ENG3004: SOCIETY AND THE ENGINEER

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Assignment 1

THE ENVIRONMENTAL IMPACT, SOCIAL PERCEPTION AND THE POSSIBLE ALTERNATIVES TO JAPAN'S DECISION TO DUMP FUKUSHIMA'S WASTEWATER INTO THE OCEAN

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Word Count: 1674

Due Friday, February 16, 2023

1 Abstract

Ten years after the Fukushima Nuclear Accident, on 13 April 2021, Japan agreed to dump 1.25 million tons of radiotoxic effluent from the Fukushima Daiichi Nuclear Power Plant into the Pacific Ocean. Despite having many other options available, it is evident that Japan has chosen the most cost-effective method for dealing with the contaminated water; however, international opposition and concerns have been raised due to the ecotoxicological properties of radioactive materials and their negative environmental impacts. This article will thus shed further light on these environmental impacts, social concerns and perceptions, public views, as well as propose many alternatives to the decision to release wastewater into the Pacific Ocean.

2 Environmental Impacts

The initial radioactive monitoring results of Fukushima Daiichi Nuclear Power Plant (FDNPP) sewage treatment facilities indicated an abnormally high tritium content in the effluent (IAEA, 2020). Tritium is a radioactive hydrogen isotope with a half-life of more than 12 years found in trace amounts in seawater and the environment. TEPCO processes water using a set of filters known as the Advanced Liquid Processing System (ALPS). The treatment catches 62 kinds of radionuclides, but not tritium, which is extremely difficult to remove since it replaces hydrogen atoms in water molecules. However, tritium is not the only significant isotope in the Fukushima nuclear effluent. In 2018, TEPCO announced that the radioactive effluent also included Ruthenium-106, Cobalt-60, and Strontium-90 in addition to tritium.

Despite the fact that the concentration of these isotopes is lower than that of tritium, the majority of these radionuclides have a greater biological concentration factor and seafloor sediment-water distribution coefficient, indicating accumulation along the trophic level of the food web and a relatively easier absorption by seabed sediments. As a result, they will not be transported by ocean currents and will instead collect on the bottom in areas near Japan. In addition, the radioactive content of marine fish in Fukushima Prefecture has decreased rather slowly (Cardis et al., 2006); the longer the half-life of the substance, the slower the degradation; consequently, radionuclides with longer half-lives will remain in the ecosystem for an extended time period. There will be concerns for hundreds or thousands of years if the radioactive effluent is dumped into the Pacific Ocean. According to the lessons learnt from the Chernobyl catastrophe, the possible health risks may continue for decades (Takamura et al., 2016).

Moreover, radionuclides with a higher biological concentration factor can be continuously increased along the food web despite the presence of lower ambient concentrations. Sea food networks connect marine life through predatory behavior (Albouy et al., 2019), and increased radioactive activity has been identified in marine biota after the event (Albouy et al., 2019). (Aono et al., 2014). When radionuclides spread extensively in the water, they will accumulate in marine organisms through food chains; the longer the food chain, the more powerful the

enrichment effect. Large and highly migratory marine organisms, such as the Pacific Bluefin tuna, can also transmit radionuclides from point sources in Japan to distant regions, including the South and North Pacific (Madigan et al., 2012). Model studies revealed that Fukushima's freshwater microflora was significantly contaminated, and the larger the fish, the higher the trophic level and the more severe the radioactive contamination (Okamura et al., 2016).

3 Social Perception

The decision by Japan to release the radioactive effluent into the ocean was met with outrage from world leaders, professionals, and the general people alike. Aside from that, there appears to be significant trust issues with the government's lack of alternatives, administration of the crisis, and the veracity of the evidence gathered by institutions associated with the decision, such as TEPCO and IAEA.

Initially, there appears to be a significant disparity between TEPCO and others, including the panel of experts (POF), who are concerned about the sufficiency, precision, and dependability of the evidence supporting the decision to release the water. Robert H. Richmond, a research professor and one of the panel's specialists, tells TIME (Gunia, 2023) that "the critical, foundational data upon which a sound decision could be made was either absent or, when we began receiving more data, extremely troubling." He also questions if the International Atomic Energy Agency (IAEA), which is responsible for the treatment plan's data, evaluation, and reports, is in the best position to assess the dangers. "They’re an agency that has a mandate to promote the use of nuclear energy,” explains Richmond, “and our mandate is to look after the people, the ocean, and the people who depend on the ocean. And our unanimous conclusion … is that this is a bad idea that is not defended properly at this point, and that there are alternatives that Japan should really be looking at."

Second, public web techniques such as Google Trends, which can represent global concern about the radiation occurrences, demonstrated a large rise in global observations following the Japan statement. Municipal governments, civil society organizations, and general people in Japan, particularly fisherman in Fukushima Prefecture, have been protesting in a variety of methods (Burnie, 2020), fearing that consumers will refuse to purchase regional produce. After the 2011 catastrophe, numerous nations banned the import of seafood obtained off the north-eastern coast of Japan, severely impacting the business. Environmental groups are likewise wary of the assertions made by the government and TEPCO (Kuhn, 2021). Ayumi Fukakusa, a campaigner at Friends of the Earth Japan, a nongovernmental group based in Tokyo, states, "This process of decision-making is quite undemocratic. The government and TEPCO said that without consent from the fishing communities, they won't discharge the contaminated water," she explains. This guarantee was utterly broken. Fukakusa continued, "TEPCO and the authorities have stated that the water includes just tritium, which cannot be separated from water. Additionally, Japan's neighbors have criticized the decision. Monday, before to the decision, South Korea's foreign minister expressed "serious regret" In addition, Chinese foreign ministry spokeswoman Zhao Lijian encouraged Japan to "act in a responsible manner" "To safeguard international public interests and Chinese people's health and safety, China has expressed grave concern to the Japanese side through the diplomatic channel," said Mr. Zhao. The United States appears to back Japan's decision, stating that the country "adopted an approach in accordance with globally accepted nuclear safety standards" while Russia and North Korea issued official comments expressing strong condemnation. International institutions and nongovernmental organizations such as the United Nations and environmental groups like as Greenpeace have long opposed releasing the water into the ocean. The NGO stated that Japan's plans to discharge the water demonstrate that the government has "once again failed the people of Fukushima"

4 Possible Alternatives

In addition to sea discharge, various additional disposal alternatives have been studied, such as evaporating the water, injecting it into deep geologic formations, and storing it in an on-site containment facility. They will be further discussed individually in the following set of paragraphs.

Evaporation Evaporating radioactive wastewater is a method by which the water is heated to a high temperature, causing the water vapor to rise and separate from the waste material (IAEA, 2015). Typically, a dedicated evaporator system consisting of a boiler, condenser, and heat exchanger is used for this process. The technique is energy-intensive and time-consuming, and is mainly utilized for modest volumes of radioactive effluent. In addition, the evaporated water still contains trace amounts of radioactive particles, necessitating additional treatment or safe disposal.

Underground Disposal Deep geological disposal is the practice of injecting radioactive material deep underground (Gunia, 2023). It requires boring a deep well into the earth, generally several hundred meters below the surface, and then filling it with nuclear waste. The hole is subsequently sealed with a concrete plug or a shaft filled with rocks, and its safety is maintained. The radioactive waste is then permitted to decompose over the course of hundreds of thousands of years. This form of nuclear waste disposal is widely regarded as safe and effective, as it reduces the possibility of contamination and assures that the waste is out of sight and out of mind. However, injecting radioactive wastes into deep geologic formations include the potential for seismic activity, the expense of drilling and closing the boreholes, and the risk of long-term groundwater pollution. In addition, this type of disposal does not eliminate the risk of radiation exposure entirely, as the waste remains in the subterranean formation and may leak over time. In addition, this process is only acceptable for specific types of trash, as radioactive elements such as plutonium cannot be disposed of efficiently using this method.

Long-term Storage **T**he ideal solution is for TEPCO to build more storage tanks (Steiner, 2021) and continue holding all contaminated water for around 15 years further, during which time the radioactive tritium level will decline by half, while simultaneously treating it with the best available technology (such as ion exchange systems and modular "detritiation" systems in the United States) to remove all radionuclides possible. Japan and TEPCO evaluated this long-term storage option, but eventually chose the least expensive alternative: releasing the effluent into the Pacific Ocean.

5 Concluding Remarks

Therefore, at the denouement of this article's discussion, we can fairly conclude that Japan's plan to release the radioactive effluent into the Pacific Ocean, which has a long nuclear history already, may be lon hazardous to the ecology and ecosystem alike. There appears to be a substantial social opposition to the choice and an even greater stain on the reputation of the government and organizations involved due to conflicts of interest, bias, and a lack of democracy in the decision. The alternatives speak for themselves and imply that there are more than a few methods to cope with this scenario if a stronger emphasis is placed on the decision's practicability and long-term viability rather than just its financial aspect. If there's one thing we've learned from the Chernobyl tragedy, it's that the financial, environmental, social, and health costs of a situation that has spiraled out of control far surpass any economic costs that can be expected at this time.

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