

PEST Analysis Based on Japan's Nuclear Wastewater Discharge Event

Kexin Yang*

Hainan University/Arizona State University, China

*Email: kyang67@asu.edu

Abstract. On April 13, 2021, the Japanese government officially issued a statement saying that it will discharge the nuclear waste water stored in the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant into the sea around the spring of 2023 for a period of 30 years. Despite almost overwhelming opposition domestic and abroad, the Japanese government has not withdrawn or delayed the plan. Based on the six stakeholders and the PEST analysis method, this paper deeply discusses the reasons for the Japanese government's unilateral decision to discharge nuclear waste water into the sea. Research shows that Japan's discharge of nuclear waste water is not just an environmental protection issue, it is a consequence of Japan's political, economic, technological, cultural and even historical factors. The purpose of this paper is to provide a reference for effective measures in the future, in the hope of better protecting the legitimate rights and interests of stakeholders by introducing international environmental law to prevent and postpone the discharge of nuclear wastewater from Japan.

Keywords: Nuclear wastewater discharge, Fukushima nuclear leak, marine pollution, stakeholders, PEST analysis.

1. Introduction

In 2011, the tsunami triggered by a magnitude 9.0 earthquake off Honshu Island, Japan caused the Fukushima nuclear leakage. Since then, the nuclear wastewater has reached the upper limit of TEPCO's sewage tank, and is still increasing at a rate of 140 tons per day [1]. On April 13, 2021, the 10th year after the Fukushima nuclear accident, the Japanese government officially issued a statement saying that it will discharge the nuclear wastewater stored in the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant into the sea around the spring of 2023 for a course of 30 years. This act will undoubtedly bring irreversible and unpredictable harm to the global marine ecology and even the life of all human beings. However, in the face of accusations from Russia, South Korea, China and other international communities, and even strong opposition from the Japan Fisheries Cooperative Association and the Japanese people, the Japanese government has not withdrawn its decision or indicated that it will adopt other methods to deal with the wastewater from the Fukushima Daiichi Nuclear Power Plant.

At present, the almost one-sided opposition at home and abroad also stems from the unreliability and untrustworthiness of the Advanced Liquid Processing System (ALPS) currently applied in Japan. According to Lehto et al., the ALPS system currently used in Japan cannot remove tritium. The water purified by the ALPS system is stored in a storage tank, and the tritium content of the nuclear wastewater in the storage tank is as high as 1×10^6 to 5×10^6 Bq/L, at least 50 to 100 times dilution is required to reach the dischargeable standard (6×10^4 Bq/L). TEPCO did not do this more for political reasons than technical reasons [2]. These nuclear wastewaters contain not only tritium, but also other radioactive substances such as ^{106}Ru , ^{60}Co and ^{90}Sr . Although their concentrations are lower than tritium, they are easily incorporated into marine organisms and seafloor sediments [3]. Also, Vives i Batlle pointed out that, The stocks of radioactive materials in different tanks that store nuclear wastewater also vary widely [4]. These radioactive materials can either cause cell damage, increase the probability of leukemia in humans, or have radiation that can cause persistent harm to the environment [5]. It can be seen that from the effect of the nuclear wastewater treatment scheme currently adopted in Japan, it is completely unsafe and unfeasible.

From the perspective of domestic stakeholders and international stakeholders, Japan's unilateral decision to discharge millions of tons of untreated nuclear waste water is completely immoral and incompatible with international morality. The German Institute for Marine Scientific Research pointed out that, under the influence of ocean currents, the radioactive material will spread to most of the Pacific Ocean within 57 days from the date of discharge, and spread to the global waters within 10 years [6]. These radioactive substances will gradually spread around the world through the ocean, atmosphere, and groundwater [7]. Chen et al. analyzed from the perspective of bioaccumulation and biological chain, the content of radionuclides in plants, invertebrates and fish may be thousands of times higher than the concentration in water. Humans at the top of the food chain are most likely to accumulate high concentrations of radionuclides in bodies [8]. After Japan discharges nuclear waste water into the sea, its own people bear the brunt. Lu et al. analyzed the hazards from the perspective of atmospheric circulation and biological migration. Through dry/wet deposition and precipitation, the surfaces of vegetables, fruits, grains, etc. will be attached to radionuclides. And the larger the size of the marine fish, the higher the trophic level, the more radionuclides it will carry. Highly migratory marine organisms such as bluefin tuna can carry these radionuclides to the North and South Pacific Oceans [9]. Nuclear radiation will not only bring a devastating blow to Japan's fishery, but also to the Pacific Rim countries. If nuclear waste water is discharged from the Fukushima nuclear power plant on the east coast of Japan, along with ocean currents, nuclear waste water will first spread to the west coast of the United States. Due to the proximity of the East China Sea and the Sea of Japan, China's pelagic fisheries will also be directly negatively affected [10].

2. Data and method

The data in this paper are mainly from journal literature. Among them, technology-related data from 2019 to 2022 are used to explain and testify the danger and severity of Fukushima's nuclear waste water. There is 1 paper in 2019, 2 in 2020, 4 in 2021, and 3 in 2022. In addition, in order to demonstrate the limited restrictive effect of international environmental law on Japan, this paper also cites relevant documents from 1983 and 1987.

PEST analysis is adopted in this paper, where P is politics, E is economy, S is society and T is technology. With regard to Japan's decision to discharge nuclear wastewater into the sea, these four factors are used to analyze the situation faced by various stakeholders, explore their reasons, and identify current or future possible opportunities and challenges.

3. Result

In April 2021, the Japanese government unilaterally decided to officially discharge nuclear wastewater into the sea around the spring of 2023. This study will first introduce and analyze the stakeholders, and then explore the reasons why Japan made this decision and the problems it may face through PEST analysis from the perspective of stakeholders. Here, I propose 6 stakeholders and divide them into Japanese stakeholders and international stakeholders. Among them, Japanese stakeholders include the Tokyo Electric Power Company (TEPCO), the Japanese government, and the Japanese people. International stakeholders include those countries affected by nuclear wastewater, international organizations represented by the International Atomic Energy Agency (IAEA), and the United States.

Tokyo Electric Power Company is the world's largest private nuclear power company, and the initiator of the plan to discharge nuclear wastewater into the sea. On March 11, 2011, an earthquake with a magnitude of 9.0 occurred off the coast of Honshu, Japan. The huge tsunami triggered by the earthquake caused devastating damage to Iwate, Miyagi, and Fukushima prefectures in northeastern Japan. After the earthquake, TEPCO was more concerned that injecting seawater to cool the reactors could permanently disable the reactors and damage long-term investment in the plant, rather than reporting the failure of the Fukushima nuclear power plant cooling system and the explosion of the

Unit 1 building. TEPCO's delay in taking timely remedial action missed the best opportunity to resolve the nuclear accident at minimal cost, and resulted in the escalation of a Level 4 nuclear accident to a Level 7 nuclear accident. Continued nuclear wastewater from this event has been treated by the Advanced Liquid Processing System (ALPS) and stored in sewage tanks. It is estimated that in the summer of 2022, the sewage tanks with a total capacity of 1.37 million tons built in the nuclear power plant will be filled with nuclear wastewater. Regarding the nuclear wastewater that TEPCO cannot store and treat, on April 13, the Japanese government agreed to TEPCO's proposal and formally decided to discharge the nuclear wastewater stored in the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant into the sea. A poll conducted by Asahi Shimbun newspaper in January 2021 showed that 55 percent of respondents are against the government's plan to discharge contaminated radioactive wastewater from Fukushima into the sea. On March 30, 2022, four civic groups in Fukushima prefecture and Miyagi Prefecture submitted to the Japanese Ministry of Economy, Trade and Industry and TEPCO a joint signature of about 180,000 people opposing the discharge of nuclear water into the sea, demanding alternative treatment of the Fukushima Daiichi nuclear power plant. Moreover, Japan's National Federation of Fisheries Associations has maintained its staunch opposition to the discharge of nuclear waste into the sea since the policy was released. However, the opposition from the Japanese people has not been responded and adopted by the government.

The German Institute for Marine Scientific Research pointed out that, under the influence of ocean currents, the radioactive material will spread to most of the Pacific Ocean within 57 days from the date of discharge, and spread to the global waters within 10 years. All Pacific coastal countries, such as The United States, Canada, South Korea, China, etc., and even the whole world, will be irreversibly affected. Officials from Russia, China, South Korea and other countries have strongly condemned the Japanese government's irresponsible unilateral announcement of the discharge of nuclear waste into the sea, but the Japanese government has not changed its decision. Excluding the United Kingdom and France, which have not taken a position on this issue, the United States is the only country in the world to support Japan's discharge of nuclear wastewater. On April 12, the U.S. State Department issued a statement saying that the Japanese government's decision to release the water from the Fukushima Daiichi nuclear power plant into the sea is in accordance with internationally recognized nuclear safety standards, and that it appreciates Japan's efforts to dispose of the wastewater. The United States, also a Pacific coast country affected by nuclear wastewater, publicly supported it despite environmental protection, more like an international political consideration for the exchange of interests. International organizations such as the International Atomic Energy Agency (IAEA), their experts' investigation report indicated that they technically agreed with Japan's method and the treatment method is in line with international practice, because the case is unique and complex, it requires the participation of multiple countries and long-term attention. The IAEA also said it was ready to provide technical support to monitor and review the safe and transparent implementation of the program.

3.1 . Political factors

The political environment in Japan and the attitude of the United States are political considerations for the Japanese authorities to discharge nuclear wastewater into the sea.

From the perspective of Japan's domestic political environment, first of all, Japan's nuclear waste water is the product of the Fukushima nuclear leakage caused by the earthquake on March 11, 2011, and it has been more than ten years from now. From the production of nuclear waste water in 2011 to the official discharge in 2023, the Japanese government has experienced changes in different parties and different prime ministers. Over the past decade, five prime ministers have had their own policy priorities and goals, so naturally, they cannot guarantee the continuity of the policy on nuclear wastewater treatment. Second, nuclear wastewater, as an increasingly serious historical problem, has reached the storage limit of sewage tanks due to technical and financial constraints after 10 years of delay and avoidance. Coupled with the impact of the new crown epidemic since 2019 and the

postponement of the 2020 Tokyo Olympics, Japan's domestic political and economic situation has become increasingly severe. The resignation of Shinzo Abe and the poor management of Yoshihide Suga have damaged the authority of the Japanese cabinet and greatly reduced the credibility of the public. In this case, facing the pressure of the chaebols and giants in control of nuclear energy, the chaotic cabinet authorities can only make this decision.

From the perspective of international politics, I think the decision of the Japanese government to discharge nuclear wastewater is most likely based on the approval of the United States. Both Japan and the United States regard the discharge of nuclear wastewater as an opportunity for exchange of interests and political struggle. The Japanese government's decision to officially discharge nuclear wastewater into the sea was met with overwhelming opposition and criticism from the international community, and the United States is the only country in the world to praise the Japanese government for its "openness and transparency". Without the support of the superpower, it is difficult for the Japanese authorities to support the one-sided pressure of international public opinion. In addition, Japan, as one of the few developed countries in Asia, has always regarded itself as a Western country and has a pro-American political tradition. Moreover, Japan's diplomatic relations with neighboring countries such as China and South Korea are relatively deadlocked, and facing domestic development bottlenecks, in order to suppress China's development and maintain its leadership in Asia, Japan urgently needs the support of the United States to jump out of the current embarrassing situation. The United States, the world's only superpower, is eager to maintain its world hegemony for as long as possible under the multipolar trend. The United States' support for Japan's nuclear wastewater discharge plan has sold Japan a great favor, and it can control Japan through further military or economic measures to achieve its own monitor and suppression in the Pacific region. For Japan and the United States, the discharge of nuclear wastewater is not a simple environmental issue, it involves a complex international political interests.

3.2 Economic factors

The downward pressure on Japan's economy is the direct reason why Tokyo Electric Power Company (TEPCO) proposed to discharge nuclear waste water into the sea.

TEPCO is now facing a dilemma. From the internal point of view of the company's operations, after the Fukushima nuclear leakage, in 2012, Tokyo Electric Power Company suffered its first loss since its establishment. Since 2011, in addition to spending a large amount of money to control the situation at the Fukushima Daiichi nuclear power plant and prevent the leakage of radioactive materials, TEPCO has also faced huge compensation costs for tens of thousands of people. From the perspective of external factors, in recent years, Japan's domestic economy is facing continuous downward pressure due to the repeated epidemic situation and the sharp decline of international import and export trade. As an island nation that relies on 88% of its energy imports, Japan's economy is suffering. With the intensified geopolitical situation in the Russian-Ukrainian conflict, on March 21, 2022, international oil prices rose sharply, and the prices of basic public service products related to daily life in Japan were also rising. Japan's electricity, gas and tap water rose by 27.5%. The current inflation may make Tepco's profits fall again. On the evening of March 16, a 7.3-magnitude earthquake occurred off the coast of Fukushima Prefecture, directly caused the operation of several power stations, including Unit 6 of TEPCO's "Hirono Thermal Power Plant" in the prefecture, to be shut down. The power supply within the company's jurisdiction was extremely difficult, making TEPCO even worse. Today's TEPCO simply does not have the funds and capacity to deal with the nuclear wastewater which has accumulated over the past 10 years.

Although TEPCO's operating conditions and reputation are not as good as before due to the Fukushima nuclear leak, as an energy giant, a nuclear energy chaebol in Japan and even Asia, TEPCO's capital, technology, energy resources, employment, and so on can still have a huge impact on government policies. In the face of economic malaise that the government is also temporarily unable to cope with, the discharge of nuclear wastewater into the ocean is the most cost-effective way for TEPCO and the government.

3.3 Social factors

The solidification of Japan's social class and its national character are the fundamental reasons why the Japanese government can make decisions ignoring the influence of the domestic people and the international community.

According to an opinion poll by the Asahi Shimbun, more than half of the respondents oppose the government's plan to discharge the contaminated radioactive wastewater from Fukushima into the sea. Recently, Japanese civil society groups against the discharge of nuclear sewage have also received joint signatures of about 180,000 people. Japanese society controversy abounds. The fact that the Japanese government was able to make this decision unilaterally, ignoring the will of its own citizens and the negative international influence, shows that the pressure brought by the former two obviously is far less than the influence exerted by the Japanese plutocrats and elites. As the first developed country in Asia, Japan's social mobility is very small and social class is highly solidified now. In a Japanese society that highly admires power and advocates elite theory, there is a serious disconnect between the perception and needs of the Japanese elite and ordinary people. There are still a large number of people in Japan who acquiesce and agree with the government's immoral behavior. This is why the Japanese government would rather throw money into public relations in an attempt to fool the public by using mascots and posters of the radioactive substance "tritium" to promote the harmlessness of nuclear wastewater. Japan's elite, such as the chaebol, have the resources and ability to enjoy special supplies even after nuclear waste has contaminated the sea; ordinary Japanese people, under the influence of a thousand-year-old feudal society, have acquiesced and accepted this power distance and class inequality in their hearts, and will not express excessive belligerence and resistance.

Japan is an island country. Historically, the ocean has separated Japan from the world, which has created Japan's narrow national concept. From the perspective of national character, On the one hand, Japan is extremely exclusive and arrogant, on the other hand, it is extremely fond of power and has a strong sense of obedience to power. The discharge of nuclear waste water into the sea is completely in line with the logic of Japanese national character and culture. From the former point of view, Japan's extreme exclusion has strengthened the extreme sense of self-supremacy. They have no concept of a community with a shared future for mankind. They are willing to sacrifice and occupy the interests of other countries in order to realize their own interests, completely ignoring the influence of the international community. From the latter point of view, after its defeat in world War II, Japan's dream of hegemony in Asia by militarism was shattered, and its national confidence was severely hit by sanctions imposed by western powers and marginalization by the international community. It even went to the other extreme of self-denial and inferiority. Since world War II, Japan's foreign policy has been centered on pro-America, which is a manifestation of inferiority, admiration for strength and obedience to power. Gaining the support of the world's only superpower allows Japan to ignore negative international influence in its decision to discharge nuclear waste into the sea.

3.4 Technological factors

The current immature and expensive nuclear wastewater treatment technology is an excuse for the Japanese authorities to decide to discharge nuclear wastewater.

At present, Japan TEPCO has added a multi-nuclide removal device ALPS (Advanced Liquid Processing System) after the original wastewater treatment system, with adsorption as the main process, the intention is to reduce the concentration of the remaining 62 kinds of nuclides except tritium in the wastewater to the emission level. The International Atomic Energy Agency (IAEA) stated that the wastewater treated by ALPS is theoretically feasible and in line with international practice. However, in the trial operation stage of ALPS, besides tritium, 12 nuclear activity concentrations such as iodine-129, cesium-135 and carbon-14 still exceeded the standard, and the effect did not reach the expected level. The Science published an article on April 13 that, during the purification process of ALPS, ruthenium, cobalt, strontium, plutonium and other radioactive longer-lived and more dangerous isotopes will be missed from time to time. It can be seen that even if ALPS

is technically feasible, it may not be fully realized in engineering and maintain long-term stable operation.

Looking at all the current nuclear wastewater treatment methods, the current adsorption method is widely used due to its low cost and convenient application, such as ALPS currently used in Japan, but it is usually difficult to achieve the ideal state of adsorption under practical conditions. In recent years, the ion exchange method and membrane separation method newly developed by nuclear powers have good effect, but the high cost and harsh operating conditions hinder their application to a certain extent. Although TEPCO stated that the current tank for storing nuclear wastewater has reached the storage limit, in fact, there is still a large amount of idle land around the Fukushima Daiichi Nuclear Power Plant that is unsuitable for living due to excessive radiation, which can be used to build new water storage tanks or solidifying contaminated water deep in the ground. However, due to the limited land area in Japan, land prices are high. Being in the geologically unstable circum-Pacific volcanic seismic belt makes Japan prone to accidents. Moreover, private companies such as TEPCO have purchased large areas of idle land to simply store nuclear waste, which may even damage commercial interests. Immature and expensive treatment methods are completely impractical for The Japanese authorities. Dumping improperly treated nuclear waste into the sea is the easiest, cheapest and fastest way for TEPCO and the government to do so.

There is no doubt that Japan's discharge of nuclear waste water into the sea will bring irreversible disaster to marine ecology and even human society. It should be an international consensus to stop the Japanese authorities' decision. However, the Japanese government has not withdrawn its decision, and Japanese research institutions and IAEA have not provided a more realistic and feasible treatment method for nuclear waste water. The international community has not united together to discuss countermeasures. The fact that the international community has no substantial containment and punishment mechanism for Japan's irresponsible willful behavior is exactly the pain point of this incident. First, according to Perritano, current international environmental law does not have an institutional framework of state obligations, which is weak in dealing with issues such as international pollution, and can only play a very limited warning and deterrent role [11]. Second, Williams points out that there is currently no global agreement on transboundary pollution liability, meaning that defining the extent of pollution and holding the Japanese government accountable is difficult in practice because there is no strong legal basis, let alone sanctions and penalties [12]. Thirdly, since the large-scale dumping of nuclear waste water into the sea has not yet begun, and the assessment of the impact of nuclear waste water involves a wide range of time. Without a precise claim standard, the rights and interests of many stakeholders cannot be protected.

Therefore, all stakeholders, whether it is the international community or ordinary people affected by nuclear wastewater, are faced with the inability to carry out extensive and in-depth international cooperation due to political considerations, difficulties in raising funds, lack of proper and feasible nuclear wastewater treatment technology, the existing laws cannot protect relevant rights and interests, and other political, economic, technological and legal problems.

4. Conclusion

Through PEST analysis of stakeholders and causes of Japan's nuclear waste water discharge, it can be concluded that this is not only an environmental protection issue but also involves political, economic, cultural and even historical considerations behind it. This article explores the reasons for Japan's nuclear waste discharge, not to rationalize the Japanese government's decision, but to understand Japan's motives at the root, so that it can better address the problem.

The generation and disposal of nuclear waste from Fukushima in Japan is a Japanese problem, but when it is released into the ocean, it becomes a global problem. In my opinion, the treatment of nuclear waste water can be considered separately before and after discharge. First of all, before the decision of the Japanese government takes effect, the most important thing is that the international community exerts pressure on Japan from various sources to prevent or at least delay this disaster,

which affects the health and sustainable development of all human beings. How to introduce more mandatory international environmental plans, agreements or regulations, and how to promote wider and in-depth cooperation between the United Nations, the International Atomic Energy Agency (IAEA), the International Maritime Organization and other international organizations on nuclear wastewater pollution, how to define pollution and jurisdiction, etc. are of great value in preventing and delaying Japan's discharge of nuclear waste water and promoting environmental safety. Secondly, all stakeholders should be aware of the seriousness of this incident. Once pollution is started, the consequences cannot be eliminated. As nuclear waste is discharged into the ocean, no country is immune to the movement of ocean currents and the growing popularity of international trade. Only by building an interconnected community with a shared future for mankind, seeking international cooperation, pooling funds, sending experts and scholars to study and control pollution, and sharing real-time monitoring data and research resources, can pollution be kept under control. Controlling and reducing pollution as far as possible is the most realistic and feasible plan after discharge.

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