

Stanford/MIT Study on the Diablo Canyon Nuclear Power Plant: Advocacy Masquerading as Analysis

In November 2021, Stanford/MIT jointly released a study entitled “An Assessment of the Diablo Canyon Nuclear Plant for Zero-Carbon Electricity, Desalination, and Hydrogen Production.”² This study examined the benefits of continuing to operate the two Diablo Canyon nuclear power reactors past their currently planned shutdown dates of 2024 and 2025. The study looks at three different modes of operating the reactors: in their current mode as electricity producers, a new mode where they would use reverse osmosis to produce fresh water from sea water in addition to electricity, or a new mode where they would use electrolysis to produce hydrogen in addition to fresh water and electricity.

Continuing to operate the reactors to produce electricity is the most straightforward of these options, though even this option will require the use of unproven methods to limit the impingement and entrainment of marine life as required by the California Water Quality Control Policy on the Use of Coastal and Estuarine Water for Power Plant Cooling. Producing fresh water is more speculative since it requires the construction of a desalination plant. The mode of operation to produce hydrogen appears to be the most speculative since it would require a hydrogen producing electrolysis plant in addition to the desalination plant. Further, the study suggests that the hydrogen could be used to power fuel cells to fuel the transportation sector. However, at the current time, it appears that electric vehicles rather than hydrogen powered vehicles are being used to address the carbon emission problem in the transportation sector.

The real problem with the study is that it is not balanced. The study is not a true cost benefit analysis and focuses solely on the benefits. The only costs it examines are the ones needed to enable the production of the benefits. The study does not examine the additional risks and costs of keeping the Diablo Canyon nuclear reactors in operation. The study attempts to evade this issue by adding this small paragraph at two places in the report:

This study was not intended to be and should not be considered to be a definitive analysis of those benefits and tradeoffs. That will require further investigation. But the authors submit that the conclusions of this report present sufficient grounds for further study and debate by setting forth a prima facie case for extending the operations of the Diablo Canyon nuclear plant.³

¹ This paper is the product of the author’s personal research and the analysis and views contained in it are solely his responsibility. Though the author is also a part-time adjunct staff member at the RAND Corporation, this paper is not related to any RAND project and therefore RAND should not be mentioned in relation to this paper. I can be reached at GregJones@proliferationmatters.com

² Justin Aborn, et. al., “An Assessment of the Diablo Canyon Nuclear Plant for Zero-Carbon Electricity, Desalination, and Hydrogen Production,” Stanford University and Massachusetts Institute of Technology, November 2021. <https://energy.stanford.edu/publications/assessment-diablo-canyon-nuclear-plant-zero-carbon-electricity-desalination-and>

³ *Ibid.*, p. 4 and p. 12.

Certainly, this caveat was lost on many. Soon after the study was released, *The Washington Post* wrote an editorial entitled “Closing California’s last nuclear power plant would be a mistake.”⁴ Similarly, two former secretaries of energy, Steven Chu and Ernest Moniz, wrote an Op-Ed entitled “Diablo Canyon should stay open to meet climate goals.”⁵

Further, the Stanford/MIT study not only does not examine the risks and costs of keeping Diablo Canyon running, but it also does even identify what they might be. One major example is the increased production of nuclear waste. Remarkably this document does not make any mention of radioactivity, spent fuel or nuclear waste. Based on this study one would have no idea that the operation of the Diablo Canyon reactors involved the production of anything radioactive.

If this were not bad enough, the study not only ignores the problem of nuclear waste, it denies that this waste even exists. The study falsely claims that the production of electric power from the reactors is “clean.” The former residents of the areas around Chernobyl and Fukushima could testify differently. Nuclear power produces its own kind of “dirt,” which is just different from that produced by fossil fuels.

The study’s denial of the drawbacks of nuclear power is all the more striking given that it repeatedly points out one of the drawbacks of solar i.e., that such facilities take up large land areas. This bias in the study’s analysis illustrates its tendency towards advocacy rather than evenhanded analysis. It is not surprising that one of the authors, Jacopo Buongiorno, said in an interview:

Nuclear plants—and Diablo Canyon is no exception—are one such clean and firm [source of] power capacity that we think should be preserved.⁶

What are some of the risks and possible downsides of keeping Diablo Canyon in operation? The most serious risk is that there could be a large-scale release of radioactivity which would convert many square miles around the reactor site into a nuclear wasteland. This risk would be most severe as long as the reactors are in operation and for about ten years after the reactors are shutdown permanently while the spent fuel is cooling in water filled “ponds.” Given the successful operation of hundreds of reactors around the world, this risk is not high. But given Chernobyl and Fukushima, it is not zero either.

A simple calculation indicates that keeping the reactors in operation until 2045 would roughly double the amount of spent fuel stored on-site. About ten years after the fuel is discharged from the reactor, the fuel is transferred to relatively safe and secure “dry casks.” These dry casks are

⁴ “Opinion: Closing California’s last nuclear power plant would be a mistake,” *The Washington Post*, November 16, 2021. <https://www.washingtonpost.com/opinions/2021/11/16/closing-californias-last-nuclear-power-plant-would-be-mistake/>

⁵ Steven Chu and Ernest Moniz, “Diablo Canyon should stay open to meet climate goals,” *Los Angeles Times*, November 21, 2021, p. A21. <https://www.latimes.com/opinion/story/2021-11-21/diablo-canyon-nuclear-plant-climate-change-zero-emissions>

⁶ Rob Nikolewski, “Keeping California’s last nuclear power plant open could help state meet its climate goals, study says,” *San Diego Union Tribune*, published in the *Los Angeles Times*, November 14, 2021. <https://www.latimes.com/california/story/2021-11-14/should-californias-last-nuclear-power-plant-stay-open?expandComments=true>

placed in the open on a large concrete pad located above the reactor site (310 feet above sea level—sufficient to keep it safe from the tsunami threat.) Initially it was thought that there would be a national nuclear waste site and this spent fuel would be transferred off site. However, the end of the national nuclear spent fuel repository program in 2010 has meant that Diablo Canyon (and all of the other nuclear reactor sites in the U.S.), have become semi-permanent high-level nuclear waste sites. There is a small risk that the radioactivity from this long-term spent fuel storage could be released due to natural or man-made events.

Additionally, the Stanford/MIT study does not account for the financial risk that results from the possibility the reactors could be forced to shut down prematurely, such that the financial investment that the study proposes to keep the reactors in operation could be lost. The Three Mile Island accident did not lead to any large-scale release of radioactivity and fortunately parts of central Pennsylvania were not converted into a nuclear wasteland. However, the accident did convert an almost brand-new reactor into a piece of junk resulting in a substantial financial loss.

Nor would it require a nuclear accident to cause a serious financial loss. Take the example of California's last two nuclear reactors to shut down, San Onofre units 2 and 3.⁷ In 2004, in light of the reactors' aging steam generators, Southern California Edison, the reactors' majority owner, undertook a project to replace them. It contracted with Mitsubishi Heavy Industries to manufacture new steam generators even though this company had never built steam generators of this size. The steam generators were successfully manufactured and installed.

In January 2012 a tube in Unit 3's steam generator failed, leading to a small radiation leak. Both reactors were shut down after only 22 and 11 months of operation with the new steam generators. Analysis revealed that "improvements" to the steam generator design caused excessive vibrations, leading to wear, damaging many of the steam generator tubes. The procurement of new steam generators would take five years, during which time the reactors would have to remain shut down, so instead the decision was made to shut the reactors down permanently. Only the fact that the utility was allowed to pass on much of the financial loss to its customers enabled it to avoid major losses.

The Diablo Canyon reactors will already be about 40 years old by the time they are currently scheduled to shut down and the Stanford/MIT study has proposed that the reactors run for perhaps 20 years after that. The study has already suggested that Diablo Canyon's troubled owner, Pacific Gas and Electric, might not be interested in continuing to operate the reactors and a new operator might need to be found. Given these financial risks, this may not be possible.

One might think that I am opposed to continuing the operation of the Diablo Canyon reactors but that is not the case. Rather, I am undecided. Leaving aside the more exotic possibilities of desalinization and hydrogen production, just having the reactors produce electricity can have major advantages. As California moves to reduce its carbon emissions, the reactors are a major source of low-carbon electricity and the reactors can operate at night and under calm conditions

⁷ See: Don Kelsen, "How San Onofre's new steam generators sealed nuclear plant's fate," *Los Angeles Times*, July 13, 2013. <https://www.latimes.com/local/la-xpm-2013-jul-13-la-me-07-14-san-onofre-tic-toc-20130714-story.html> and "Dark days for San Onofre," *Nuclear Engineering International*, January 23, 2013. <https://www.neimagazine.com/features/featuredark-days-for-san-onofre/>

when many other such sources cannot. Further as the study points out, any alternative source of electricity such as photovoltaic, has its own drawbacks.

However, no decision should be made until a serious analysis of the risks and costs of keeping the reactors in operation is performed. As discussed, these risks involve both financial and that of a large-scale release of radioactivity. Certainly, institutions as distinguished as Stanford and MIT should be capable of performing such an analysis.

It should also be recognized that the decision to keep Diablo Canyon operating involves not only technical and economic issues but political ones as well. Major reductions in carbon emissions will require taking a large number of small steps. Keeping Diablo Canyon in operation could be one of these small steps and would benefit people all over the world. One problem with nuclear power is that while the benefit of reduced carbon emissions is diffused over a large number of people, the risk of a large-scale release of radioactivity is borne by a relatively small number living close to the plant. This latter group is strongly motivated to oppose the continued operation of Diablo Canyon. This fact alone may be enough to doom any attempt to keep the reactors in operation.