TECHNICAL NOTE

With regard to Prof. Kate Brown's opinion letter "California's San Onofre nuclear plant is a Chernobyl waiting to happen" (published in the L.A. Times on Nov. 19, 2019), we note here that the association of San Onofre with Chernobyl is technically inaccurate and grossly misleading for the reasons listed below.

1) The context is completely different. San Onofre is a spent fuel storage facility in the U.S., which experienced a minor mishandling of a dry cask in 2018. The events at Chernobyl represent a major accident and radioactive release at a large operating reactor in the former Soviet Union in 1986.

2) Spent fuel in a dry cask cannot sustain a critical nuclear chain reaction. Dry casks are cylindrical containers made of steel and concrete, each storing a few dozen elements of spent fuel from a nuclear reactor. However, a dry cask is *not* a nuclear reactor. It would be physically impossible for the spent fuel in a dry cask to sustain a chain reaction even if it was flooded with water or its geometry was changed, for example, because of a drop. As such, a dry cask cannot experience an explosive runaway reaction like the Chernobyl reactor, eliminating a major driving force for radioactivity dispersal.

3) Spent fuel casks contain far less radioactivity than whole reactors. The radioactivity inventory in these dry casks is vastly lower than in an operating reactor because (i) each dry cask stores a relatively small amount of fuel, and (ii) radioactivity naturally decays over time[1].

4) Dry casks are specifically engineered to stop leaks through multiple safety barriers, and mitigate the consequences of a release, should a leak occur. The residual radioactivity is contained within sealed fuel rods, which in turn sit within the dry casks. The casks are properly shielded to protect workers from direct exposure to excessive levels of radiation. Should the cask be breached, the radioactivity will stay within the fuel rods. Should there also be a breach of one or multiple rods within one cask, the vast majority of radioactive material will not be released into the environment because it is in the form of solid (non-volatile) ceramic pellets. A small amount of gaseous (volatile) radioactivity could be released, but the amount is so small that no discernable health consequences are expected for the site workers, let alone the general public or the environment[2]. This remains true whether one inspects the dry casks or not.

5) The casks are robustly designed and tested to withstand normal ageing effects and corrosion over the course of their licensed 60-year lifetime, as well as abnormal situations such as drop from a height, exposure to fire, submersion in water (as a result of site flooding from a hypothetical tsunami for example), lightning strikes, earthquakes, tornadoes, etc. Minor cracks and deformations can occur of course, but would not result in a significant release of radioactivity, as explained above.

6) The spent fuel in the dry casks cannot overheat. In fact, the amount of heat generated by the spent fuel is so small that the casks do not need any active cooling[3]: the air in contact with the exterior of the casks is sufficient to keep all the material at an acceptable temperature.

7) This is not a new technology with major uncertainties. The operators of nuclear power plants in the U.S. have been using dry casks for spent fuel storage for over two decades. Their safety record is outstanding. Having

[1] For example, the radioactive iodine released from Chernobyl, mentioned in Prof. Brown's opinion letter, has a half life of eight days. This means that in a few months, nearly all of it naturally decays away.

[2] The radiation dose at the spent fuel storage site boundary for a dry cask leak accident, estimated under conservative assumptions is about 0.4 mSv. This is about the same dose received during two roundtrip intercontinental flights, and less than an abdomen X-ray scan.

[3] The design heat generation rate in a dry cask is less than 40 kW, about 100,000 lower than the heat generation rate in the Chernobyl reactor.

said that, it would be desirable to move the dry casks from San Onofre and other permanently shutdown nuclear plant sites throughout the U.S. to a long-term centralized spent fuel storage facility, so that such sites can be returned to "green field" conditions.

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References:

- U.S. Nuclear Regulatory Commission, Holtec International HI STORM 100 Cask System, Safety Evaluation Report, ML003711865, May 4, 2000.
- Holtec International, Final Safety Analysis Report on the HI-STORM UMAX Canister Storage System, Rev. 3, June 29, 2016.
- Electric Power Research Institute, Dry Cask Storage Welded Stainless Steel Canister Breach Consequence Analysis Scoping Study, November 17, 2017

Figure 1. Spent nuclear fuel in dry casks is shown here at the Connecticut Yankee nuclear power plant site. This storage area is all that is left of the now-decommissioned nuclear plant, which generated 580 MW of electricity for 21 effective full-power years. (source: http://www.connyankee.com/html/fuel_storage.html)

Figure 2. The site of the now-decommissioned Maine Yankee nuclear power plant. The site has been returned to "green field" conditions with the exception of the spent fuel dry casks, which are stored in open air within the small well-fenced area shown in this picture. (source: Bangor Daily News)

Figure 3. Dry casks containing spent nuclear fuel are inspected at an unspecified U.S. nuclear power plant. The cask design includes radiation shielding, so that approaching and handling these casks exposes the workers to a negligibly low radiation dose. (source: Nuclear Energy Institute)

Figure 4. MIT nuclear science and engineering faculty and students visiting the spent fuel dry-cask storage facility at the Pilgrim nuclear power plant in Plymouth, Massachusetts. (Source: MIT)

Figure 5. Highway Patrol Officers conduct radiological surveys on the first Nevada Test Site transuranic waste shipment at the Area 5 Radioactive Waste Management Complex located on the Nevada Test Site. These shipments travel on normal public roads to their final destination at the Waste Pilot Isolation Plant near Carlsbad, New Mexico. (source: NNSA)

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