

Analysis of Japan's Decision on Nuclear Waste Water and Its Influence

Wei Zeng^{1,*}, Junye Zou², Sirui Qian², Yuexi Liao²

¹Shanghai World Foreign Language Academy, Shanghai, China

²Golden Apple Jincheng No.1 Secondary School, Chengdu, China

*Corresponding author: 13875990882@163.com

Keywords: Nuclear waste water, the Fukushima nuclear accident, marine environment

Abstract: Japan decided to discharge the nuclear waste water left by the Fukushima nuclear accident earlier, which aroused great concerns and accusation at home and abroad. Experts point out that the nuclear waste water will not only affect the marine environment and human beings nearby Japan, but also influence the whole world, so Japanese government should seek for safer method to deal with it. In this paper, the author introduces the cause of the nuclear waste water – the Fukushima nuclear accident in details, analyzes possible effects the water has on the world and appeals to more concerns and solutions to this discharge.

1. Introduction

Recently, the Japanese government decided to discharge the harmful nuclear waste water from the Fukushima Daiichi nuclear power plant into the sea, which was questioned and attacked by the international societies. Regardless of the doubts and opposition at home and abroad, Japanese government claimed that the nuclear waste water which they are going to discharge was purified and would not cause much damage. This decision was extremely irresponsible and would seriously damage the health, safety and the vital interests of the people of neighboring countries and the international community. The Fukushima nuclear waste water will not only leave a profound impact on the marine environment, food safety and human health, but also will affecting the global marine ecology and environmental security. In this paper, the author aims at digging out the cause of the Fukushima nuclear waste water and what influence it may have on other areas and countries.

2. The Causes of Japan's Decision

The nuclear waste water of Japan was the result of the Fukushima Nuclear Disaster, which happened in 2011 and left many radioactive elements in Fukushima nuclear plant. It is estimated that the tanks used to store those nuclear waste water will be filled before the autumn of 2022, so the Japanese government is eager to tackle with these waste water. In this paper, the author is going to introduce the Fukushima nuclear disaster in details and analysis the reason why Japanese government made this decision.

2.1 The Fukushima Nuclear Disaster

On March 11, 2011, an 8.9-degree earthquake occurred near the northwest coast of Japan and caused a tsunami of 14 meters high, which led to the Fukushima nuclear disaster – the second worst nuclear accident in the history of nuclear power generation. The 14-meter-high tsunami flooded the six nuclear reactors located on the seashore and destroyed the power grid and emergency generators, as a result of which the cooling systems stopped function. Because of the no-operation cooling system, residual heat rising within the core of each reactor caused the fuel rods in reactors 1, 2, and 3 to overheat and partially melt down, leading to the release of radiation.

On March 12 and March 14, explosions resulting from the buildup of pressurized hydrogen gas occurred in the outer containment buildings of reactors 1 and 3. Workers sought to cool and stabilize the three cores of the reactors by pumping seawater and boric acid into them. For fear of the possible

radiation exposure, Japanese government officials established a 30-km no-fly zone around the facility, and a land area of 20-km radius around the plant—which covered nearly 600 square km was evacuated.

A third explosion occurred on March 15 in the building surrounding reactor 2. At that time the explosion was thought to have destroyed the containment vessel housing the fuel rods. In response to the concerns, the government officials established a wider zone, extending to a radius of 30 km around the plant, within which residents were asked to remain indoors. Then on April 12, nuclear regulators elevated the severity level of the nuclear emergency from 5 to 7—the highest level on the scale created by the International Atomic Energy Agency. It was not until the middle of December 2011 that the Japanese Prime Minister declared the facility stable, after the cold shutdown of the reactors was completed.

At that time, in order to drop the temperature of the reactor to avoid the core melting, the Tokyo Electric Power Company affiliated to the Fukushima nuclear power plant filled the reactor with a large amount of cooling water. What's more, there was a large amount of high concentration water in underground facilities bringing by the tsunami, which increasingly produced nuclear waste water with radioactive substances. According to the statistics, there was about 1.25 million tons of waste water needed to be processed by March of the year, which is kept in 1061 storage tanks. It is estimated that by the autumn of 2022, the storage tanks for nuclear waste water will reach the upper limit, so the Japanese government is eager to deal with it. Meanwhile, in the past 10 years since the Fukushima nuclear accident, the water storage tank has also suffered a certain degree of corrosion, which is likely to leak. Therefore, how to deal with these nuclear waste water has become a top priority.

2.2 The Possible Methods for Japan to Deal with the Nuclear Waste Water

Fukushima Daiichi nuclear power station repeatedly claimed that after the Fukushima accident, TEPCO set up purification and treatment devices for the radioactive waste water, including strontium cesium adsorption device, reverse osmosis membrane desalination device and multi nuclide removal device (ALPS), etc., to remove most of the radionuclides in the radioactive waste water, and set up a large number of storage tanks to store the treated and purified wastewater. However, scientists said that those methods have little effects on the radioactive water and the Japanese government needs to seek other methods to purify the nuclear waste water.

The experts mainly provided five methods to deal with the nuclear waste water, such as injection into deep formation, discharging into the sea, heating and atmospheric evaporation, and electrolytic atmosphere release and so on. Due to the consideration of technology development and money, the Japanese government chooses to discharge the waste water into the sea, which there is no the precedents, so the international societies appeal to Japan to seek for a more mature method to deal with the waste water. And Chinese government also points out that Japan should re-examine the issue of nuclear waste water disposal at the Fukushima nuclear power plant, and shall not start the sea discharge without authorization until full consultation and agreement are reached with all interested countries and the International Atomic Energy Agency. China will continue to pay close attention to the development of the situation together with the international community, and reserves the right to make further response.

3. The Influence of Nuclear Waste Water on the Environment and Human

The Fukushima nuclear accident was a level 7 nuclear accident like Chernobyl, while there is no precedent for waste water to be discharged into the sea after nuclear accident treatment and the impact of it is immeasurable.

First of all, let's talk about the nuclear waste water, which by definition is sewage with radioactive elements in it. In fact, radioactive elements are everywhere, for instance, the water we drink is also radioactive, while compared with nuclear waste water, and the radioactive elements in it are not that much. According to the national regulations, the standard for drinking water is less than 0.5 becquerel/L for total alpha specific activity and less than 1 becquerel/L for total beta specific activity (excluding tritium). And the standard for nuclear waste water is greater than 1,000 Becquerels, which

is about 2,000 Becquerels more intuitively, and the impact is calculated exponentially, 4,000 times and 2,000 times.

The Fukushima waste water contained large amounts of radioactive elements such as tritium, carbon-14, and cesium 134 and cobalt-60. These pollutants will enter the body of Marine organisms and cannot be absorbed, resulting in the deformity of Marine organisms. Then through the food chain, these contaminants will enter the human body, the respiratory tract and even the skin. According to Greenpeace International, the tritium and carbon-14 may be altering our DNA. Nuclear waste water contains large amount of radioactive elements and tritium, as well as carbon 14, cobalt 60 and strontium 90, which needs a long period of time to degrade. The isotope has a potential toxicity in marine animals, and can also affect the marine environment in longer periods and more complex form. For example, the physiological concentration of carbon-14 in fish may be 50,000 times that of tritium. Cobalt-60, on the other hand, can accumulate in seabed sediments, where concentrations can rise up to 300,000 times. Except for the serious pollution of the marine environment caused by them, radioactive materials may also spread to the entire Pacific Ocean and even the other oceans due to the action of ocean currents.

The Greenpeace International report also shows that carbon-14 is “a major contributor to human collective radiation doses.” Shaun Burnie, a senior nuclear expert at Greenpeace, said that storage tanks may contain as much as 63.6 Gbq (gigabquerels) of carbon-14. “These and other radionuclides in sewage will be dangerous for thousands of years and have the potential to cause genetic damage. That's the reason why it has to be abandoned.” The harmfulness of the radioactive nuclear contaminated water is very likely to have a bad effect on the health of living things, such as causing the pathological changes of various tissues and organs. Radionuclides can produce strong radiation to the surrounding area, forming nuclear contamination. Radioactive fallout can also enter the human body through the food chain as we mentioned above. These radioactive elements can leave harmful effects on the body with certain doses, causing symptoms such as dizziness, headaches, loss of appetite and a decrease in white blood cells and thrombocytopenia as time passed. Ultra-high doses of radioactive substances can cause tumors, leukemia and genetic disorders if they are exposed to the body for a long time.

4. The Influence of Nuclear Waste Water on the Whole World

The harmfulness of the nuclear waste water will not only affect the environment and human health near the Japan, but also have negative effects on the whole world.

First, we are going to talk about the influence on the Pacific Ocean. In the waters near Fukushima, there is one of the strongest currents in the world, the Kuroshio Current, which originates from the North Equatorial Current in the Pacific Ocean and flows northeast along Okinawa and the east side of the Japanese island. The Kuroshio Current will carry the contaminated water over northern Hawaii to the West Coast of the United States and California. That is the reason why, in the first few years after Japan 311, debris with Japanese markings and fish that originally lived in Japanese waters were found in California and Hawaii. And when the Kuroshio Current passes the Taiwan Island, it extends a circulation (branch) into the East China Sea. As the scientists stimulated, if a million tons of nuclear waste water were dumped into the Pacific Ocean, most of the radioactive pollutants would be carried to the West Coast of the United States by the Kuroshio Current, and a small part of the radioactive pollutants might enter the East China Sea within four years due to the movement of ocean currents.

Over the past seven years, Marine Conservation, with the help of citizen scientists in the Pacific, has tracked the spread of cesium-137 in the western United States and western Canada through research voyages and field trips. Before the Fukushima disaster, the only source of radioactive cesium in the Pacific was nuclear weapons tests in the 1950s and 1960s. Therefore, only a small amount of radioactive elements was detected in the ocean which is 150 kilometers west of Eureka, California before 2011. However, in the year of 2014, a large increase in radioactive cesium was detected on the West Coast of the United States. Meanwhile, in 2017, cesium from the Fukushima spill was detected in salmon and bluefin tuna off the coast of Oklahoma and the west coast of Canada. The radiation levels of these materials are quite low and will not cause much harms to humans because only about

500 tons of contaminated water was released into the sea from the Fukushima nuclear plant. However, if 1.37 million tons of contaminated water were dumped into the Pacific Ocean, the radioactive material would accumulate in all the fish in the Pacific Ocean. And large fish, such as tuna and swordfish, which migrate long distances and live long lives, can carry radioactive material into the world's oceans, ultimately endangering humans.

Some political figures and media in Japan insist that “it is international practice to discharge nuclear sewage into the sea”, and say that they will do their best to purify the nuclear sewage to minimize or even eliminate its pollution. However, studies by a number of international organizations and research institutions show that the situation is not as simple as Japan claims. According to the calculation of a German Marine Scientific Research Institute, radioactive materials will spread to most of the Pacific Ocean within 57 days from the date of discharge, and the United States and Canada will be affected by nuclear pollution three years later. The German Antarctic Ocean agency has warned that if Japan discharges all the wastewater into the sea, the entire Pacific Ocean will face a high radiation threat in less than half a year, including the United States, which is far away from the other end of the ocean. At that time, not only the coastal residents will be directly injured, but also the marine environment and organisms will be polluted, eventually causing secondary harm to the human body.

Li Shunyi, a professor at Zhengzhou University, pointed out that after the nuclear waste water is discharged into the sea, it will first affect the surrounding countries, and then pass through the ocean circulation of the ocean. Ten years later, the entire Pacific Ocean will be completely polluted. If it exists in human body, it may lead to “three causes”, carcinogenesis, teratogenesis and mutation, which has a significant impact on human genetic.

5. Conclusion

In conclusion, the Fukushima nuclear waste water has great potential to cause great harms on both the environment and human beings, not only in Japan but also in the whole world. The ocean is the common property of mankind and the disposal of nuclear waste water from the Fukushima nuclear power plant accident is not just a domestic problem in Japan. The international society strongly urges Japan to recognize its responsibilities, uphold a scientific attitude, fulfill its international obligations, and respond appropriately to the serious concerns of the international community, neighboring countries and its nationals. The Japanese government should adopt the wastewater treatment technology and device with high decontamination factor to further purify the excess nuclides and reduce the content of radionuclides in the treated wastewater as much as possible; we should study the tritium treatment technology and disclose the research progress and achievements in time. If there is a feasible technology, it should be used for the treatment of tritium in wastewater immediately.

References

- [1] Kim Eunjoo, Yajima Kazuaki (2021). Intake Ratio of ^{131}I to ^{137}Cs Derived from Thyroid and Whole-body Doses to Residents of Iwaki City in Japan's Fukushima Prefecture. *Health Physics*, vol.120, no.4, pp120-133.
- [2] Anonymous (2013). Potentially radioactive leak at Japan's Fukushima plant. *Water & Wastewater International*, vol.28, no.2, pp153-157.
- [3] Isaac Leung (2011). Robots at Japan's Fukushima Daiichi nuclear plant. *FEN*, vol.5, no.2, pp34-43.
- [4] Mai Ichihara, Kazumasa Inoue (2021). Changes on distribution of absorbed dose rates in air in an urban area after the Fukushima Daiichi Nuclear Power Plant accident. *Journal of Radioanalytical and Nuclear Chemistry*, vol.329, no.7, pp45-65.

[5] Mizuki Rie (2021). Disruption of Child Environments and Its Psychological Consequences after the Fukushima Disaster: a Narrative Review Based on the Ecological Systems Model. *Current psychiatry reports*, vol.23, no.8, pp190-205.

[6] Kobayashi Tomoyuki (2013). Offshore Wind Farm Near Japan's Fukushima Reactor Goes Live. *Transmission & Distribution World*, vol.77, no.2, pp123-133.