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The Generating Process of Japan's Nuclear Wastewater Discharge Policy into the Sea from the Perspective of Multi-source Flow Theory

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Abstract: Against the backdrop of the Fukushima nuclear disaster, the Japanese government announced its unilateral decision to discharge nuclear contaminated water into the ocean, undoubtedly putting Pacific Rim countries and even the world at great potential nuclear risk. This article uses the multi-source flow theory to analyze the elements and mechanisms of Japan's nuclear wastewater discharge policy from the perspectives of problem flow, policy flow, and political flow, and further dissects the decision-making source system diagram. The Japanese nuclear policy has always had a "chrysanthemum and knife" style contradiction with its own characteristics. Analyzing the Japanese government's decision to "discharge pollutants into the sea" can help better understand its decision-making essence and political philosophy, and provide a clear reference framework and precise response strategies for policy makers to propose solutions to common challenges.

Keywords: Nuclear wastewater, Fukushima nuclear accident, multi-source flow theory, Japanese policy analysis

1. Introduction

In 1945, two atomic bombs exploded in Hiroshima and Nagasaki, Japan, declaring that humanity had entered the era of nuclear weapons filled with fear and anxiety. In 2011, the Fukushima Daiichi nuclear power plant in Japan melted down in a 9.0 magnitude earthquake, causing a serious nuclear leakage accident, which was one of the most serious nuclear disasters after the Chernobyl nuclear accident. From "nuclear weapons" to "nuclear power plants", from "Hiroshima" to "Fukushima", tragic spiritual memories coexist with real interests and demands. The conflicted mentality of "fearing nuclear" and "loving nuclear", "abandoning nuclear" and "owning nuclear" has always been embedded and integrated into the entire Japanese society [1]. Japan should have had a deeper understanding of the devastating impact of nuclear pollution on all humanity than any other country in the world. However, ten years after the Fukushima nuclear disaster, the Japanese government disregarded the health and safety interests of all humanity and decided to discharge nuclear contaminated water into the sea. This decision is not a random proposal put forward by the Japanese government. According to the multi-source flow theory, the policy window will only open when the problem flow, political flow, and policy flow are coupled. The analysis of this process deeply reflects the Japanese government's decision-making preferences and political philosophy.

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2. Overview of Japan's Nuclear Wastewater Discharge Incident into the Sea

On March 11, 2011, an accident occurred at the Fukushima Daiichi nuclear power plant, resulting in a core meltdown. Since the accident occurred, the cooling water in direct contact with the accident core, which is still emitting decay heat for cooling purposes, has been continuously accumulating. In addition, rainwater, groundwater, etc. flow into the reactor, resulting in a large amount of nuclear wastewater. After the Fukushima nuclear accident in 2011, more than 1000 water storage tanks have been built locally. The nuclear wastewater generated is stored in the water storage tanks built by Tokyo Electric Power Company at the nuclear power plant, except for some leakage into the Pacific Ocean and leakage from sewage storage tanks. As of March 2021, there are 1.25 million cubic meters of nuclear wastewater coexisting within the nuclear power plant area.

On April 13, 2021, the Japanese government announced that due to the lack of more storage space in 2022, it would discharge nuclear contaminated water treated with multi nuclide removal equipment (ALPS) in 2023, causing huge controversy domestically and internationally. Relying on the support of the United States and the assessment report provided by the International Atomic Energy Agency, Japan completely disregarded its domestic and international opposition and launched the first round of nuclear wastewater discharge into the sea on August 24, 2023. As shown in Figure 1, Japan has launched a total of four rounds of sea discharge as for now, with over 30000 tons of nuclear wastewater discharged into the sea.

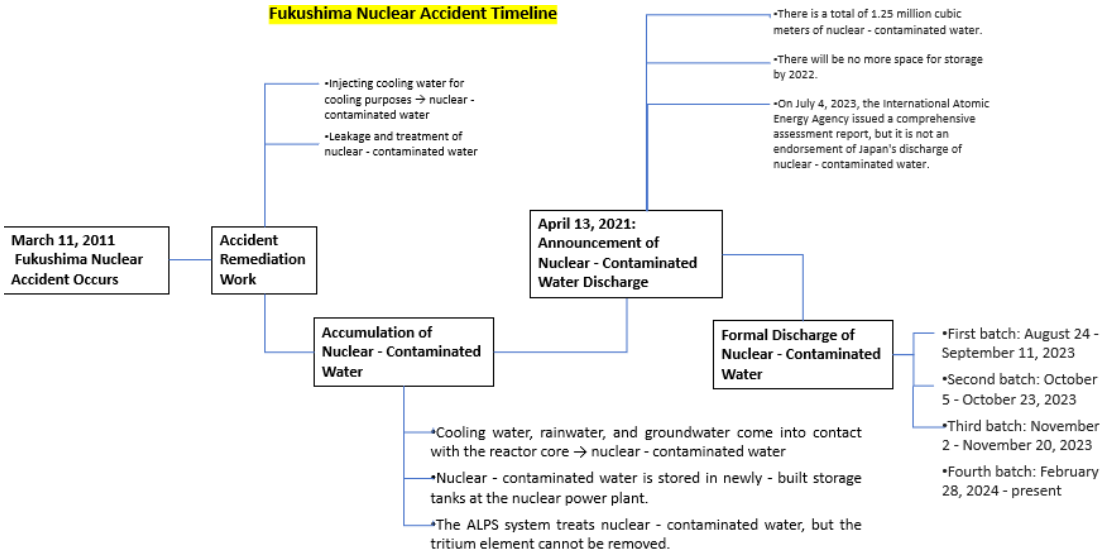

Figure 1: Nuclear wastewater discharge into the sea related events

3. Review of the Current Status of Nuclear Wastewater Research in Japan

The "discharge of nuclear wastewater into the sea" incident in Japan has attracted profound attention and extensive discussion in the international community. Current scholars generally define it as a non-traditional safety event when studying Japan's discharge of nuclear wastewater, and focus more on its impact, analyzing it from the aspects of environmental safety, legal obligations, international cooperation, and public health [2]. Ren Hu discussed the international liability issues that may arise from Japan's discharge of nuclear wastewater into the sea, and proposed temporary measures from the International Court of Justice and the International Tribunal for the Law of the Sea, as well as the new approach of "anticipatory breach of contract liability" in the field of international private law to solve the problem [3]. Hu Zhengliang analyzed the illegality of Japan's Fukushima nuclear wastewater discharge into the sea, as well as the response measures that neighboring countries, such

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as South Korea, China, and Russia should take. From the perspective of Japan's violation of cross-border environmental impact assessment obligations, radiation protection obligations, and notification and consultation obligations under international environmental law and nuclear safety related international law [4]. Fu Benchao discussed the potential damage to the surrounding marine environment caused by the discharge of Fukushima nuclear wastewater into the sea, focusing on how China can respond to the issue of Fukushima nuclear wastewater discharge into the sea from a domestic judicial perspective [5]. These fields of research provide a legal basis and moral judgment perspective for condemning Japan's "discharge into the sea" behavior, while also providing strategies for the international community to comprehensively address the environmental and legal challenges that may arise from Japan's nuclear wastewater discharge into the sea. Yin Xiaoliang explored the relationship and utilization logic of Japan's decision to discharge the nuclear wastewater from the Fukushima nuclear power plant into the sea from the perspective of process constructivism, and analyzed how this decision utilized the network of inter state relations in international relations to fertilize decision-making power [6]. Dissecting the diplomatic design of Japan's "big goals" and "big strategies" can help understand the Japanese behavioral framework. However, there are relatively few existing studies that trace the internal logic of the decision-making process from a political perspective, and the analysis of its policy essence is not diverse enough. This article explores the process of Japan's nuclear wastewater discharge policy from multiple dimensions, in order to open up a new perspective for analyzing Japan's nuclear policy decision-making.

4. Multi Source Flow Theory and its Application in Policy Research

The multi-source flow theory was proposed by American political scientist John Kingdon in his book "Agendas, Alternatives, and Public Policies" [7]. This theory mainly studies the establishment of agendas and the formation process of public policies, and mainly answers the questions of how to attract government attention and how to establish policy agendas, becoming one of the important theories guiding public policy research.

Jin Deng regards public policy as a field full of uncertainty, believing that the policy decision-making process is driven by the convergence of three independent sources: problem sources, policy sources, and political sources. Each source has its own characteristics and its own driving force and rules. The source of the problem is the issue that attracts the government's attention through socio-economic indicators, such as monitoring crises and disasters, or evaluating government plans. Policy origin refers to the process in which experts collectively discuss and generate technically feasible policy recommendations, proposals, and plans that are in line with decision-makers' values, cost-effective, and attractive to the public. Political origins refer to political factors, such as changes in government, changes in political sentiment, political ideology, opinions of advocacy or opposition groups, and public opinion that influence the agenda. In addition, policy entrepreneurs are also an important indicator for policy recommendations, as they link problems and solutions to politics and encourage decision-makers to pay attention [8]. Generally speaking, the "three sources" operate independently of each other, but at a critical moment, when the independent streams of issues, policies, and politics overlap, the "policy window" will open.

5. Analysis of the Decision-making Process for Japan's "Discharge into the Sea" Policy

5.1. Problem Flow

There are three main sources of radioactive wastewater from the Fukushima nuclear power plant: the original coolant of the reactor, the water injected after the accident for continuous cooling of the core, and a large amount of groundwater and rainwater infiltrating the reactor. After a nuclear leakage accident, in order to control the temperature of the reactor, continuous water injection is needed for

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cooling and cooling. Although nuclear wastewater can be used for circulating cooling, due to the coastal and low-lying terrain of the Fukushima nuclear power plant, groundwater and rainwater continue to seep out, making nuclear wastewater increasingly abundant. Japan is facing the problem of how to deal with a large amount of nuclear wastewater [9].

Meanwhile, the Japanese government has been researching a complex filtration system to remove most radioactive isotopes from water. It is called Advanced Liquid Processing System (ALPS), which can remove several different radioactive pollutants from water. The authorities have used ALPS and other systems to remove some of the most dangerous isotopes, such as cesium-137 and strontium-90. But there are some radioactive isotopes that they cannot filter out, such as tritium. Tritium is an isotope of hydrogen, which is a part of water itself (H2), so it is impossible to create a filter that can remove tritium. In addition to tritium, more dangerous isotopes with longer radioactive lifetimes [10], such as ruthenium, cobalt, strontium, and plutonium sometimes pass through the ALPS process, which Tokyo Electric Power Company only acknowledged in 2018. The company now states that these additional nuclides are present in 71% of the water tanks. These radioactive isotopes are different from tritium in the ocean and are more easily integrated into marine biota or seabed sediments.

In the face of nuclear pollution that cannot be degraded by existing technology, there is no completely safe solution. As time goes by and the amount of nuclear pollution increases, the problem of nuclear wastewater has become increasingly urgent [11] and has gradually become a crisis event that the Japanese government urgently needs to solve.

5.2. Policy Flow

The Japanese government has convened experts to evaluate five nuclear wastewater treatment options, including injection into geological formations, discharge into the ocean, steam release, hydrogen release, and underground burial. Among these five options, the cost of treating nuclear wastewater and discharging it into the sea is the lowest, estimated to be 1.7 billion to 3.4 billion yen, approximately 102 million to 203 million yuan; Underground burial, as the most expensive treatment option, is estimated to cost tens or even hundreds of times more than discharging into the sea. In February 2020, the ALPS Purified Water Treatment Subcommittee released the "Evaluation Report on the Treatment of Nuclear Wastewater from the Fukushima Nuclear Accident in Japan" [12], which concluded that both discharging into the ocean and releasing steam were feasible options. Among them, discharging into the ocean was more convenient for operation, while other disposal options lacked feasibility in terms of economy and technological maturity. Therefore, the ocean discharge option was ultimately chosen.

In practical operation, the sea discharge plan will dilute nuclear wastewater with seawater until the tritium concentration reaches one fortieth of the allowable concentration in Japanese drinking water. The government stated that they will keep tritium levels far below all safety limits and below the levels released by some operating nuclear power plants. In addition, they transported the diluted water through underwater tunnels to a location near the Fukushima coast in the Pacific Ocean for discharge, in order to minimize the impact. The Japanese government insists that tritium is a part of water and only releases low-energy β particles [13], posing little risk to health, especially compared to other radioactive substances around Fukushima. Its radioactive decay is relatively weak, with a half-life of 12 years. Therefore, unlike elements such as uranium-235 with a half-life of 700 million years, it will not exist in the environment for too long.

The plan of "discharging pollutants into the sea" was immediately strongly opposed by Japanese society, especially coastal residents and fishing organizations, once it was released. However, the International Atomic Energy Agency has sent a completely different signal from the Japanese public. In April 2020, the International Atomic Energy Agency organized a special working group, including

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international experts from 11 countries, to review the safety of treated water discharge at the Fukushima Daiichi nuclear power plant in Japan [14]. The IAEA conducted a series of independent verification activities, including on-site sampling and analysis, to provide comprehensive, transparent, and objective verification, helping to establish confidence in the accuracy and reliability of Japan's reported data. After a comprehensive review of international safety standards by the working group, the IAEA has released a comprehensive safety review report, confirming that Japan's discharge plan and activities comply with relevant international safety standards, and that the planned discharge of treated water into the sea has negligible radioactive effects on people and the environment.

The proposal put forward by the Japanese expert group is in line with the interests of the Japanese government. At the same time, the International Atomic Energy Agency's overall positive evaluation of the treatment of water discharge from the Fukushima nuclear power plant in Japan also supports the plan to some extent. The IAEA has signed a cooperation agreement with Japan, clarifying its long-term scope of activities during the discharge process, including monitoring, evaluating, and protecting the safety of people and the environment. This move helps to calm the emotions of the public and build international confidence, and the government is more inclined to recognize the implementation of this policy.

5.3. Political Flow

The political strategy and election considerations of the Japanese government's top officials have an undeniable driving force in making the decision to discharge nuclear contaminated water into the sea. The House of Representatives expires no later than October 21, 2021, and Prime Minister Yoshihide Suga, as a member of the Liberal Democratic Party, is eager to expand his support among the party's voters. Looking back at history, Japan's nuclear power research and development was vigorously introduced and developed during the ruling period of the Liberal Democratic Party [15], which can undoubtedly be called a "nuclear party". Liberal Democratic Party lawmakers form an "iron triangle" alliance with the responsible departments or departments of the provincial government and related industries in the policy-making process, playing a key role in promoting and implementing nuclear power policies. This large group of traditional voters from the Liberal Democratic Party comes from various sectors of society (business, academia, and politics, etc.), who support the government's continued development of nuclear energy and hope to see the nuclear energy industry, which has been severely damaged since the Fukushima accident, revive. In order to win back the support of the "masses" within the party and ensure the stability of the traditional nuclear energy voter "voting pool", Suga Yoshihide made the decision to discharge nuclear contaminated water into the sea despite strong opposition from fishing organizations. In addition to the personal election considerations of the Prime Minister, the huge profits of the nuclear power industry have been "fed back" to politicians and bureaucrats who support nuclear power in the form of political donations. These bureaucrats also play an important role in the formulation and promotion of nuclear power policies [16]. A large number of retired officials from the Ministry of Economy, Trade and Industry have "descended" to major power companies to serve as consultants, directors and other positions. These individuals have influence in the implementation of nuclear power policies and the development of the nuclear power industry. For example, Tetsuya Ishida, former head of the Department of Resources and Energy at the Ministry of Economy, Trade and Industry, became an advisor to Tokyo Electric Power Company shortly after leaving office. These individuals and groups constitute the core force supporting the rapid resolution of the nuclear wastewater issue [17], and their mutual support and exchange of interests have played a key role in the formulation and implementation of Japan's "discharge into the sea" policy.

In addition, Japan announced the discharge of nuclear contaminated water into the sea just before the exchange of heads of state with the United States, and it is difficult not to doubt whether there is

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another "clever idea" behind this "coincidence". On the one hand, the United States has always held a positive attitude towards Japan's nuclear energy development. Japan and the United States have significant economic interests in nuclear energy, and Japan fully adopts American nuclear power technology, paying billions or even billions of dollars in patent fees to American companies every year. After the Fukushima nuclear contaminated water incident, the US also has a certain degree of concern about cooperation in the nuclear energy field between the two countries. The decision to "discharge pollutants into the sea" seems to be aimed at proving to the United States the Japanese government's determination to thoroughly address this impact and enhancing the cohesion of the Japan US alliance. On the other hand, due to the long geographical distance, the probability of the United States being affected by Japanese nuclear contaminated water is low and the period is long, with strong resilience. Compared to the strong opposition from East Asian countries, the US has a much softer attitude towards Japan's decision to discharge nuclear contaminated water into the sea. Obtaining US support will help Japan implement this policy in the long term, taking into account its own political factors.

6. Conclusion

The decision-making process of Japan's nuclear wastewater discharge into the sea depicted in this article starts from the triple perspectives of problem flow, policy flow, and political flow, and sorts out the internal and external factors of Japan's government decision-making, demonstrating the complexity and contradictions of Japan's nuclear energy policy. At the level of problem flow, the Japanese government utilizes enterprises, namely Tokyo Electric Power Company, to conduct problem assessments in terms of urgency, danger, and impact. At the policy level, the Japanese government has hired a team of experts to develop multiple plans for nuclear wastewater treatment, and has chosen the sea discharge plan with the lowest economic cost and relatively mature technology. At the political level, the decision-making of the Japanese government is influenced by domestic and international political environments, election considerations, and the interaction of political and economic interests with countries such as the United States.

The decision-making process of Japan's nuclear wastewater discharge into the sea indicates that the formulation of nuclear policy is a complex multi-party game involving multiple levels such as science, economy, and politics. This study not only provides a new perspective for understanding Japan's nuclear policy decisions, but also serves as a reference for the international community to address similar nuclear environmental issues. The analysis of this decision-making process has important implications for neighboring countries, such as China in formulating response strategies.

In the future, with the continuous discharge of nuclear wastewater into the sea, its long-term impact on the global marine environment and public health still needs to be closely monitored. The international community should strengthen cooperation to jointly monitor and evaluate the impact of Japan's nuclear wastewater discharge into the sea, ensuring the safety and sustainable development of the global marine environment. At the same time, countries should also learn from Japan's experience, strengthen nuclear safety supervision, prevent similar nuclear accidents, and jointly safeguard the global environment and human health.

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