

Date of Hearing: March 13, 2024

ASSEMBLY COMMITTEE ON UTILITIES AND ENERGY

Cottie Petrie-Norris, Chair

AB 2092 (Mathis) – As Introduced February 5, 2024

SUBJECT: Energy: small modular reactors: feasibility study

SUMMARY: Requires the California Public Utilities Commission (CPUC), in coordination with the California Independent System Operator (CAISO) to conduct a feasibility study – including consideration of reliability, affordability, workforce, and decarbonization benefits – on the impact of permitting small modular nuclear reactors (SMRs) and to submit the study to the Legislature no later than January 1, 2027.

EXISTING LAW: Prohibits permitting any new nuclear fission power plant until the California Energy Commission (CEC) has determined that there exist technologies for the reprocessing of nuclear fuel rods and the disposal of high-level nuclear waste. (Public Resources Code § 25524.1 and 25524.2).

FISCAL EFFECT: Unknown. This bill is keyed fiscal and will be referred to the Committee on Appropriations for its review.

BACKGROUND:

Nuclear Power in California. Of the four nuclear power plants developed in California by electric utilities, only one continues to operate today: Pacific Gas & Electric's (PG&E) Diablo Canyon power plant. The three other commercial nuclear power facilities, including PG&E's Humboldt Bay plant, Sacramento Municipal Utility District's Rancho Seco plant, and the San Onofre Nuclear Generation Station (SONGS) owned jointly by Southern California Edison, San Diego Gas & Electric, and the City of Riverside Utilities, are in various stages of decommissioning. Developed in the early 1960s, Humboldt Bay was shut down in 1976 for refueling and never restarted due to seismic and cost issues. Developed in the early 1970s, Rancho Seco was shut down in 1989 in response to voter referendum. Developed in the late 1960s, SONGS was closed in 2012 for repairs and permanently retired in 2013 due to uncertainty about repair timelines.

In 1976, the Legislature enacted a moratorium on new nuclear power plants until the federal government implements a solution to radioactive waste. The moratorium was challenged by PG&E and ultimately reviewed by the U.S. Supreme Court. In *PG&E v. Energy Commission* (1983), the Supreme Court upheld California's moratorium law. A key basis of the Court's decision was a division of authority to make safety determinations (federal) and economic determinations (state). The Court found that the absence of a permanent waste disposal site could lead to unknown negative economic consequences. So the moratorium has remained in effect and no new nuclear plant has been proposed in California since the Diablo Canyon and SONGS units that were in the permitting pipeline at the time the moratorium was enacted.

Spent fuel from nuclear power plants can either be reprocessed to recover usable uranium and plutonium, or it can be managed as a waste for long-term ultimate disposal. Since fuel

reprocessing is not commercially available in the U.S.,¹ spent fuel is typically held in temporary storage at reactor sites until a permanent long-term waste disposal option becomes available.² To date, the CEC and federal Nuclear Regulatory Commission (NRC) have not found that a demonstrated technology exists for the disposal of high-level nuclear waste. The federal government was required to begin accepting spent nuclear fuel from nuclear power plants by 1998, but the federal waste disposal program, designated for Nevada’s Yucca Mountain, has been plagued with technical and legal challenges, managerial problems, licensing delays, persistent weaknesses in quality assurance for the program, and increasing costs.³ As such, high-level radioactive waste from all four California nuclear power plants remains stored on site.

Small Modular Reactors. The Diablo Canyon power plant has twin 1,100 megawatt (MW) reactors that produce about 18,000 gigawatt-hours (GWh) of electricity annually.⁴ In contrast, SMRs are nuclear reactors that produce 300 MW or less. These reactors generate electricity by a process similar to the one used in large nuclear power plants like Diablo Canyon: the reactor splits atoms in a pressurized core, giving off heat; the heat can then be used to turn water into steam that powers a turbine, generating electricity.⁵ Because of their small size and modularity, the Department of Energy (DOE) and International Atomic Energy Agency remark that SMRs have the potential for large-scale deployment because: they are quicker and less expensive to build; they are more versatile for deployment to locations unable to support large reactors or with limited water; they have increased operational safety margins; and they have reduced fuel requirements.^{6,7} Despite its purported benefits, SMRs are still in various phases of design and development. Questions regarding their benefits – including cost towards ratepayers and public safety – linger.

COMMENTS:

- 1) *Author’s statement.* According to the author, “With the Legislature mandating 100% carbon-neutrality by 2045, we need to rapidly scale up carbon-free energy sources without drastically increasing energy costs for consumers or exacerbating the likelihood of energy shortages. Nuclear power grants us the ability to reach our carbon-neutrality goal without imposing an undue burden on consumers and businesses. This bill will give the Legislature a detailed analysis of the potential benefits of Small Modular Reactors so the State can make more informed-choices when deciding the future of California’s clean energy policy.”
- 2) *Nuclear waste from SMRs.* Advocates for SMRs purport the technology has reduced fuel requirements compared to traditional nuclear reactors, presumably due to the SMRs’ smaller size and more modern design. However, a 2022 Stanford study found that “SMRs will produce more voluminous and chemically/physically reactive waste than [large nuclear reactors].”⁸ Argonne National Laboratory and the Vienna University of Natural

¹ <https://www.nrc.gov/materials/reprocessing.html>

² <https://www.gao.gov/nuclear-waste-disposal>

³ Nevada Appeal; “Yucca Mountain remains in debate over nuclear waste storage”; January 2022.

⁴ California Energy Commission; “Diablo Canyon Power Plant Extension: Final Draft CEC Analysis of Need to Support Reliability”; March 2023.

⁵ MIT Technology Review; “We were promised smaller nuclear reactors. Where are they?”; February 2023.

⁶ Office of Nuclear Energy; “4 Key Benefits of Advanced Small Modular Reactors”; May 2020.

⁷ International Atomic Energy Agency; “What are Small Modular Reactors (SMRs)?”; November 2021.

⁸ L.M. Krall, et al.; “Nuclear waste from small modular reactors”; March 2022.

Resources and Applied Life Sciences have both concluded that a repository for nuclear waste remains necessary for SMRs.^{9,10} Given the uncertainty around waste disposal needs for SMRs specifically and the continued lack of permanent nuclear waste disposal technologies broadly, the associated costs and permitting needs for SMRs' waste disposal remain unclear. *As such, the committee may wish to consider an amendment to the study proposed in this measure, adding consideration of the costs and regulatory requirements for SMR waste disposal.*

- 3) *What is the commercial status of SMRs?* SMRs have not yet been demonstrated in the U.S. Abroad, Russia and China are the only countries that commercially operate SMR plants; Russia's dual 35 MW SMRs came online in May 2020 and China's 300 MW SMR came online in December 2023.^{8,11} Both public and private institutions are actively participating in collaborative efforts to commercialize SMR technology domestically. The DOE has provided more than \$600 million since 2014 to support the design, licensing, and siting of SMR concepts.¹² In January 2023, the NRC certified the first SMR design in the U.S., from Oregon-based NuScale. Despite this progress, NuScale announced in November 2023 that they were abandoning the country's first planned commercial SMR.¹³ Substantial cost overruns for construction – resulting in increased target prices for power from \$55 per MWh in 2016, when the regulatory process for the plant kicked off, to \$89 per MWh in 2023 – and delays from the project's originally scheduled 2026 operational date led utilities to withdraw from agreements to buy generation from the project.¹⁴ Three other SMR developments for near-term deployment have been announced, but none have begun construction.^{15,16,17} Thus, the question of when SMRs can be deployed, particularly with the continued lack of a nuclear waste repository, remains. Producing a feasibility study, as put forward by this measure, on affordability or other benefits today, may result in study findings that will not be reflective of reality whenever SMRs become commercially viable.
- 4) *Wrong place, wrong time?* As alluded to above, doubt regarding the practicality of a feasibility study on SMRs for energy generation looms large. The author claims that SMRs will benefit the state due to lower costs compared to other renewables, but, as mentioned above, target prices for power appear highly vulnerable to change. Led by the Environmental Defense Fund, a 2021 analysis on firm power modeled SMRs' capital costs in 2045 at \$5,210/kilowatt; whereas solar was \$903/kW and offshore wind was \$2,059/kW.¹⁸ These data seem to indicate, from a purely cost perspective, the difficulties SMR construction would face in California. Additionally, there is no anticipated date

⁹ Clean Energy Wire; “Small modular reactors not the solution—German nuclear authority assessments”; March 2021.

¹⁰ Argonne National Laboratory, Idaho National Laboratory; “Nuclear waste attributes of SMRs scheduled for near-term deployment”; November 2022.

¹¹ Reuters; “China starts up world's first fourth-generation nuclear reactor”; December 2023.

¹² Office of Nuclear Energy; “NRC Certifies First US Small Modular Reactor Design”; January 2023.

¹³ Energy Wire; “NuScale cancels first-of-a-kind nuclear project as costs surge”; November 2023.

¹⁴ Institute for Energy Economics and Financial Analysis; “Eye-popping new cost estimates released for NuScale small modular reactor”; January 2023.

¹⁵ <https://corporate.dow.com/en-us/news/press-releases/dow-x-energy-collaborate-on-smr-nuclear.html>

¹⁶ <https://www.tva.com/newsroom/press-releases/tennessee-valley-authority-ontario-power-generation-and-synthos-green-energy-invest-in-development-of-ge-hitachi-small-modular-reactor-technology>

¹⁷ <https://www.world-nuclear-news.org/Articles/Palisades-SMR-programme-is-under-way-Holtec>

¹⁸ J.C.S. Long, et al.; “California needs clean firm power, and so does the rest of the world”; September 2021.

when we can expect the federal government to open a high-level nuclear waste repository. Without this repository, the existing statutory moratorium on nuclear power plants presumably prohibits the siting and development of SMRs within California.

Regardless of these questions, the author and supporters of this measure purport the benefits of this technology. Given the federal government's continued funding of research into SMR feasibility, it may be meritorious for California to consider studying the role SMRs might play in our electricity grid.

- 5) *Goals and metrics of the feasibility study.* This bill identifies some metrics, including but not limited to reliability, affordability, labor, and decarbonization, to evaluate a minimum feasible capacity and quantity of SMRs. As some of these metrics may not have a defined target ceiling to efficiently evaluate a “minimum capacity” for SMRs – such as what is affordable and how many added jobs are enough – *the committee may wish to amend and reframe the goal of the feasibility study to evaluate the benefits of SMRs in comparison with other renewable resources.*

In 2021, the DOE provided a grant to the Nuclear Alternative Project to evaluate the general site suitability for SMRs and microreactors in Puerto Rico.¹⁹ This report required an evaluation of impacts on socioeconomics, environmental justice, noise, and ecological systems, among others. To gain greater insight on the impacts of SMRs for disadvantaged communities and help increase potential eligibility of future state projects and technical studies for federal grants, *the committee may wish to expand the metrics the bill explicitly lists to include, but not limit to, environmental and socioeconomic impacts.*

- 6) *Best fit agency.* The CPUC is responsible for Integrated Resource Planning (IRP), wherein they determine the amounts and types of resources that are necessary to achieve the State's greenhouse gas emissions reduction target while meeting future electricity needs. CAISO uses the IRP in its Transmission Planning Process to ensure that the State's transmission system can support anticipated load growth and resource requirements. Since the CPUC makes final determinations on resource requirements, *the committee may wish to remove CAISO's coordination and have the CPUC be the sole responsible agency for the feasibility study.*

- 7) *Related Legislation.*

AB 65 (Mathis) would have exempted small modular reactors from the conditional moratorium on certifying and permitting new nuclear fission thermal powerplants unless certain conditions are met regarding the existence of technology for the construction and operation of nuclear fuel rod processing plants and of demonstrated technology or means for the disposal of high-level nuclear waste. It would also have required the CPUC to adopt a plan to increase the procurement of electricity generated from nuclear facilities and to phase out the procurement of electricity generated from natural gas facilities. Status: Failed in the Assembly Committee on Natural Resources on April 10, 2023 by a 3-7-1 vote.

- 8) *Prior Legislation.*

¹⁹ <https://www.energy.gov/sites/default/files/2021-11/ne-abstract-smr-112321.pdf>

SB 846 (Dodd) authorizes the extension of operating the Diablo Canyon power plant beyond the previous expiration dates to up to five additional years (no later than 2029 for Unit 1 and 2030 for Unit 2), under specified conditions. Status: Chapter 239, Statutes of 2022.

AB525 (Chiu) requires the CEC, in coordination with several state agencies, to develop a strategic plan for offshore wind energy developments installed off the California coast in federal waters. The bill required the CEC, on or before June 1, 2022, to evaluate and quantify the maximum feasible capacity of offshore wind to achieve reliability, ratepayer, employment, and decarbonization benefits and to establish offshore wind planning goals for 2030 and 2045, as specified. Status: Chapter 231, Statutes of 2021.

AB 1776 (DeVore) would repeal the moratorium on the construction of new nuclear fission powerplants in California and would, instead, prohibit the Energy Commission from certifying a site for a nuclear fission thermal powerplant in seismically active areas or a nuclear fission thermal powerplant using a once-through nuclear reactor cooling system with a nuclear coolant outflow that is within 5 miles of a designated coastal area of biological significance or is to a navigable water. The Energy Commission and other state agencies would be required to consider a dry cask storage system method approved by the United States Nuclear Regulatory Commission to be an appropriate method for storing spent nuclear fuel and associated material. Status: Failed in the Assembly Committee on Natural Resources on April 7, 2008.

REGISTERED SUPPORT / OPPOSITION:

Support

California State Pipe Trades Council
Generation Atomic
Mothers for Nuclear
Nuclear Energy Institute

Support If Amended

Fission Transition

Opposition

None on file.

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