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Not My Fault: Decommissioning a nuclear power plant is a long slow process

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Nothing happens quickly with a nuclear plant. Power is generated through fission, a process of splitting atoms in a controlled way. Once fission begins, it can be slowed or increased, but there's no on-off switch and a controlled shutdown takes 6 – 12 hours. The radioactive byproducts last for millennia

The fuel at PG&E's former nuclear facility at King Salmon was small ceramic uranium oxide pellets compressed into fuel rods. A single new rod is only mildly radioactive, but when groups of rods (assemblies) are brought closely together in a reactor core, fission commences. PG&E's Unit #3 was a boiling water reactor (BWR), where water pumped into the core was brought to a boil and steam produced electricity.

All first-generation nuclear reactors were BWRs. Built in the late 1950s to mid-1960s, seven became operational in the US and none are operating today. In the late 1960s, the second generation BWRs came online with improved efficiency, lifespan, containment, and safety features. The Fukushima-Daichi Nuclear Power Plant that failed during the 2011 Japan tsunami was this type. Of the 93 operating reactors in the US today, 31 are BWRs.

During its 13-year operational history, the Humboldt nuclear facility generated most of the County's electricity. It was shut down yearly for refueling and maintenance and the spent fuel rods were placed in a cooling pool on the site. The pool was within the containment structure and made of steel-lined reinforced concrete several feet thick.

Spent fuel and reactor waste has been and continues to be the Achilles heel of the nuclear industry. In the early decades of the nuclear era, it was often glossed over as something that science and technology could solve. The Nuclear Regulatory Commission (NRC) classifies nuclear waste as high level or low level depending upon how long lived the radioactive material is.

Low level waste is produced by medical facilities, research labs, commercial facilities and in reactor operations. Often short-lived, it has radioactivity levels only slightly above background and can be safely handled with simple precautions. Small amounts can be disposed as ordinary trash and larger amounts moved on highways to approved low-level waste repositories.

It's the high-level waste that is the big problem. High-level waste is predominately spent nuclear fuel rods. "Spent" is a misnomer as it still contains a substantial amount of energy. Unlike the new, unused fuel rods, they are now highly radioactive and very hot. That's because once fission starts, it can't be totally stopped. Not all the uranium has been used up; it's just no longer concentrated enough to be economically worthwhile. Fission is a complex process and creates toxic daughters such as cesium-137 and strontium-90. Fission releases neutrons which may be captured by other uranium atoms to form heavier elements such as plutonium. They aren't as hot as the daughters but take much longer to decay. Plutonium-239 has a half-life (the time for half to be used up) of 24,100 years.

I admit to much ignorance when it comes to nuclear reactors. In talking about the Humboldt plant, I used to remark how silly it seemed that new fuel rods could be transported on highways and used ones could not. Now I understand why. There is no fission going on in the new ones and emissions are very low.

PG&E announced intentions to decommission Unit #3 in 1983. Three years later the company requested a SAFSTOR license amendment from the NRC. SAFSTOR means "possess-but-not-operate" so that the plant is maintained and monitored and much of the waste can decay before dismantling begins. In 2003, PG&E submitted an application to the NRC to begin transferring the spent fuel rods into dry cask storage.

The Humboldt plant produced 390 spent fuel assemblies in its lifetime. After several years in a storage pool, the NRC considers the waste cool enough to be moved into a dry cask storage facility on site. High level waste repositories are known as ISFSIs (independent spent fuel storage installation). Finding an ISFSI spot on Buhne Point was problematic in many ways.

The biggest problem was that the ISFSI had to be on the PG&E site. Buhne Point site is exposed to earthquake and tsunami threats, erosion, and sea-level rise. Many people were involved with environmental and hazards studies over the years including a number of HSU geology grads. A site was selected at an elevation of 44 feet just to the west of Unit #3 with the capacity to store 37 tons of high-level waste in six casks.

I attended a community meeting about the ISFSI plan in the early 2000s. It was well attended with scientists, environmental organizations, and other community representatives. What surprised me most was that everyone agreed it was the best solution to a problem all of us wish we never had. Oh, if only time travel were possible – PG&E would be the first in line to reverse the decision to build the Humboldt nuclear facility. But given the legal realities, this was the best option.

NRC issued the Humboldt SAFSTOR license to PG&E in November 2005. By 2008, all of the spent fuel had been moved to the dry casks. The active decommissioning of the site began in 2009 and included removal of the reactor vessel, nuclear systems, containment structure, and other infrastructure. Even the soils at the site were removed. The final step was site restoration and soil remediation. It's unclear what the footprint of the former nuclear facility may eventually become; at present it is a parking lot.

Is this the final chapter? The NRC will soon revoke the operating license for PG&E Unit #3, formally ending its official existence. But the waste is still on-site. The NRC considers cask storage a temporary solution and suggests a 40-year life span. Some hope the casks can last up to 100 years but even this is far shorter than the time needed to safely store high-level waste.

Note: The Humboldt ISFSI is covered at http://archive.wmsym.org/2010/pdfs/10217.pdf. If anyone wants to get into the weeds with nuclear reactor technology, see https://www.amacad.org/sites/default/files/academy/pdfs/nuclearReactors.pdf

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