes a great deal of attention to the safety of managing high-level and low-level radioactive waste, which remains a matter of public fear and political controversy today.

Regulatory Activities

NRC's regulatory activities are focused on:

- Inspections.
- Security and safeguards.
- Plant licensing.
- Operator licensing.

Inspections

NRC conducts inspections to ensure that licensees meet NRC's regulatory requirements. These inspections include licensed nuclear power plants, fuel cycle facilities, and radioactive materials activities and operations. There are roughly 1,000 inspections conducted a year that cover areas such as training of personnel who use materials, radiation protection programs, radiation patient dose records, and security of nuclear materials.²¹ Inspectors follow guidance in the NRC Inspection Manual,²² which contains objectives and procedures to use for each type of inspection. If an inspection shows that a licensee is not safely conducting an activity or safely operating a facility, the plant is informed. NRC will continue to inspect that activity or facility until the problems are corrected.

In addition to region-based inspectors, NRC has resident inspectors at each of the nation's operating nuclear plants and fuel cycle facilities to carry out the inspection program on a day-to-day basis. DCPD has two full-time on-site NRC inspectors.

Security and Safeguards

NRC has instituted programs that protect public health and safety by promoting the common defense and security of the DCPD and guarding against theft and sabotage. NRC reviews and approves licensees' security programs and contingency plans dealing with threats, thefts, and sabotage relating to special nuclear material, high-level radioactive wastes, nuclear facilities, and other radioactive materials and activities. NRC also ensures safeguards and security by regulating licensees' accounting systems for special nuclear and source materials and security programs and contingency plans. NRC security and safeguard responsibilities include:

- Domestic safeguards, which are aimed at ensuring that special nuclear material within the United States is not stolen or otherwise diverted from civilian facilities for possible

21 United States Nuclear Regulatory Commission. 2020. *Inspections*. <https://www.nrc.gov/about-nrc/regulatory/safety-oversight.html>

22 United States Nuclear Regulatory Commission. 2023. *Inspection Manual*. <https://www.nrc.gov/reading-rm/doc-collections/insp-manual/index.html>

use in clandestine fissile explosives and does not pose an unreasonable risk owing to radiological sabotage.

- Information security, which is the protection of classified and sensitive unclassified non safeguards information related to U.S. government programs for the physical protection and safeguarding of nuclear materials or facilities against unauthorized disclosure.
- Cybersecurity, which is composed of establishing and maintaining an effective cybersecurity program. Digital systems are increasingly used in nuclear power plants to maximize productivity. In response to the cybersecurity challenges facing nuclear power plants, the NRC has implemented infrastructure changes, enhanced interagency interfaces, performed enhanced inspections, and developed a cybersecurity roadmap.
- Radioactive material security, aimed at regulating the use of radioactive material to protect people and the environment.
- Required reporting for clearance holders, which is oversight of the reporting requirements for NRC employees and NRC contractors, as well as cleared licensee personnel, cleared licensee contractors, and others who hold national security clearances issued by NRC.
- Insider threat program for licensees. Executive Order 13587 required all federal agencies to establish and implement an insider threat program to cover contractors and licensees who have exposure to classified information.
- Licensee criminal history records and firearms background checks.²³

Plant Licensing

Through the licensing process, NRC authorizes an applicant to conduct any, or all, of the following activities:

- Construct, operate, and decommission commercial reactors and fuel cycle facilities.
- Possess, use, process, export and import nuclear materials and waste, and handle certain aspects of their transportation.
- Site, design, construct, operate, and close waste disposal sites.

To become licensed for any of these activities (or to amend, renew, or transfer an existing license), an entity or individual applies to NRC. NRC staff reviews the submission, using standard review plans, to ensure that the applicant's assumptions are technically correct and that the proposed activities will not adversely impact the environment.²⁴

Operator Licensing

NRC regulations in the Code of Federal Regulations (CFR), Title 10, Part 55 require personnel who operate a reactor to have either a reactor operator or a senior operator license issued by NRC. Reactor operators are licensed to operate the reactor under most routine conditions without supervision, such as start-up and shutdown of the reactor, along with monitoring

²³ United States Nuclear Regulatory Commission. 2021. *Security*. <https://www.nrc.gov/security.html>

²⁴ United States Nuclear Regulatory Commission. 2021. *Licensing*. <https://www.nrc.gov/about-nrc/regulatory/licensing.html>

reactor parameters. However, a senior operator must be present to supervise operation of the reactor during some nonroutine plant conditions such as performing fuel movement, making reactor core alterations within the reactor vessel, and overseeing plant operations during emergencies.

To ensure that these operators have the required knowledge, skills, and abilities to control the reactor during routine processes and emergencies, NRC staff prepares and administers a comprehensive written examination and a hands-on operating test to all candidates for a new reactor operator or senior operator license. These examinations, developed from NRC regulations, are designed to measure the candidate's qualifications to operate the reactor. NRC operator licenses are valid for six years.

Once licensed, operators and senior operators are required to maintain their expertise. Each facility is required to maintain an operator training and requalification program, covering refresher training (material covered during initial licensing) and training on recently changed systems. The operator training and requalification program must be submitted to NRC for approval. The training program is divided into two-year cycles and requires a comprehensive written examination and an annual operating test. These examinations are administered by the facility staff. At the end of the six-year period, operators and senior operators are required to submit a renewal application to renew their licenses. As part of the application, the applicant must certify satisfactory participation in the Operator Training and Requalification Program.²⁵

California

Since 2012, California has one operating nuclear power plant, DCP, owned by PG&E. DCP consists of two units. Unit 1 was originally estimated as a nominal 1,073-MW pressurized water reactor (PWR) and began commercial operation in May 1985. Unit 2 was originally estimated as a nominal 1,087-MW PWR and began commercial operation in March 1986.²⁶ Today, the two reactors each produce about 1,140 MW and combined produce about 18,000 GWh of electricity annually, which is nearly nine percent of California's total electricity supply.

DCP has two Westinghouse-designed four-loop PWRs. The once-through cooling system of the facility draws water from the Pacific Ocean to condense steam that is used to drive the turbine systems.

On June 21, 2016, PG&E announced a joint proposal with labor and environmental organizations to increase investment in energy efficiency, renewables, and storage, while phasing out nuclear power. The proposal indicated that the operating licenses for Diablo Canyon Units 1 and 2 would not be renewed when they were to expire November 2, 2024, and August 26, 2025. PG&E's application to close DCP was approved by the CPUC in January 2018. In February 2018, PG&E withdrew its application from NRC for a 20-year licensing extension beyond 2024 and 2025.

²⁵ United States Nuclear Regulatory Commission. 2022. *Licensing Process for Operators*. <https://www.nrc.gov/reactors/operator-licensing/licensing-process.html>

²⁶ California Energy Commission. 2020. *Nuclear Power Reactors in California*. https://www.energy.ca.gov/sites/default/files/2020-03/Nuclear_Power_Reactors_in_California_ada.pdf

On September 2, 2022, the Governor approved SB 846, which authorized the extension of operating DCPD beyond the current expiration dates, up to five additional years (no later than 2029 and 2030, respectively), under specified conditions.²⁷

In November 2023, PG&E submitted its license renewal application (LRA) with the NRC for a 20-year extension. In April 2026, the NRC approved PG&E's LRA for extended operations at DCPD through November 2, 2044, for Unit 1, and August 26, 2045, for Unit 2. However, SB 846, as well as the CPUC's conditional approval (Decision 23-12-036), only provide for a five-year extension for DCPD operations through October 31, 2029, for Unit 1 and October 31, 2030, for Unit 2.

Power Reactor Decommissioning

California hosts three commercial nuclear power reactor facilities in various stages of decommissioning or are decommissioned: the Humboldt Bay Nuclear Power Plant near Eureka, the Rancho Seco Nuclear Power Plant near Sacramento, and the San Onofre Nuclear Generating Station south of San Clemente.

Under all NRC operating licenses, once a nuclear plant ceases reactor operations, it must be decommissioned. Decommissioning is defined in the CFR, Title 10, Part 50.2 as the safe removal of a facility from service along with the reduction of residual radioactivity to a level that permits termination of NRC operating license. In preparation for the eventual decommissioning of a plant, nuclear plant owners must maintain trust funds while the plants are in operation to ensure sufficient funding will be available to decommission their facilities and manage the spent nuclear fuel.

In general, spent fuel can be either reprocessed to recover usable uranium and plutonium or managed as a waste for long-term ultimate disposal. Since fuel reprocessing is not commercially available in the United States, spent fuel is held in temporary storage at reactor sites until a permanent long-term waste disposal option becomes available.

Because of the lack of permanent long-term waste disposal options in the United States, in 1976, the California legislature placed a moratorium (Chapters 194 and 196, Statutes of 1976) on the construction and licensing of new nuclear reactors until the CEC determines that the federal government has identified and approved a demonstrated technology for:

- The construction and operation of nuclear fuel rod reprocessing plants.
- The permanent disposal of high-level nuclear waste.

In effect, these two conditions halted the construction of new nuclear power plants in California. Accordingly, no new nuclear power plants have been constructed in California since 1976.

The three commercial nuclear power reactor facilities in various stages of decommissioning or are decommissioned are discussed below.

Humboldt Bay Nuclear Power Plant

²⁷ Dodd, Bill. 2022. *California Senate Bill No. 846, Diablo Canyon Power Plant: Extension of Operations*. https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB846

Unit 3 of the Humboldt Bay Power Plant, also known as the Humboldt Bay Nuclear Power Plant, was a roughly 65 MW boiling water nuclear reactor, owned by PG&E that operated from August 1963 to July 1976. Units 1 and 2 of the Humboldt Bay Power Plant were fossil fuel steam plants built in 1956 and 1958, respectively. Unit 3 was shut down in 1976 for refueling and seismic upgrades. Repairs subsequently extended the planned shutdown period, and in that interval, significant regulatory changes were made for reactor operation and design. As such, PG&E decided to not restart Unit 3.²⁸

In 1983, PG&E announced plans to close Unit 3 permanently. In 1988, PG&E placed Unit 3 in SAFSTOR inactive status. SAFSTOR is an NRC facility decommissioning program considered “deferred dismantling,” where a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay; afterward, the plant is dismantled, and the property decontaminated. The other available NRC decommissioning program is called DECON and is considered “immediate dismantling” where soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits the release of the property and termination of the NRC license.²⁹

In 2003, PG&E formally submitted a license application to NRC for approval of a dry-cask Independent Spent Fuel Storage Installation (ISFSI) for Unit 3. A license and safety evaluation for the ISFSI were issued on November 17, 2005. The transfer of spent fuel from the fuel storage pool to the ISFSI was completed in December 2008. Decommissioning of Unit 3, which included decontamination and dismantlement, followed.³⁰

NRC granted CFR, Title 10, Part 50 termination of Unit 3, apart from the ISFSI, on November 18, 2021. The Humboldt Bay Nuclear Power Plant is considered decommissioned.³¹

Rancho Seco Nuclear Power Plant

The Rancho Seco Nuclear Power Plant, located about 25 miles south of Sacramento, is owned by the Sacramento Municipal Utility District. The unit, an approximately 913 MW PWR, was operational from April 1975 to June 1989. Public referendum closed the Rancho Seco Nuclear Power Plant.

In 1996, NRC approved the decommissioning plan for the Rancho Seco Nuclear Power Plant. The spent fuel produced during operation remains onsite in protective dry storage.

28 United States Nuclear Regulatory Commission. 2021. *Humboldt Bay, Unit 3, Licensing Termination Federal Register Notice (FRN)*. <https://www.nrc.gov/docs/ML2129/ML21295A430.pdf>

29 California Energy Commission. 2020. *Nuclear Reactors in California*. https://www.energy.ca.gov/sites/default/files/2020-03/Nuclear_Power_Reactors_in_California_ada.pdf

30 United States Nuclear Regulatory Commission. 2021. *NRC Terminates Humboldt Bay Nuclear Power Plant License*. <https://www.nrc.gov/reading-rm/doc-collections/news/2021/21-051.pdf>

31 *Ibid*.

All power-generating equipment were removed from the plant except the now-empty cooling towers. In October 2009, NRC released most of the site for unrestricted public use.³²

San Onofre Nuclear Generating Station

The San Onofre Nuclear Generating Station, operated by majority owner Southern California Edison, is midway between Los Angeles and San Diego and contained three units. Unit 1 was in operation from 1968 to 1992. Unit 1 was a Westinghouse three-loop about 450-megawatts equivalent (MWe) PWR. Unit 1 was shut down and placed in SAFSTOR inactive status.³³

Units 2 and 3 were Combustion Engineering two-loop roughly 1,110-MWe PWRs. Unit 2 began operation in 1983. Unit 3 began operation in 1984.

Unit 2 was shut down in early January 2012 for routine refueling and replacement of the reactor vessel head. On January 31, 2012, Unit 3 suffered a radioactive leak, largely inside the containment shell, with a release to the environment below allowable limits. The reactor was shut down per standard procedure. An investigation found that the replacement steam generators that were installed in both units in 2011 showed premature wear on over 3,000 tubes in 15,000 places. In March 2012, NRC forbade the plant to be reopened until the causes of equipment problems were thoroughly understood and fixed. In June 2013, the plant owners announced that Units 2 and 3 would be permanently retired and enter decommissioning.³⁴

³² California Energy Commission. 2020. *Nuclear Reactors in California*. https://www.energy.ca.gov/sites/default/files/2020-03/Nuclear_Power_Reactors_in_California_ada.pdf

³³ United States Nuclear Regulatory Commission. 2023. *San Onofre*. <https://www.nrc.gov/info-finder/decommissioning/power-reactor/san-onofre-unit-1.html>

³⁴ California Energy Commission. 2020. *Nuclear Reactors in California*. https://www.energy.ca.gov/sites/default/files/2020-03/Nuclear_Power_Reactors_in_California_ada.pdf