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Hidden Dangers: Nuclear Waste and Its Disproportionate Effects on California Residents

The dangers of nuclear radiation are well-known and evoke deep concerns among experts across various disciplines. Notably, both the Environmental Protection Agency (EPA) and the World Health Organization (WHO) have issued stern warnings concerning the severe health risks associated with nuclear radiation exposure, which encompass the potential for cancer, enduring health complications, and even fatalities (WHO & EPA). Nuclear waste and its enduring impact on human health over an extended timeframe is examined by Professor Claire Corkhill in her work "Nuclear Management." She reveals that the by-products of nuclear power generation, particularly spent nuclear fuel(SNF), remain lethally radioactive for up to 100,000 years before reaching a safe level(as depicted in Figure 1). This protracted radioactive life creates significant challenges in the treatment and storage of nuclear waste. The primary concern is not only the extended radioactive half-life but also the intricate process required for these hazardous materials to cool down(Corkhill).

In this essay, we will delve into the implications of environmental justice concerning nuclear waste in the United States. Our exploration will commence with the potential pollution emanating from nuclear power plants, encompassing the entire life cycle from mining to spent fuel waste. Subsequently, we will delve into the resistance exhibited by affected communities, the risk factors that disproportionately affect marginalized communities, and the most recent data pertinent to these issues. Ultimately, our focus will shift towards an assessment of California's

current involvement with nuclear waste and the potential issues entailed in extending temporary storage.

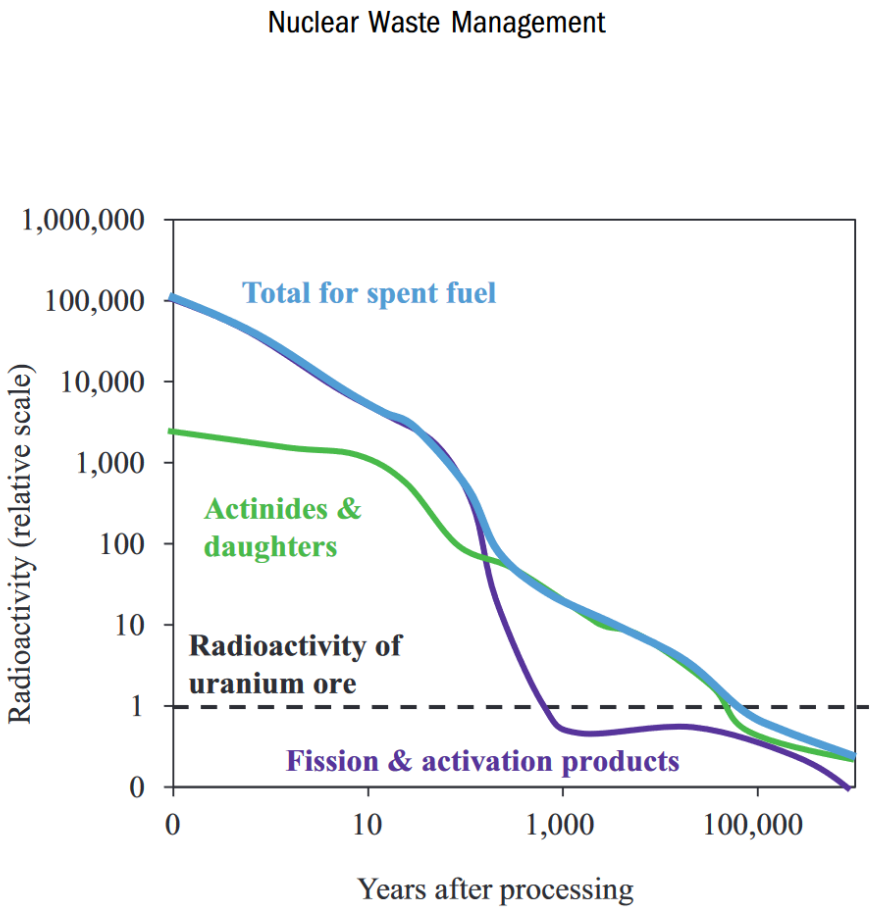


Figure 1. Illustration of the timeframe required for SNF and other nuclear radioactive materials to decay to safe levels (Corkhill).

For a comprehensive grasp of California's nuclear waste predicament, it is imperative to scrutinize the entire life cycle of nuclear materials, thus enabling us to discern the origins of pollution and radioactive waste while pinpointing potential issues. Commencing with the extraction of uranium ore from subterranean sources, a sequence of processing stages is imperative to convert it into usable fuel for nuclear power generation, as depicted in Figure 2. The initial extraction and transformation of uranium ore into fuel inaugurate a pollution challenge that necessitates amelioration. As aptly noted by the Environmental Protection Agency (EPA), "Regardless of the method employed for uranium extraction from rock, the processes inevitably leave behind radioactive waste. These procedures segregate uranium from its radioactive decay products, which actually constitute the majority (80-90%) of the radioactivity within the rock (ore)" (EPA). This situation is particularly unsettling, especially when considering that California possesses 58 uranium mines, outnumbering the uranium mines owned by 24 other states ("Uranium Mining in California").

Transitioning to the post-usage phase, spent nuclear fuel(SNF) can follow either an open cycle or a closed cycle. In the context of an open cycle, spent fuel requires reprocessing to be used as fuel in other nuclear reactors or in the development of nuclear weapons. While this process offers certain advantages, it is paramount to acknowledge that its development and implementation remain ongoing (Corkhill). Before advancing to subsequent stages, the spent fuel must undergo a cooling period within a pool, typically situated at the nuclear power plant's site, prior to being transferred in massive containers to an alternate storage location(Corkhill). However, a significant dilemma emerges as few entities are willing to host these colossal containers. Therefore, our exploration will delve into the multifaceted challenges linked to the transportation and storage of these substantial tanks of nuclear waste. Nevertheless, before

embarking on this exploration, a psychological analysis will be conducted, focusing on the "Not In My Backyard" (NIMBY) psychology, while simultaneously reflecting on the extensive history of nuclear energy in the United States. This analysis will contribute to a better comprehension of the impact of nuclear plants and disposal facilities on nearby residents.

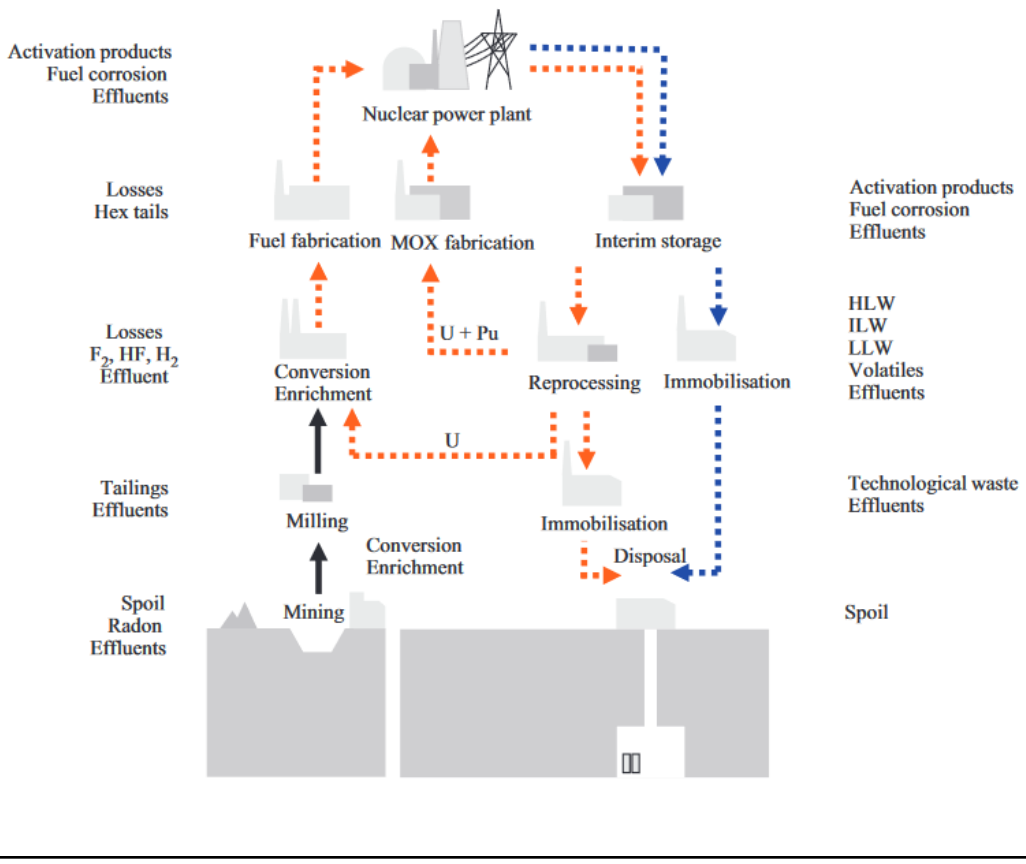


Figure 2. The journey of Nuclear Fuel (Corkhill).

As early as 1992, researchers such as Flynn began documenting the widespread "Not In My Backyard" (NIMBY) phenomenon as a significant obstacle to finding solutions for nuclear waste storage. In his seminal study titled "Time to Rethink Nuclear Waste Storage," Flynn provides a compelling example of NIMBY opposition reaching such intensity that it hindered even the initial studies on potential nuclear storage sites. He recounts an incident from March 1991 in sparsely populated Grant County, North Dakota, where residents, fueled by vehement opposition, removed all three county commissioners in a recall election. The trigger for this electoral upheaval was the mere application for a $100,000 grant aimed at investigating the feasibility of hosting a Monitored Retrieval System (MRS) facility within the county's boundaries (Flynn 44).

Flynn's study goes beyond mere documentation; he offers crucial insights derived from the nuclear policies of other nations as a contrast to the United States' approach. His recommendations rely on a multifaceted strategy. Firstly, he underscores the importance of fostering trust in the government's handling of nuclear waste. Second, he highlights the need for robust and sustained research efforts to inform sound decision-making. Third, Flynn draws valuable lessons from past experiences and failures in managing nuclear waste. Finally, and perhaps most significantly, he emphasizes the ethical imperative surrounding nuclear waste management. To underscore this point, Flynn invokes a poignant quote that encapsulates his unwavering commitment to a fair and safe nuclear waste treatment approach: "No community should be forced to accept a repository against its will" (Flynn 46).

Figure 3. Political Cartoon illustrating the impact of NIMBY ("NOT IN MY BACKYARD").

Unfortunately, nuclear and environmental justice issues continue to persist, impacting the present day. In 2016, Kyne and his fellow researcher shed light on this ongoing concern through their publication in the International Journal of Environmental Research and Public Health. Their study critically examined the safety and equity of nuclear-related facilities while presenting some alarming statistics. As the article's author, Kyne leveraged data as recent as 2010 to unveil stark disparities. The research revealed that African Americans faced a higher likelihood of residing within radioactive zones (17% compared to 10%) and were less likely than their white counterparts to live in nuclear-free and safe areas (71% compared to 75%) (Kyne).

Critically, the paper emphasized that many nuclear plants had obtained their licenses and construction permits before the Energy Reorganization Act passed in 1974, which imposed stricter restrictions and introduced hearings for public input prior to nuclear plant construction. Figure 4 depicts how construction permits had leveled around 1980 yet many are still in operation without being questioned. The paper called for the United States to significantly enhance its preparedness for nuclear accidents, especially those that evolve rapidly, involving a cascade of reactor failures, as seen in the Fukushima incident.

Moreover, the paper criticized the practice of numerous nuclear plants that turned a blind eye to delays in critical processes such as license renewals, labeling this failure to incorporate public participation as a clear violation of procedural justice norms. In the context of planning for high-level waste storage, Kyne stressed the importance of democratic procedures and comprehensive consultations with those individuals and communities most affected. Failing to do so, he warned, would perpetuate a history of nuclear injustice, underscoring the urgent need to address these issues with care and a sense of immediacy.

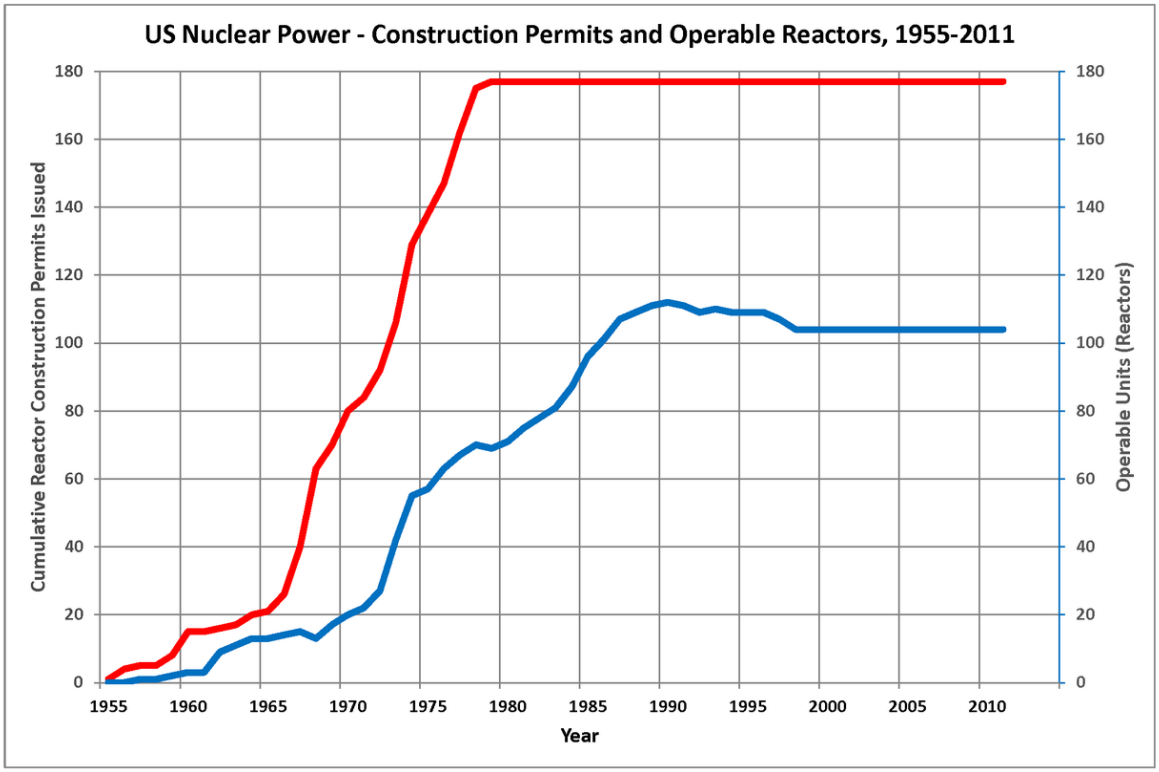


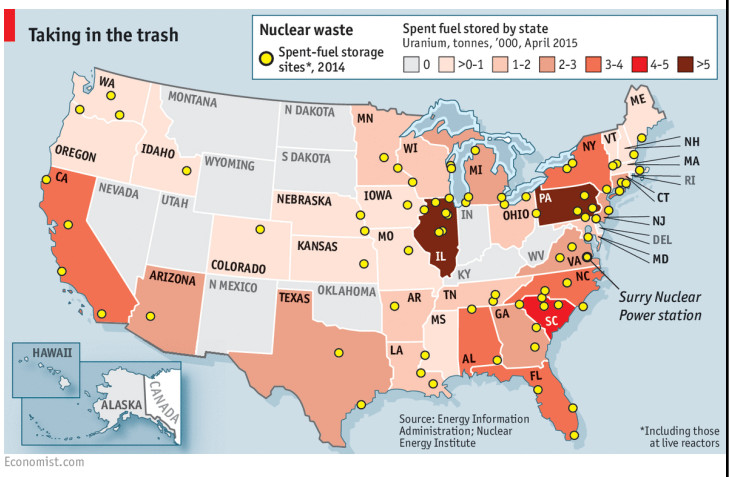
Figure 4: Growth of Operational Nuclear Plants Since 1980, Despite Leveled Construction Trends ("Nuclear Power in the United States").

California, home to seven nuclear plants, with only one remaining operational (as depicted in Figure 5a), plays a significant role in the nuclear energy landscape ("Nuclear power in the United States"). The "Not In My Backyard" (NIMBY) effect has been particularly pronounced as reactors like the Sodium Reactor Experiment and others were shuttered due to nuclear incidents and safety concerns. Even the lone active plant faces intense protests and controversy, raising profound questions about environmental justice ("Sodium Reactor Experiment" and "Diablo Canyon Power Plant"). Currently, the state hosts over four tons of uranium, solidifying its position as a leading state in uranium storage (as illustrated in Figure 5b) ("Taking in trash"). These aspects collectively raise the pertinent question: Why California?

The rationale behind distributing nuclear waste storage across multiple locations becomes evident when considering a report by The Washington Post, which reveals the alarming fact that approximately 1,600 tons of spent fuel rods are intended to remain indefinitely at various storage sites across the country, pending the establishment of a centralized storage solution. Per federal law, the responsibility for the safe and permanent disposal of commercial spent nuclear fuel squarely rests with the government. However, since the Yucca Mountain project in Nevada was halted during the Obama administration in 2010, a tangible plan to fulfill this responsibility has been conspicuously absent (Tuhus-Dubrow).

One significant safety concern in storing nuclear material for extended periods is material effectiveness in preventing corrosion. During the period when the Yucca Mountain nuclear waste repository was defunct, materials engineers like Ewing raised concerns about the materials used for nuclear storage. Ewing's critique specifically highlighted the lack of long-term data supporting the effectiveness of materials, notably the Ni-Cr-Mo alloy, C-22, used at Yucca Mountain (Ewing 660). Prolonged storage of nuclear waste in temporary facilities poses the very

risks Ewing cautioned against, particularly for residents nearby. It is imperative to carefully consider all these risk factors. Residents living near nuclear waste storage sites should have access to comprehensive knowledge about these risks and equitable opportunities to relocate. Moreover, it's crucial to promptly implement comprehensive preventive measures and vigilant monitoring of these temporary storage facilities to ensure their long-term safety and effective response in case of system failures. In the following sections, we will delve into the intricate risk factors associated with the transportation of radioactive waste.



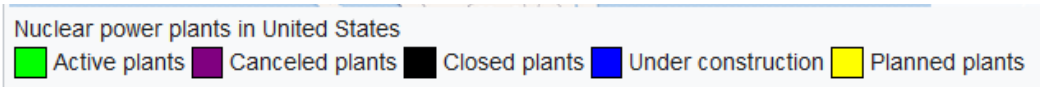


Figure 5a (left): Distribution of Current Nuclear Plants in California ("Nuclear Power in the United States").
Figure 5b (right): California's Uranium Storage Capacity ("Taking in Trash").

The hazards associated with nuclear waste reach far beyond the disposal sites and extend into the domain of waste transportation. This critical issue took center stage at a conference held in Phoenix, Arizona, dedicated to addressing concerns related to nuclear waste management. During this event, Roger A. Nelson, a former member of the US Department of Energy, shared his extensive research findings concerning nuclear treatment safety, with a specific focus on transportation. His primary case study revolved around incidents at the Waste Isolation Pilot Plant (WIPP), a deep geological repository designed for storing nuclear waste from the United States' nuclear weapons research and production ("Waste Isolation Pilot Plant"). However, the implications of his findings resonate with the entire nuclear industry.

One of the highlighted case studies in his presentation involved a serious accident where a drunk driver crashed while transporting nuclear materials, causing significant damage to the vehicle. Fortunately, no nuclear material leakage occurred, as confirmed by multiple measurements taken along the shipment route afterward (Roger).

Nelson's presentation raised fundamental questions regarding the safety and reliability of current transportation systems for nuclear waste. His recommendations included mandatory testing for drivers, improving road conditions and visibility, and enhancing weather reports for transportation routes. These concerns are intrinsically linked to environmental justice, as the risks extend far beyond the conference's boundaries, affecting communities near nuclear facilities, such as those in California. The need for ongoing vigilance and improvements in waste management practices is especially relevant to these residents.

In conclusion, our exploration of the intricate journey of nuclear materials, spanning from the initial stages of mining to fueling power plants and ultimately reaching the challenges of waste storage, has revealed the pressing need for robust scientific research and ethical policies,

particularly in the context of environmental justice for California residents living near nuclear facilities.

This essay has shed light on the historical complexities and contemporary concerns associated with nuclear energy. We've come to recognize that a collective effort is paramount to ensure the well-being and equitable treatment of all citizens, especially those residing in proximity to nuclear facilities in California. Instances of historical disparities and the disproportionate burden borne by minority communities in these areas underscore the imperative to prioritize safety and equality throughout the entire nuclear process.

Furthermore, the long-lasting impacts of nuclear materials across generations serve as a sobering reminder of the urgency with which we must address these issues. Expert voices, such as those cited in the preceding papers, must guide us in navigating the intricate challenges posed by nuclear energy. By heeding their critiques and insights, we can be better prepared to prevent potential hazards from escalating further and harming vulnerable communities.

Additionally, it is essential for governments to be transparent in their actions and actively engage the public in nuclear-related decision-making processes. This inclusive approach not only leads to more informed and equitable policies but also fosters a sense of shared responsibility for our nuclear future, which is especially crucial for the communities most affected.

In this collaborative effort, we have the potential to alleviate the hazards and injustices associated with nuclear technologies, ensuring the safety and well-being of our communities and the environment. While the path to a safer and more equitable nuclear future may be challenging, it is one we must tread to protect the rights and health of California residents and address the complex environmental justice issues intertwined with nuclear storage.

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