

Japan is enigmatic in many different ways. For instance, the Liberal Democratic Party (LDP)'s long-lasting resilience in free elections intrigues many Western political scientists. Meanwhile, the country's dramatic transformation from the enemy that attacked Pearl Harbor in 1941 to the closest ally of the United States remains puzzling to others.

Japan's reliance on nuclear energy has also been difficult for many foreigners to understand. Japan is the only country victimized by atomic bombs in human history. Nonetheless, less than a decade after the atomic bombings of Hiroshima and Nagasaki, Japan surprisingly 'embraced' atomic power for its economic growth. Since March 1954 when the Japanese Diet approved Yasuhiro Nakasone's request for budgeting nuclear energy research and development, which totaled 235 (a number reminiscent of Uranium-235) million Japanese Yen, the Japanese government has vigorously promoted nuclear energy as a reliable energy source for this extremely resource-poor country.

For the past several decades, the development of nuclear energy has been eye-opening in Japan. As the famous manga character Mighty Atoms (Astro Boy) symbolizes, Japan became one of the major nuclear states in the world; it had 54 reactors in operation before the Fukushima Accident and a closed fuel cycle. Japan's global leadership in this field has been outstanding, as Yukiya Amano has shown through his exemplary leadership as Director General of the International Atomic Energy Agency (IAEA).

The Fukushima Accident that deeply injured Japan's global reputation added more puzzles. After the accident, which was of unprecedented scale, Japan promptly decided to stop all remaining nuclear power reactors in the country, but was not able to phase out nuclear energy like Germany. Instead, operation of these halted reactors has resumed since Shinzo Abe returned to the Prime Minister's office in spite of massive protests and the objection of the majority of the public; Sendai 1 Reactor in Kagoshima Prefecture was restarted on August 11, 2015 and Sendai 2 Reactor successively went online on October 15. And now, Japan's global leadership in the nuclear field faces another serious challenge from the point of view of non-proliferation.

Japanese Exceptionalism and Missions Impossible

Japan's decision to restart its idle nuclear reactors should be understood together with two other important components of the back end of its nuclear fuel cycle, namely reprocessing and plu-thermal because nuclear power generation, reprocessing, and plu-thermal together make up the trinity in Japan's national plan for securing nuclear energy.

Japan is the only country in the world that is permitted to reprocess its spent fuel, which means it can possess plutonium — a weapon-usable material — without acquiring nuclear weapons. Originally, Japan envisioned fast breeder reactors (FBR) for generating electricity with plutonium separated from reprocessing. Japan's sodium-cooled FBR Monju, which is supposed to produce more fuel than it consumes and thus is regarded as a dream reactor, has never been realized mainly because of insuperable technical problems, despite astronomical

investment that exceeded 1 trillion Japanese Yen.

Eventually, on November 13, 2015, the Nuclear Regulation Authority (NRA) recommended that the Ministry of Education, Culture, Sports, Science and Technology (MEXT) find another entity to replace the Japan Atomic Energy Agency (JAEA) as operator of Monju; JAEA is under the jurisdiction of MEXT. If MEXT fails to find a replacement for JAEA, Japan might need to reexamine the national FBR project.

Whereas the FBR project did not show any significant progress, Japan built the idea of "plu-thermal" as an alternative plan in the late 1990s. "Plu-thermal" per se is combination of the words "plutonium" and "thermal reactor" (generally indicating Light Water Reactor (LWR)), and stipulates burning mixed plutonium-uranium oxide (MOX) fuel in LWR. Japan has continued to justify its reprocessing and its plutonium stockpile with its plu-thermal strategy and planned to transition to MOX fuel in 16 to 18 reactors by 2015; in the aftermath of the Fukushima Accident this proved unrealistic.

Meanwhile, it has never been easy to start up the reprocessing plant in Rokkasho Village, Aomori Prefecture. This reprocessing plant was initially planned to start its operation in 2000, but completion of reprocessing plant construction has been delayed more than twenty times. Moreover, the construction cost has surged up to approximately 22 billion USD, almost four times higher than the original cost planned back in 1989. And on November 16, 2015, Japan Nuclear Fuel Ltd. (JNFL), the operator of reprocessing plant, announced that the operation of the reprocessing plant is postponed again to as late as September 2018. JNFL's President Kenji Kudo reported that a separate plant for producing MOX fuel had also been delayed by early 2019.

The Chicken or the Egg? Japan's Nuclear Trilemma

Nonetheless, the Japanese government still shows reluctance to withdraw from reprocessing with the excuse of its scarcity of natural resources. Without a technical way out, however, the plutonium stockpile of Japan continues to rise. As for July 2015, its plutonium stockpile reached 47.8 metric tons - 10.8 tons in Japan, 16.3 tons in France, and 20.7 tons in the United Kingdom - the fifth largest next to the United Kingdom, France, Russia, and the United States. Considering the fact that Japan is not a nuclear-armed state, this number is obviously an outlier. For instance, Germany, which also does not possess nuclear weapons, only had 3 tons of separated plutonium at the end of 2013.

Japan's 'entrapped' situation with regards to reprocessing has been controversial both domestically and internationally. James Acton, co-director of the Nuclear Policy Program at Carnegie Endowment, analyzes why Japan is 'entrapped' in reprocessing in his recent report,

"Wagging the Plutonium Dog". Acton explains that the operation of the reprocessing plant in Rokkasho Village is unlikely to be avoided regardless of lots of criticism because of densely intertwined commitments between the central government and the local communities coupled with a lot of pressure from those communities on the central government.

As Acton points out, pressure from the local communities to maintain the reprocessing plan was intense. When Japan Atomic Energy Commission (JAEC) proposed "it is more economical not to reprocess spent fuel" in February 2012 and a serious reexamination on reprocessing plan was on the table, then-Rokkasho Mayor Kenji Furukawa strongly appealed his anxieties as the head of the host community. Moreover, both Rokkasho Village and Aomori Prefecture intimidated the central government into adhering to the original plan; they contended that the more than 3,000 tons of spent fuel in the area should otherwise be transferred back to the reactors where the spent fuel was originally produced. This alternative however, is politically and technically implausible because the host communities of reactors also expect spent fuel to be removed from their backyards almost immediately.

Thus it can be said that Japan fell into the following trilemma after the Fukushima Accident: first, without restarting nuclear reactors, reprocessing lacks enough justification; second, without having the reprocessing plant in operation, restarting nuclear reactors will only produce more spent fuel that does not have a final destination; and third, without having the MOX fuel plant and reactors using MOX fuel in operation, reprocessing alone will add more plutonium to the existing stockpile that is already overwhelming. Technical difficulties that relate to every pillar of the trinity in the Japanese national project bogs the central government down to a stalemate. Yet what the Abe Cabinet has chosen to pursue is restarting stopped reactors and sticking to reprocessing, which is likely to increase the plutonium stockpile.

Growing Anxieties and the Missing Link of the Trilemma

Japan's unusual surplus of plutonium creates tremendous political pressures for the Japanese government. Japan's neighbors like China and South Korea often become suspicious of Japan's real reasons for having that amount of plutonium. Not only its neighbors but experts and lawmakers in the United States, its closest ally, have also demonstrated their deep concerns about the Japanese massive stockpile of plutonium. Furthermore, Japan's recent performance triggered a backlash even from the IAEA, whose head is a former Japanese diplomat; 640 kilogram of unused plutonium was not included in Japan's annual reports to IAEA in 2012 and 2013. IAEA experts criticized this as "inappropriate omission" though JAEC explained that the stock was part of MOX fuel stored in a reactor that was not in operation during that period of time, and accordingly assumed exempt from reporting requirements. Japan has insisted that it would be impossible to inappropriately separate plutonium at the reprocessing plant in Rokkasho Village under the IAEA's 24-hour surveillance. However, surveillance burdens for safeguards have aggravated simply because of the absolute amount of stockpile.

Thus, Japan seriously needs to concentrate its all efforts on how to consume existing plutonium for peaceful purposes; in other words it needs to downsize its plutonium stockpile. At the Hague

Nuclear Security Summit (NSS) in March 2014, Prime Minister Abe explicitly stated that Japan "should possess no plutonium reserves without specified purposes." However, the outcome of what Japan is trying to do now — re-operation of reactors and operation of the reprocessing plant — is contradictory to his statement.

The missing link here that is also related to the trilemma stated above is whether or not Japan can continue using MOX fuel. Without MOX fuel-burning reactors and the MOX fuel plant in operation, re-operation of non-MOX fuel reactors will only produce more spent fuel and operation of the reprocessing plant will only add more plutonium to the stockpile. The important thing to remember is there is no final destination for spent fuel and high-level radioactive waste (HLW) in Japan. Regardless of the Nuclear Waste Management Organization (NUMO)'s strenuous efforts since 2000, Japan does not have any site for permanent repositories of HLW produced after reprocessing. On the other hand, operation of an interim storage facility under construction in Mutsu City, Aomori Prefecture has not been realized either. On January 27, 2015, Japan's Recyclable-Fuel Storage Company announced its decision to postpone the scheduled operation of the Recyclable Fuel Storage Center — an interim storage facility — from March 2015 to October 2016 by stating that the facility needs to be investigated by NRA for compatibility with new regulatory standards.

What Needs to Be Done to Restore Japan's Leadership

The following things, therefore, need to be done to restore Japan's global reputation and its leadership in the nuclear field. First, as long as Japan does not want to phase out nuclear energy and needs nuclear energy as a "key base-load power source", Japan should prioritize restarting those of its nuclear power plants that can use MOX fuel; for example, the Ōma Nuclear Power Plant in Aomori Prefecture is supposed to be capable of using a 100% MOX fuel core. The Tomari Plant in Hokkaidō and the Onagawa Plant in Aomori Prefecture can use MOX fuel as well. It is encouraging that Shikoku Electric Power and Kansai Electric Power recently decided on using MOX fuels for their reactors to go online in the near future.

Second, Japan should not obsess over the hurried operation of the reprocessing plant until technical problems are cleared and MOX fuel consumption reaches a certain level. A declaration of temporary moratorium of the reprocessing plant might be necessary and may be possible under Abe's consolidated leadership. In order to persuade host communities including Aomori Prefecture and Rokkasho Village, relevant legislation needs to be passed; for instance, from the point of view of Rokkasho Village's interests, financial aid originally promised in case of starting the reprocessing plant should be either fully or partially guaranteed under the name of a storage fee. And from the Aomori Prefecture's point of view, it should be clarified that this moratorium is not a dead end for the region but a temporary decision until Japan can figure out more pragmatic solutions.

In March 2016, the fifth anniversary of the Fukushima Accident, the last NSS will be held in Washington DC, and the international community will pay further attention to Japan's decisions and announcements regarding the issue.

Japan's Nuclear Trilemma

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