Proposals to the Japanese Government concerning International Management of Plutonium

Aiming for reduction in plutonium stocks and adoption of new international norms

May, 2019

The Sasakawa Peace Foundation

Working Group on New Initiatives for Nuclear Energy and Nuclear Non-Proliferation

Preface

The Sasakawa Peace Foundation (SPF), as a public interest foundation, works to promote and maintain peace and stability in Japan and around the world by conducting research and making policy recommendations on security issues.

In September 2018, SPF launched the Working Group on New Initiatives for Nuclear Energy and Nuclear Non-Proliferation. Japan, as a leading nation in the peaceful uses of nuclear energy and the only country that suffered nuclear bombings during World War II, has a significant role to play in advancing the conversation around nuclear disarmament and non-proliferation. To this end, the Working Group set out to consider a range of topics including Japan's lessons learned from the Fukushima nuclear accident, strategies to control and manage nuclear fuel on a global scale, ways for Japan to contribute to denuclearizing North Korea, and the new approaches to nuclear disarmament, nuclear non-proliferation, and the peaceful use of nuclear energy, to name a few. The results of these discussions will be compiled into a comprehensive set of policy recommendations arranged according to subject. This report presents the first set of proposals, which focus on the international management of plutonium with the ultimate aim of reducing global plutonium stocks and encouraging the adoption of new international norms.

At the end of 2016, total stocks of fissionable materials that can be diverted to nuclear weapons, i.e. highly enriched uranium and separated plutonium, were equivalent to more than 100,000 warheads, posing a major threat to international security. In particular, stockpiles of separated plutonium have been increasing, with global totals now reaching 520 tons. Japan, with 47 tons, accounts for 95% of the separated plutonium held by non-nuclear weapon states. This report presents the Working Group's policy recommendations for Japan to reduce international threats and increase confidence in the country's plans for plutonium use, suggesting that the Japanese government should play a key role in promoting the new international norms for global plutonium stocks.

These proposals are supported by the Working Group members listed below. However, this Working Group takes no particular position on the peaceful use of nuclear energy.

Members of the Working Group

SUZUKI Tatsujiro	Vice Director/Professor, Research Center for Nuclear Weapons Abolition at Nagasaki University
ENDO Tetsuya	Former Vice Chairman, Japan Atomic Energy Commission Former Ambassador
ENDO Noriko	Project Professor, Graduate School of Media and Governance at Keio University
OTA Masakatsu	Senior Feature Writer, Kyodo News
OBA Mie	Professor, Tokyo University of Science Former member, Japan Atomic Energy Commission
SAKATA Toichi	President, Japan Space Forum Former Ambassador, Japan to Ukraine and the Republic of Moldova
SAGAYAMA Yutaka	Assistant to the President, Japan Atomic Energy Agency ＊
TAKEDA Yu	Lecturer, Hiroshima City University
NISHIDA Tsuneo	Honorary Director, The Center for Peace at Hiroshima University Former U.N. ambassador
TANAKA Nobuo	Chairman, The Sasakawa Peace Foundation

（Observer）

NAGAYAMA Chieko	Former high school teacher in Fukushima

＊ Please note that Mr. Sagayama asked not to be listed as a member who supports the recommendations.

Proposals to the Japanese Government concerning International Management of Plutonium

Aiming for reduction in plutonium stocks and adoption of new international norms

Working Group on New Initiatives for Nuclear Energy and Nuclear Non-Proliferation

As of the end of 2016, total stocks of fissionable materials that can be diverted to nuclear weapons (highly enriched uranium (HEU) and separated plutonium (Pu)) were equivalent to more than 100,000 nuclear warheads, posing a major threat to international security. Of these, HEU stocks have been declining, while separated plutonium has been increasing and is now at 520 tons, equivalent to 86,000 or more Nagasaki-class atomic bombs (6 kg/bomb). Some 56 percent of the total separated plutonium stocks (approximately 290 tons) are for civilian use. Japan at 47 tons accounts for 95 percent of the stocks held by non-nuclear weapon states, making Japan's responsibility large as a leading nation for peaceful use of nuclear energy that wishes to make use of plutonium as fuel. The Japanese Government continues to maintain the basic policy of promoting the nuclear fuel cycle, yet at a nuclear security summit, it has already declared its commitment to helping minimize stocks of global fissionable materials (The Hague Nuclear Security Summit Communiqué, 2014). This report summarizes proposals of policy measures Japan should take toward reducing international nuclear threats and increasing confidence in Japan's plans for plutonium use, resulting from our studies of how Japan can contribute to solving the problem of global plutonium stocks. The Working Group asks the Japanese Government to play a leading role in globally promoting the new international norms for plutonium indicated here.

Some nuclear energy experts claim that in the case of reactor-grade plutonium recovered from spent nuclear fuel at civilian nuclear reactors (light water reactors), the low isotopic concentration of fissile plutonium makes diversion to nuclear weapons "impractical". In this Working Group, we support the International Atomic Energy Agency (IAEA) view, in its *IAEA Safeguards: Guidelines for States' Systems of Accounting for and Control of Nuclear Materials*, that even reactor-grade plutonium can be diverted for use in nuclear bombs or weapons and requires strict international control.

These proposals are made from the standpoint of international security, based on the recognition that reducing existing plutonium stocks is necessary regardless of the pros and cons of peaceful use of nuclear energy. This Working Group, however, takes no particular position on peaceful use of nuclear energy.

Proposals

1. **Pursuing international storage of plutonium: Put "excess" plutonium under International Atomic Energy Agency (IAEA) custody.**
2. **Strengthening the international Guidelines for the Management of Plutonium that are current international norms: Propose new international norms for reducing existing stocks based on the decision of Japan's Atomic Energy Commission, and restrain reprocessing.**

3. **International cooperation toward reducing existing stocks: Establish an international forum on the disposal of plutonium stocks.**
4. **Give priority to dry storage for spent fuel management, and have a third party agency assess the options for the nuclear fuel cycle.**
5. **Play a leading role in globally promoting new international norms for plutonium.**

A summary explanation of each of the proposals is given below.

1. **Pursuing international storage of plutonium: Put "excess" plutonium under IAEA custody.**

Japan has used the term "excess" to refer to plutonium with no designated purpose of use; but as the stocks have grown, the large volume of these stocks has raised concerns in other countries given the lack of transparency regarding plans for their use. Therefore we propose here that, with the aim of reducing concerns and fostering confidence, Japan should start with placing this "excess" plutonium in the custody of the IAEA (Endo, Takeda, 2019; McGlodrick, 2014; Suzuki, 2018). Defining "excess," however, is not easy. Four ways of defining "excess" plutonium can be thought of, as follows. 1) Define as "excess" stocks of plutonium exceeding "reasonable working stocks"; 2) Define as "excess" stocks of plutonium for which no plans for use in the near term (up to around three years) have been made; 3) Have the institutions storing the plutonium define excess plutonium voluntarily (e.g., plutonium stocks stored outside Japan); 4) Consider all currently held stocks as "excess." Of these four choices, the Working Group considers 1) as most appropriate, but it would be desirable for the Japanese Government to define "reasonable working stocks" according to the fuel cycle situation while listening to the views of an IAEA experts group (Reference: (Jor-Shan Choi, 2018)). It is proposed that the right to use this excess plutonium will be restored once Japan has confirmed a plan for its use. In such a case, the reasonableness of the plutonium use plan would be subject to objective assessment, such as by an experts group set up jointly by Japan and the IAEA. It is further proposed that reprocessing be carried out at a controlled pace until the excess plutonium reaches zero.[1] Regarding international storage of excess plutonium, as well, the Japanese Government should advocate this as a new international norm, to be adopted also by other countries currently holding plutonium and those promoting future use of plutonium.

2. **Strengthening the international Guidelines for the Management of Plutonium that are current international norms: Propose new international norms for reducing existing stocks based on the decision of Japan's Atomic Energy Commission, and restrain reprocessing.**

Historically, various efforts have been made toward international management of plutonium. The initial wave was in the late 1970s and early 1980s following nuclear testing by India. The second wave was in the 1990s to early 2000s, when commercial use of plutonium was starting in earnest

[1]Under the Spent Nuclear Fuel Reprocessing Fund Act enacted in 2016, reprocessing businesses must be licensed by the government, and their reprocessing plans must be approved by the government. In the approvals process, in consideration of the plutonium balance, the views of the Atomic Energy Commission must be obtained, and the pace of reprocessing can be controlled based on those views.

(Endo, Takeda, 2019). The agreement reached in the course of the second wave was the "Guidelines for the Management of Plutonium" (INFCIRC/549).[2] These were voluntary guidelines by nine countries with holdings of separated plutonium, mainly about making public the amounts of these stocks in the interests of improving transparency.

As a principle of plutonium policy, the guidelines note the importance of "balancing supply and demand" in consideration of "reasonable working stocks," but do not touch on reducing stocks.[3] It is therefore proposed here that the international Guidelines for the Management of Plutonium be strengthened along the lines of the announcement by Japan's Atomic Energy Commission, "Basic Principles on Japan's Utilization of Plutonium" (July 2018) (Atomic Energy Commission, 2018) (Carlson, 2018; Suzuki, 2018). Specific ways this might be done include the following three.

1) Declare that existing plutonium stocks will be reduced, and make timely announcements of the plans for doing so.
2) Carry out reprocessing only in the amounts for which demand has been made clear.
3) For this purpose, publish a plutonium use plan before carrying out the reprocessing.

It is proposed that Japan play a leading role in spreading new management policies like the above to other countries beyond the nine that have adopted the guidelines, and in making them into new international norms.

3. International cooperation toward reducing existing stocks: Establish an international forum on the disposal of plutonium stocks.

[2]Guidelines on voluntary management of plutonium, agreed to in December 1997 by nine nations (USA, Russia, UK, France, China, Japan, Germany, Belgium, Switzerland). Besides indicating fundamental principles regarding the safety of plutonium management, nuclear nonproliferation, and nuclear security, it was decided that for improved transparency, the participating nations would annually report the volume of their own plutonium holdings (civilian-use plutonium and plutonium no longer required for defense purposes). The guidelines begin by noting the "inalienable right" of each State to the use of nuclear energy for peaceful purposes, along with their sovereign responsibility for the use and management of their plutonium holdings. Moreover, recognizing the potential for use of plutonium in the manufacture of nuclear weapons, each State agrees to take responsibility for management based on the guidelines.
https://www.iaea.org/sites/default/files/infcirc549.pdf

[3]The guidelines state the following under Policies for the Management of Plutonium.
"The Government of [State] is committed to management of plutonium in ways which are consistent with its national decisions on the nuclear fuel cycle and which will ensure the peaceful use or the safe and permanent disposal of plutonium. The formulation of that strategy will take into account: the need to avoid contributing to the risks of nuclear proliferation … ; the need to protect the environment, workers and the public; the resource value of the material, the costs and benefits involved and budgetary requirements; and the importance of balancing supply and demand, including demand for *reasonable working stocks* for nuclear operations, as soon as practical."

Current holders of large stocks of separated plutonium are the five nations Japan, the US, UK, France, and Russia (Table 1).

Table 1.

Separated Plutonium around the World

COUNTRY	Military use (tons)	Non-military use (tons)
Russia	94.0	91.5
United States	38.4	49.4
France	6.0	65.4
China	2.9	0.04
United Kingdom	3.2	110.3
Israel	0.9	
Pakistan	0.3	
India	6.6	0.4
North Korea	0.04	
Japan		47.0
Germany		0.5
Other non-nuclear weapon states *		1.8
Subtotal	152.3	366.3
Total	518.6	

Source: Research Center for Nuclear Weapons Abolition, Nagasaki University (RECNA) web site, http://www.recna.nagasaki-u.ac.jp/recna/bd/files/FMIe2018p.pdf

It is therefore proposed that an "International Forum on the Disposal of Plutonium Stocks" (provisional name) be established among the five countries and the IAEA, with each country announcing reduction plans and research and development plans, and identifying areas for mutual cooperation. It is further desirable that in this Forum, the US and Russia include as objects of disposal the plutonium defined as "excess" for military use.

The following specific proposals are possible. 1) As proposed by the UK, take custody of the plutonium of other nations that is in the UK for a fee, and dispose of it along with UK's plutonium; 2) As in the case of the US taking plutonium from Japan, have the original supplier nation in principle take custody of and dispose of it;[4] 3) Have France and Russia, which already have advanced combustion plans, take custody of the plutonium of other nations for a fee and dispose of it; 4) Jointly conduct technology development aimed at achieving burning or direct

[4]In 2014, the US agreed to take custody of Japan's plutonium supplied by the US and UK (331 kg used in a Fast Critical Assembly (FCA) reactor). (See the "Joint Statement by the Leaders of Japan and the United States on Contributions to Global Minimization of Nuclear Materials" of March 24, 2014, https://www.mofa.go.jp/dns/n_s_ne/page18e_000059.html). Final disposal, however, as with other US excess plutonium, is planned to take place in the Waste Isolation Pilot Plant in New Mexico (Japan Atomic Industrial Forum News, June 10, 2016, https://www.jaif.or.jp/160610-b [in Japanese]).

disposal. In Japan, the implementation of pluthermal plans for plutonium consumption as fuel is important as a short-term measure for reducing plutonium; but if the Rokkasho Reprocessing Plant were to go into operation, unless a minimum of at least 13 MOX-using reactors were realized, the reduction in plutonium would be limited (Shutaro Takeda, 2019). It follows that for achieving early reductions, an effective approach would be to carry out the plutonium stockpile reductions through international cooperation. In so doing, it will be necessary for plutonium moved to nuclear weapons countries to be subject to IAEA safeguards. In this case, however, from the standpoint of nuclear security, care must be taken so that transport of large volumes of plutonium is not necessary.

4. Give priority to dry storage for spent fuel management, and have a third party agency assess the options for the nuclear fuel cycle.

The two main options for spent fuel are direct disposal and reprocessing, but interim storage is essential regardless of which option is chosen. Obtaining storage capacity for spent fuel is a top priority issue of each country. From the standpoint of nuclear security, however, it is proposed that spent fuel be moved from storage pools to dry storage as early as possible. As for the handling of spent MOX fuel, use of dry storage should be carried out due to the high degree of uncertainty. In addition, although the Atomic Energy Commission conducted an overall assessment of nuclear fuel cycle options immediately after the Fukushima nuclear accident, no such assessments have been conducted since then. Moreover, the Atomic Energy Commission itself lost much of its credibility, such as by having staff from electric utility companies, who are concerned parties, serve in its Secretariat. It would be possible for the Atomic Energy Commission to carry out such assessment independently; but according to the Atomic Energy Basic Act, it is in the position of promoting nuclear energy use, raising questions about its objectivity. It is therefore proposed here once again to launch an objective comprehensive assessment project by a third party agency[5] in Japan from an independent position, which would look at all aspects including the advantages and demerits of reprocessing and the nuclear fuel cycle using fast-breeder reactors, assessment of the risks, the costs (including to society), the sustainability of policy including acceptance by society, the technical feasibility, impact on international security and nuclear nonproliferation, and the potential for technology transfer. This

[5]Past examples of such an agency include the Blue Ribbon Commission on America's Nuclear Future appointed by US President Obama to look into disposal of high-level waste; and in Japan, the Science Council of Japan, or the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC). To ensure functioning as a true third party agency, there would need to be legal backing, an independent secretariat and budget, and expert knowledge; and in the selection of members, strict criteria are demanded for appointing fair and unbiased persons.

project, over a period of around three years, would consider the preferable options and the best approach to future research and development (Suzuki 2019). It is important that this agency not have a prior position on nuclear energy use and the nuclear fuel cycle. The process should be designed with a highly democratic and transparent process, such as participation by members of the general public (Hwang, 2018).

5. Play a leading role in globally promoting new international norms for plutonium.

The Japanese Government continues to maintain the basic policy of promoting the nuclear fuel cycle, yet at a nuclear security summit, it has already declared its commitment to helping minimize global fissionable materials stocks (The Hague Nuclear Security Summit Communiqué, 2014). In moving to fulfill that commitment, by playing a leading role in making the above four points into new international norms, Japan can contribute to mitigating the risks associated with the world's plutonium stocks, while alleviating concerns about Japan's own plutonium holdings. In Northeast Asia, China is going ahead with construction of a commercial-scale reprocessing plant with French cooperation, and a growing list of countries, including South Korea and Saudi Arabia, are seeking to maintain their reprocessing rights. In this international situation, there would be great significance in Japan taking the lead in advocating for new international norms. It would further be desirable for Japan to begin studying issues it needs to deal with, such as the transfer of reprocessing technologies through bilateral treaties, and the handling of reprocessing itself.

This Working Group also intends to continue studying such topics as the following considered to have additional relevance.

1) International response to expansion of enrichment and reprocessing capabilities (bilateral and multilateral management initiatives, etc.)
2) Possibility of Japanese cooperation in North Korean denuclearization
3) Suggestions for multilateral management of the nuclear fuel cycle in Northeast Asia
4) Possible new approaches to nuclear disarmament, nuclear nonproliferation, and peaceful use of nuclear energy as we near fifty years since the Non-Proliferation Treaty (NPT) went into effect

References

1. Tetsuya Endo, Yu Takeda, "Draft plan for international management of plutonium," 2019 (Attachment 1) [in Japanese]

2. Shutaro Takeda, “Japanese Plutonium Balance Outlook to 2050: A Monte Carlo Approach.” Transactions of the American Nuclear Society, Vol. 120 (2019, in press). (Attachment 2)
3. Atomic Energy Commission, “Basic Principles on Japan’s Utilization of Plutonium” (decision by Atomic Energy Commission), July 31, 2018. http://www.aec.go.jp/jicst/NC/iinkai/teirei/3-3set.pdf (Attachment 3)
4. The Hague Nuclear Security Summit Communiqué, Netherlands, March 25, 2014. https://www.mofa.go.jp/files/000135986.pdf
5. John Carlson, “Mitigating Security Risks from Separated Plutonium: Some Near-Term Steps,” NTI Paper, March 2018. https://www.nti.org/media/documents/NTI_Paper_Mitigating_Security_Risks_FINAL-April2018.pdf
6. Jor-Chan Choi, “Reasonable Working Stocks at Reprocessing Plants,” in “Civil Plutonium Transparency in Asia,” Sharon Squassoni, Editor, The George Washington University, October 2018. https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/c/1963/files/2018/10/54368_GWU_low-2gp77wb.pdf
7. Fred McGoldrick, “IAEA Custody of Japanese Plutonium Stocks: Strengthening Confidence and Transparency,” Arms Control Today, Vol. 44, No.7 (September 2014). https://www.armscontrol.org/print/6555
8. Tatsujiro Suzuki, “Possible Options for International Management of Plutonium Stockpile,” in “Civil Plutonium Transparency in Asia,” Sharon Squassoni, Editor, The George Washington University, October 2018. https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/c/1963/files/2018/10/54368_GWU_low-2gp77wb.pdf
9. Tatsujiro Suzuki, “Nuclear Energy Policy after the Fukushima Nuclear Accident: An Analysis of ‘Polarized Debate’ in Japan,” IntechOpen, online journal, February 6, 2019. https://www.intechopen.com/online-first/nuclear-energy-policy-after-the-fukushima-nuclear-accident-an-analysis-of-polarized-debate-in-japan

Attachment

Attachment 1

2019年3月11日

プルトニウムをめぐる国際管理構想（案）

遠藤哲也・武田悠

１．はじめに

平和利用と軍事利用の垣根が低い原子力エネルギーに関しては、その垣根を乗り越えさせないための国際管理が模索されてきた。軍事利用されて核兵器が製造された際の影響の巨大さゆえに、1945年に米国が原子爆弾を製造し、広島と長崎に投下した直後から、様々な形での国際管理が唱えられてきたのである。

それゆえ早くも1946年には、核兵器や核物質、さらには原子力に関する活動の管理を検討すべく設置された国際連合（国連）原子力委員会の初回会合で、バーナード・バルーク米国代表が国際管理案を提案した[1]。これは国際原子力開発機関（International Atomic Development Authority：IADA）を新たに設置し、民軍双方の研究、原料、施設を独占的に管理させるという包括的な国際管理案であった。しかしIADAの活動が本格化するまでは当時唯一の核兵器国であった米国の核保有を認めていたため、既に米国との対立を深めつつあったソ連が反発して審議は行き詰まり、国連原子力委員会自体も1949年には活動を停止した。その後、1957年には国際的な原子力協力や核不拡散のための機関として国際原子力機関（International Atomic Energy Agency: IAEA）が設置され、その憲章にも国際管理についての規定が盛り込まれたが[2]、現実化されるには至っていない。

ただしその後も、国際管理の模索は続いた。特に軍事転用が容易なことから問題視されてきたプルトニウムに関するものに絞ると、その歴史には、2つの波がある。第一の波は、インドが平和利用を目的として取得した原子力資機材を使って核爆発装置を製造し、核実験を成功させた後の1970年代から1980年代初頭にかけて訪れた。それが収まった後、冷戦の終結や原子力エネルギーへの再度の注目に伴い、1990年代から2000年代にかけて第二の波が訪れた。第二の波も大きな成果を出すには至らなかったが、今もなお、原子力平和利用の核拡散リスクを抑えるべく国際管理は議論され続けている。

そこで問題となっているものの一つが、日本の持つ分離プルトニウムである[3]。エネルギー確保のために核燃料サイクルの整備を続けてきた日本では、原子力発電所（原発）から取り出した使用済み燃料を再処理し、再び利用できるプルトニウム等を分離してきた。その分離プルトニウム

---

[1] Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939/1946 (A History of the Atomic Energy Commission, Volume I)*, Pennsylvania State University Press, 1962, pp.531-619.

[2] 第3条（機関の任務）A、第9条（物質の供給）、第12条（機関の保障措置）Aに核物質等の国際管理を想定した条項がある。

[3] James M. Acton, "Time for a Nuclear Intervention With Japan," *Wall Street Journal*, May 15, 2017, https://www.wsj.com/articles/time-for-a-nuclear-intervention-with-japan-1494866950.

このような近年の議論を理解するため、本稿ではこれまでのプルトニウムに関する国際管理構想の歴史を紹介すると共に、今後どのような国際管理がありうるのかを検討する。それによって、日本のプルトニウム管理に関するより現実的な議論を期待したい。

2．第一の波：1970 年代～1980 年代初頭

（1） 米フォード政権下の多国間再処理構想

1940 年代に議論された国際管理構想が再び議論されるようになったのは、1974 年 5 月のインドによる核実験がきっかけであった[4]。この時インドは、平和利用を目的としてカナダから導入した重水炉や重水を使って抽出したプルトニウムで核爆発装置を製造し、平和的核爆発（Peaceful Nuclear Explosion：PNE）と称する地下核実験を成功させた。原子力平和利用の拡大が核の拡散につながりうることはもちろん、インドが核実験を行うであろうことも以前から予想されていたが、それが現実となったことで、米国をはじめとする原子力供給国は対応を迫られた。

主な対応策は、同年に開始されたロンドン供給国会議（後の原子力供給国［NSG］会議）であった。しかし NSG 会議は、独仏等のヨーロッパの新興供給国が米国、カナダ、オーストラリアというウラン資源国の唱える輸出規制の強化に反発し、実質的な成果を出すのが難しかった。

そのため米フォード政権は、多国間再処理構想も模索する[5]。これは、イランと日本に他国からの使用済み燃料も受け入れる多国間再処理施設を建設し、イランにパキスタン等の南西アジアでの、日本に韓国等のアジアでの再処理需要を引き受けさせるという計画である。プルトニウムを生産しうる再処理能力の拡散を、当時中東とアジアで米国にとって最も緊密な関係を持つ同盟国だった両国に限定しようというのが米国の企図であった。

しかし既に環境保護運動が活発化して原子力関連施設の新規立地が難しくなりつつあったうえ、当事国も消極的であり、この構想は頓挫した。原子力平和利用の拡大に伴う核拡散リスクにどう対応するかという問題は、この年の大統領選挙でフォードを破ったカーター政権に引き継がれた。

（2） 米カーター政権下の国際会議：INFCE

1977 年に発足したカーター政権は、インドが核開発に利用したプルトニウムの平和利用を問題視し、国際的にこれを規制しようとした[6]。そのため政権発足直後、各国の専門家を集めてプルトニウムの平和利用を中心とする既存の核燃料サイクルを再検討する国際会議 INFCE

---

[4] Michael J. Brenner, *Nuclear Power and Non-Proliferation: The Remaking of U.S. Policy*, Cambridge University Press, 1981, pp.62-105.

[5] 友次晋介「1970 年代の米国核不拡散政策と核燃料サイクル政策―東アジア多国間再処理構想と東海村施設を巡る外交交渉からの考察」『人間環境学研究』第 7 巻第 2 号（2009 年 12 月）、107-127 頁。

[6] 武田悠『「経済大国」日本の対米協調―安保・経済・原子力をめぐる試行錯誤、1975～1981 年』ミネルヴァ書房、2015 年、159-204 頁。

（International Nuclear Fuel Cycle Evaluation）を提案する。

この会議で米国は、プルトニウムが核拡散上危険であり、世界中の全ての国がプルトニウムを単体で抽出する既存の核燃料サイクルを中止すべきだという結論を出そうとしていた。しかし原子力平和利用の権利を重視する非同盟諸国、ソ連をはじめとする東側諸国、さらには日本や西欧諸国といった西側同盟国も反対し、核燃料サイクルの核拡散リスクは管理可能との結論に達して会議は1980年に閉幕する。当時の日本は近い将来に原子力供給国となるとみなされている受領国という独特の立場にあったため、規制強化を求める米国、それに反発する他の供給国、受領国たる途上国のいずれの勢力とも協議を続け、最終総会で報告書をとりまとめ、米国を国際協調重視の路線に引き戻す重要な役割を担った。

ただ、この会議を通じて、日本や西欧諸国は核燃料サイクルの核拡散リスクに対する米国の懸念には同意した。これが1980年代以降、輸出規制や保障措置、核物質防護の基準を厳格化するきっかけの一つともなった。こうした核不拡散の手段に関し、INFCEの報告書は国際制度、保障措置、技術の3つの措置が重要だと指摘している。このうちINFCEと同時並行で各国が熱心に取り組み、後に「ポストINFCE」と言われたのが、国際制度の創設すなわち国際管理の試みであった。

（3） ポストINFCE

ポストINFCEには主として3つの構想があった[7]。1978年から検討された余剰プルトニウムを国際管理するIPS（International Plutonium Storage）、1979年から検討された核物質、機器、技術、核燃料サイクルの供給を保証するCAS（Committee on Assurances of Supply）、同じく1979年から作業が始まった使用済み燃料の国際管理で必要になる貯蔵や輸送に関する技術的、経済的、制度的な検討を行うISFM（International Spent Fuel Management）である。

しかしこれらの構想はいずれも失敗した。最も具体化が進んだIPSで顕在化したように、問題は当時原子力発電の導入を検討していた途上国の反発であった。IPSは各国で原子力平和利用に伴って生じたプルトニウムを国際管理し、必要に応じて保有国が取り出すことのできる制度を目指していた。INFCEの検討作業や最終報告書でもたびたび言及され、核燃料サイクルの利用を認めつつも核不拡散を担保する有力な手段とみなされていた。そのためINFCE閉幕後、日本を含めた原子力供給国が主導して作業部会での検討が進み、具体案も作成された。

なお、日本もこの作業に積極的に参加している。当時は米国が、原子力協力協定に基づく事前同意権を強化するよう各国に求めていた。IPSはこの事前同意権を不要にすることも可能であったため、プルトニウム利用への過度な規制に反対する日本はこの国際制度を成立させるべく努力していたのである[8]。

---

[7] 武田悠『日本の原子力外交—資源小国70年の苦闘』中央公論新社、2018年、160-162頁。
[8] 外務省原子力課「IPSに関するポジション・ペーパー」1981年12月23日、戦後外交記録「IAEAプルトニウム国際貯蔵構想関係会議」2016-1834、外務省外交史料館。

しかしその後、IPS に注目が集まるにつれ、途上国も検討作業への参加を求めることになる。最終段階で実際に参加した途上国は平和利用の権利を主張し、IPS に預けるプルトニウムの定義や引き出す際の手続き等で供給国側と対立した。そのため供給国案と途上国案の 2 つが作成され、さらに途上国案に対する反発からスウェーデン等の一部の先進国が供給国案より更に核不拡散上の規制を強化した案を作成した。このため 1982 年に IAEA 理事会に提出された報告書は 3 つの案を併記したものとなり、そのままたなざらしとなった。

CAS と ISFM も、具体化する前に同様の経緯で成果を出せないままに終わった。非同盟諸国を中心とした途上国は、1970 年に発効した核不拡散条約（Treaty on the Non-Proliferation of Nuclear Weapons: NPT）が定める平和利用の「奪い得ない権利」を重視していた上、1973 年の第一次石油危機以降は現実に原発の導入を検討していた。そのため、国際管理による規制強化への反発はその後も続くこととなった。

3．第二の波：1990 年代～2000 年代

（1） プルトニウム利用の透明化

途上国の反発で頓挫した国際管理に関する議論は、冷戦終結と共に再び活発化した[9]。当時は、米ソの核軍縮に伴い、解体核兵器由来のプルトニウムが生じると予想されていた。また 1979 年のスリーマイル島、1986 年のチェルノブイリという 2 度の原発事故と原油価格の低落によって、1980 年代後半からは米国や西欧諸国で核燃料サイクルの開発が停滞し、プルトニウムの需要は低下していた。

こうした事情から、冷戦終結直後、プルトニウムの余剰が生じるのではないかという懸念が高まる。そこで米国や崩壊したソ連の核兵器、核物質等を引き継いだロシア、中国、日本等のプルトニウム保有国が 1992 年から協議を開始し、プルトニウム国際管理指針（INFCIRC/549）を作成した。

これは 1970 年代のような今後導入される核燃料サイクルも対象とした包括的な国際管理ではなく、既にあるプルトニウムという核物質に絞った、関係国のみが自発的に行う情報公開であった。こうして範囲を絞ったことによって、国際管理制度の設置が可能となった。

（2） 核燃料サイクルの国際化

その後、2000 年代に入ると原発の新規導入が国際的に再び検討されはじめる。地球温暖化問題への注目の高まり、石油価格の高騰、天然ガスの政治的利用等によって、地球温暖化に寄与せず、ある程度自立した発電が可能な原子力を導入しようとする途上国が増加した。アメリカ等の先進国でも、再び核燃料サイクルの研究開発が活発化しはじめ、この現象は「原子力ルネッサンス」と呼ばれた。

---

[9] 同上、211-215 頁。

このうち特に中東諸国の原発導入に関しては、紛争の絶えない地域ということもあり、核拡散につながりかねないという懸念があった。また1990年代には北朝鮮とイラクが秘密裏に核開発を進めていたことが明らかとなっており、2002年にはイランの核開発計画も暴露されていた。

そのため2003年、エルバラダイIAEA事務局長は核燃料サイクルの国際化を提案する。モデルとしたのは西ドイツ、イギリス、オランダが1973年に設立した多国籍濃縮企業ウレンコである。濃縮と再処理を多国籍企業の管理下に置き、経済性を向上させると共に、核不拡散を担保しようという構想であった。専門家会合による検討を経て、2005年3月にはIAEA理事会に報告書が提出され、国際的な核燃料供給保証や既存の施設の多国籍化が提案された。またこのエルバラダイ構想が口火となって、以後2000年代後半にかけて各国が様々な国際管理構想を提案している[10]。

しかしこれらの構想も、1970年代と同じくその多くが挫折した。新規の原子力導入国には濃縮と再処理を禁止し、その代償として核燃料の供給保証を提供することを想定していたため、導入を検討している途上国や市場を開拓したい中国やロシア等が反発し、合意が得られなかったのである。実現したのは市場が機能しない緊急時に限って供給を保証する国際ウラン濃縮センターと核燃料銀行のみであり、前者はロシアの国営企業ロスアトムが、後者はカザフスタンが運営することとなった。この他に米ブッシュ政権が次世代の核燃料サイクルを推進するべく提唱したGNEP（Global Nuclear Energy Partnership）も、次のオバマ政権によって米国内での取り組みは中止され、国際協力枠組みのみがIFNEC（International Framework For Nuclear Energy Cooperation）として存続しているが、情報交換等の活動にとどまっている。

４．日本のプルトニウムに関する議論

このようにプルトニウムに関係する原子力の国際管理構想は、なんらかの問題が生じると議論が活発化するが、具体論となると合意を形成できず失速する、というサイクルを繰り返してきた。それでも核拡散の深刻さに対する共通認識や核セキュリティに関する議論の高まりもあって、国際管理をめぐる議論は今なお消えていない。その議論の現在の論点の一つが、日本のプルトニウムである。

日本のプルトニウム利用政策は、国内に立地自治体の反対やもんじゅの廃炉、国外に中国の批判や米国の懸念等を抱えている。特に核不拡散に熱心な米国では議論が盛んで、日本のみならず核兵器国も含めた各国の余剰プルトニウムについて、INFCIRC/549の参加国を基にした国際フォーラムを設置し、需給バランスの維持やMOX燃料への加工によるリスク低減等を行動規範として採択すべきといった提案がなされてきた[11]。

また日本のプルトニウムに絞ったものとしては、これまでの国際管理構想の失敗を踏まえ、

---

[10] 小林直樹他『核燃料供給システムについての調査』JAEA-Review 2009-035、2009年9月、11-35頁。
[11] John Carlson, "Mitigating Security Risks from Separated Plutonium: Some Near-Term Steps," *NTI Paper*, March 2018, https://www.nti.org/media/documents/NTI_Paper_Mitigating_Security_Risks_FINAL-April2018.pdf.

IAEA 憲章第 12 条 A5 の規定を使い、日本のプルトニウムのうち余剰となったものを IAEA の管理下（custody）に置くという案も議論されている[12]。これは特定の期間内に使いみちがないと日本政府が特定したプルトニウムを、六ケ所村のような既にプルトニウムを取り扱っている場所で管理し、日本がこのプルトニウムを利用したい場合には使用予定や目的を記した書類を IAEA に提出するというものである。

このうち後者の国際管理案には、日本と IAEA が当事者となり、これまでの同種の構想でネックとなってきた途上国の反発を避けられる利点があるものの、余剰の定義や保管場所等、多くの問題も残されている。とはいえ、日本にとって最重要の同盟国である米国での議論は、日本のプルトニウム平和利用や原子力政策によって重要な意味を持っており、無視しえないように思われる

５．国際管理に関する試案

以上の経緯から、今後日本の保有するプルトニウムについても、国際管理を考えなければならない事態となることもありえよう。これまでに概観してきた国際管理構想の歴史と米国での現在の議論を踏まえると、ありうべき国際管理は以下のような形をとるのではないか。

まず国際管理の方式は、少数の関係国のみに絞ることになろう。多数の国を巻き込む国際管理に対しては、原子力平和利用の権利を重視する途上国の反対が一貫して強かった。そのため、例えば日本のプルトニウムであれば、当事国の日本、管理する IAEA、自国起源のプルトニウムについて事前同意権を持つ米国、日本のプルトニウムを再処理し保管している英仏の五者による協定が望ましいであろう。

次に貯蔵の方法については、現在英仏にあるプルトニウムを国際管理の対象とすることが最も実現可能性が高いであろう。それ以外の形をとると、国内外において新たにプルトニウムを移動させなくてはならず、多くの問題や経費、時間を要すると思われる。

また実際にどのプルトニウムを余剰とみなして国際管理下に置くかについては、管理と利用の双方に配慮した手続きが必要となる。すなわち、国際管理するべき余剰プルトニウムは日本が決定することとし、過剰な規制がかけられるのではないかという日本国内の不安に対処する。一方で余剰プルトニウムの定義や要件については、五者間の協定を締結する際に関係国や IAEA の意見も踏まえてあらかじめ決定しておき、国際的な核不拡散・核セキュリティへの要求に応えなくてはならない。

最後に、こうして国際管理の下に置かれたプルトニウムを引き出す手続きについても、同様の配慮が必要となる。例えば国際的な懸念に応えるため、引き出しの際に必要となるプルトニウム利用計画の基本概念を事前に決定しておく。現在の日米原子力協力協定において、施設に適用されるべき保障措置の基本概念が保障措置コンセプトとしてあらかじめ決定されているのと同じ

---

[12] Fred McGoldrick, "IAEA Custody of Japanese Plutonium Stocks: Strengthening Confidence and Transparency," *Arms Control Today*, Vol. 44, No.7 (September 2014), https://www.armscontrol.org/print/6555.

構図である。一方で実際の引き出しは手続きを利用する日本側の単なる通告とすれば、改めて利用を申請し、それをIAEAの事務局ないし理事会で審議するといった形をとらず、日本国内の利用制限に対する不安を解消させることができよう。

以上の案はあくまで試案にすぎない。ただ、どのような対応をとるにせよ、日本のプルトニウム利用に向けられる批判について考える際には、本稿で紹介してきた国際管理構想の歴史や現在の米国での議論等を踏まえる必要があろう。

Japanese Plutonium Balance Outlook to 2050: A Monte Carlo Approach

Shutaro Takeda*

** Graduate School of Advanced Integrated Studies in Human Survivability, Kyoto University, 1 Nakaadachi, Yoshida, Sakyo, Kyoto 606-8306, JAPAN: takeda.shutarou.55r@kyoto-u.jp*

INTRODUCTION

Japanese Policy on its Plutonium Stockpile

The concerns regarding the Japanese plutonium balance leapt to public attention again in the last few years due to the heightened nuclear security tension in the region. Amid the political tension, the U.S.-Japan Agreement for Cooperation on Peaceful Uses of Nuclear Energy, set to expire in July 2018, was renewed automatically under Trump administration; however, succumbing to the concerns on the plutonium stockpile, Japan Atomic Energy Commission (JAEC) publicly stated for the first time that "Japan will reduce the size of its plutonium stockpile [1]" right after the renewal on July 31, 2018. This is a significant statement since the Japanese reprocessing policy has been seriously undermined both by the Fukushima accident in 2011 and by the closure of the Monju fast breeding reactor in 2016. As a result, this renewal of the policy led to a concern if the Japanese government can actually reduce the plutonium stockpile while continuing its "total reprocessing" policy.

Preceding Studies

Scholars have raised concerns on the prospect of plutonium surplus in Japan since 1990s. Berkhout, Suzuki and Walker pointed out the possibility of the over-production of plutonium by Japan, presenting a forecast of Japanese plutonium production and consumption until 2010 [2]. Although the estimation method is robust and the scenario presumptions are off from the actual situation today, the study successfully illustrated the possibility of the plutonium over-production in Japan. More direct concerns were raised in the late 1990s by Manning [3] and Kitamura [4] among others, where political arguments were made that the plutonium over-production in Japan may be a proliferation risk in the region, albeit lacking quantitative discussions. This trend continued in 2000s, where more studies threw concern posed concerns about the Japanese plutonium policy. Turner reviewed the prospect of MOX (plutonium mixed oxide fuel) operation in Japan, while providing critical views on the policy in terms of safety and economic perspectives [5].

Notable recent studies on this matter include a report by Acton [6]. His report discussed the political issues surrounding this issue comprehensively while providing a very insightful observations on the MOX operation in Japan. Yet, Action did not choose to go on to provide quantitative considerations about the future prospect of Japanese plutonium balance in his discussions.

The Purpose of this Study

Based on the situation, what is needed the most for policy makers now would be a reasonable, neutral and grounded quantitative future outlook for the plutonium stockpile. While many preceding studies provides insightful qualitative discussions from political perspective, the author believe it is scientific quantitative analyses that would prove truly useful. For this reason, the purpose of this study is to conduct a quantitative reevaluation of the Japanese plutonium balance outlook to 2050 with a monte-carlo approach, taking the discussions by Acton [6] into the modeling to provide a neutral and grounded outlook.

METHOD

A simulation on the plutonium stockpile outlook requires two separate modeling efforts: 1) the modeling of the Japanese nuclear fuel cycle and 2) the modeling of nuclear power plant (NPP) operations capacities outlook in Japan until 2050.

Japanese Fuel Cycle Model

A nuclear fuel cycle is a system comprised of stocks and flows; thus, it is most suitable to be described as a system dynamics model by nature. A comprehensive nuclear fuel cycle model was constructed on Stella for this reason, based on publicly available statistical data to replicate Japanese nuclear fuel cycle. The constructed system dynamics model is shown in Fig. 1.

Key Modeling Assumptions

January 1st of 2018 was chosen as the starting point of the calculation, and the duration of the simulation was set to be 32 years, until January 1st of 2050, with the differential time of 1/4 years. Four essential capacities were chosen as the input variables: the operation capacities of the restarted NPPs, the capacity of the MOX operation, the Rokkasho reprocessing plant operating capacity and the J-MOX fuel fabrication plant operating capacity. Similarly, four essential stock values were chosen as the output results: the plutonium amount in MOX in Japan, the total plutonium amount, the spent MOX fuel amount and the total spent fuel amount.

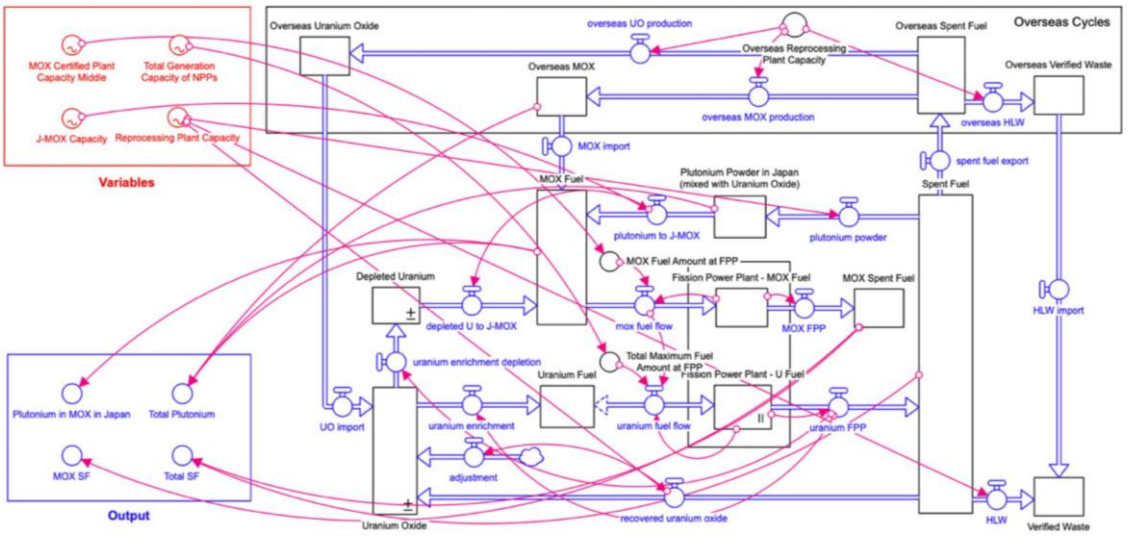

Fig. 1. System Dynamics Model of the Japanese Nuclear Fuel Cycle

Fuel Consumption and Replacement

Total loaded amount of nuclear fuel per rated capacity [ton/GW] and per electricity generation [ton/TWh] at light water reactors were calculated based on the statistical data by Kyushu Electric Power Company as 79.80 ton/GW and 9.11 ton/TWh, respectively [7]. It was assumed 28.57% of the fuel in every reactor will be replaced each year for all reactors. This is to replicate the replacement of one-third of the loaded fuel every 14 months, which is the standard procedure at Japanese NPPs. This leads to the nuclear fuel consumption rate of 2.58 ton/TWh, which is consistent with the statistics by FEPC [8]. For MOX operation, it was assumed all MOX-operation reactors would load MOX fuel for 25% the core loading.

Reprocessing

Out of one ton of spent fuel, it was assumed 10 kg of plutonium, 130 kg of uranium fuel, 810 of depleted uranium and 50 kg of HLW will be extracted at Rokkasho, considering the Pu-241 depletion [9]. For simplicity, this model does not distinguish fissile and non-fissile plutonium, and all MOX fuels are assumed to contain 10% of plutonium.

Initial Values

The initial amount (the amount at the end of 2017) of the separated plutonium in Japan were taken from Cabinet Office Nuclear Policy Office as 3,863 kg at the reprocessing plant as 3,854 kg at the MOX fabrication facility (in total of 7.72 ton) [9]. The initial amount of the MOX was taken from the same literature as 28.29 ton (or 2.83 ton-plutonium). The initial processed plutonium amount stored overseas was assumed as 36.718 ton-plutonium [9].

Validation

The validity of the model was tested against FAMILY-21 simulation code developed by JAEA, and it was confirmed the results of the system dynamics model saw good fits to the results of FAMILY-21.

NPP Operating Capacity Modeling

The future outlook of NPP operations in Japan is highly uncertain given that the restarting of NPPs is more a political issue than a technical one. For this reason, the authors used a monte carlo approach to estimate the probabilistic outlook of the capacities of NPP and MOX operation until 2050.

Key Modeling Assumptions

In this calculation, it was assumed that no new reactors will be constructed until 2050 in Japan, and that the lifetime of all reactors are 60 years. The NPPs are classified into two groups: MOX accepting reactors and non-MOX accepting reactors. The name, rated power, type of the reactor, starting year of operations of each category are summarized in Table I and II, respectively.

Since predicting the restarting trends of NPPs are highly difficult due to its political nature, this study will calculate the outlook of NPP operation in Japan based through a simple monte carlo method. The outlook will be calculated in form of probability distributions based on 10,000 trials. Assumptions for MOX accepting and non-accepting reactors are summarized in the following section.

Operation Capacity of MOX Accepting Reactors

In his report in 2015, Acton conducted detailed field analysis to give each MOX accepting reactors with "prospect" ratings from 1 to 7: by definition, the rating n are related to Acton's estimate of the probability that a reactor will be available for MOX burning operation by 2023 simply by p = (n -1)/6. The author then converted this rating into the probability of the given MOX accepting reactor to start its operation for a given year by q = 1 – [1 - (n - 1)/6]^1/7.

Table I. Considered MOX Accepting Reactors

Name	Power [MW]	Year	Probability of MOX Operation [per year]
Tokai Daini	1,100	1978	2.57%
Tsuruga No. 2	1,160	1987	2.57%
Ohma	1,383	-	9.43%
Tomari No. 3	912	2009	14.52%
Onagawa No. 3	825	2002	14.52%
Kashiwazaki No. 3	1,100	1993	2.57%
Kashiwazaki No. 6	1,356	1996	0%
Kashiwazaki No. 7	1,356	1997	0%
Hamaoka No. 4	1,137	1993	2.57%
Shiga No.1	540	1993	5.63%
Takahama No. 3	870	1985	22.58%
Takahama No. 4	870	1985	22.58%
Ohi No. 3	1,180	1991	22.58%
Ohi No. 4	1,180	1993	22.58%
Shimane No. 2	820	1989	14.52%
Ikata No. 3	890	1994	22.58%
Genkai No. 3	1,180	1994	22.58%

Operation Capacity of Non-MOX Accepting Reactors

The new safety regulation for NPPs came into force in Japan on June of 2013. Since then, 28 out of 51 reactors submitted an application to recertification; 14 out of the 51 were closed for decommission; out of the 28 applications, 15 were approved; and finally, out of the 15 approved reactors, 9 has started its operation again by the end of 2018 [10]. This leads to the chances that a given stopped NPP can apply for the recertification is 13.48% for a given year; the application gets through with a probability of 13.02% each year after the application; and that 19.39% of the certified NPP can start operation again for a given year after the certification.

In order to simplify the outlook, the author assumed all non-MOX accepting NPPs in Japan to restart based on the probabilities calculated above.

Table II. Non-MOX Accepting Reactors (Stage 0: not applied, 1: under review, 2: recertified, 3: in operation)

Name	Power [MW]	Year	Restarting Stage
Tomari No. 1	579	1989	1
Tomari No. 2	579	1991	1
Onagawa No. 2	825	1995	1
Higashi-Dori	1,100	1998	1
Kashiwazaki No. 1	1,100	1985	1
Kashiwazaki No. 2	1,100	1990	0
Kashiwazaki No. 4	1,100	1994	0
Kashiwazaki No. 5	1,100	1990	0
Hamaoka No. 3	1,100	1987	1
Hamaoka No. 5	1,380	2005	0
Shiga No. 2	1,358	2006	1
Mihama No. 3	826	1976	2
Takahama No. 1	826	1974	2
Takahama No. 2	826	1975	2
Shimane No. 3	1,373	-	1
Genkai No. 2	559	1981	0
Genkai No. 4	1,180	1997	3
Sendai No. 1	890	1984	3
Sendai No. 2	890	1985	3
Sendai No. 3	1,590	-	0

RESULTS

NPP Operating Capacity Outlook

The outlook of the operating capacity of NPPs (Total and MOX) in Japan to 2050 was estimated as Fig. 2. (For the legends of the graph, please see Fig. 3.)

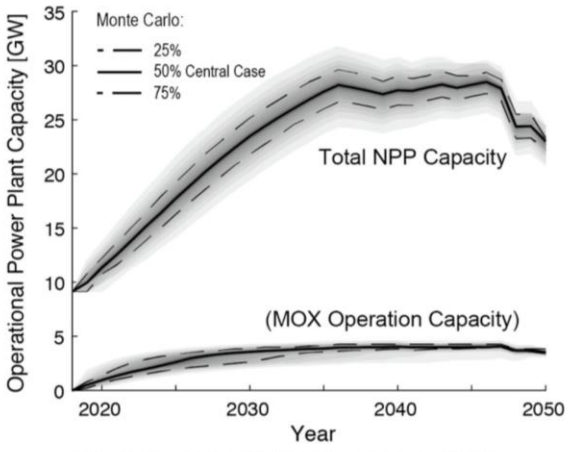

Fig. 2. Outlook of NPPs Operation to 2050.

Japanese Plutonium Stockpile Outlook

The outlook of the Japanese Plutonium Stockpile was calculated as a probability distribution as Fig. 3. The solid line shows the central case of the monte carlo calculation, while the dotted lines show the quarterly cases; i.e., the probability of the plutonium stockpile to stay between the two dotted lines is estimated to be 50%. While the outlook shows a wide range of estimation, Fig. 3 shows a declining trend in the Japanese Plutonium stockpile.

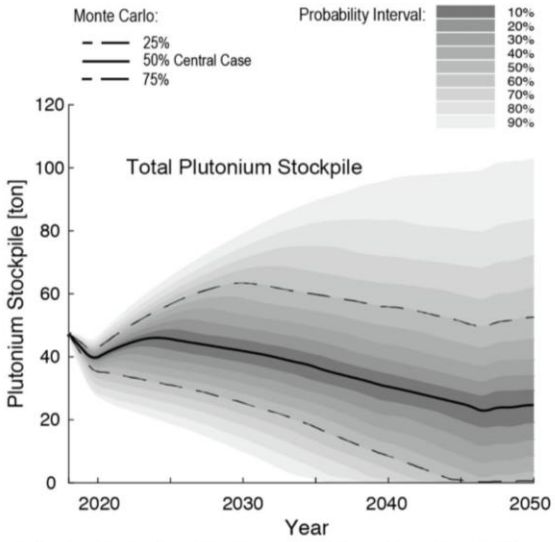

Fig. 3. Outlook of the Japanese Plutonium Stockpile to 2050.

The outlook of the amount of the spent fuel was similarly calculated to 2050, with the uranium and the MOX spent fuel separated, as Fig. 4.

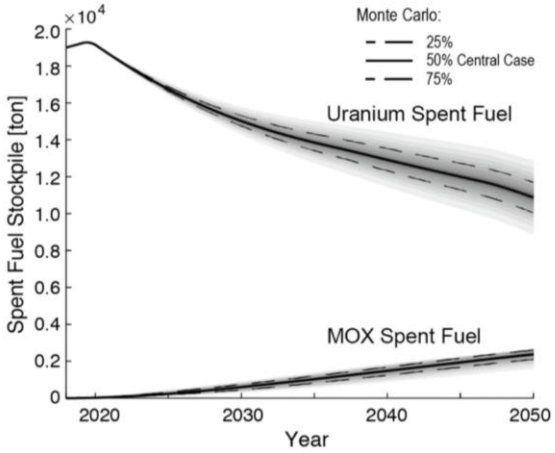

Fig. 4. Outlook of the Spent Fuel Stockpile to 2050.

DISCUSSIONS

This study quantitatively estimated the future Japanese plutonium stockpile though a monte carlo approach to give a neutral outlook to 2050. The results indicated that;

1) The probability that the Japanese government keeps its promise of reducing the plutonium stockpile without changing its reprocessing policies is around 60%.

2) The peak amount of accumulated plutonium was observed around 2024. Therefore, while the current plutonium imbalance in Japan is certainly a point of concern for now, it is likely that the plutonium imbalance in Japan would not pose a long-time proliferation threat to the region.

3) The Japanese government may have to suppress the operation of Rokkasho reprocessing plant from the start. Given the strong opposition expected from the local representatives in case of enforcing such policy, it might be desirable to consider a prospect of utilizing Rokkasho to embrace foreign spent fuel to occupy the surplus capacity.

ACKNOWLEDGEMENTS

This research was funded by The Sasakawa Peace Foundation. The author acknowledges Prof. Takeshi Sakade and Prof. Hideki Iwaki for their invaluable feedbacks.

REFERENCES

1. JAPAN ATOMIC ENERGY COMMISSION, *The Basic Principles on Japan's Utilization of Plutonium*, JAEC, Tokyo, Japan (2018).
2. E. BERKHOUT et al., "The approaching plutonium surplus: a Japanese/European predicament," *International Affairs*, **66**, 3, 523 (1990).
3. R. A. MANNING, "Rethinking Japan's Plutonium Policy: Key to Global Non-Proliferation and Northeast Asian Security," *The Journal of East Asian Affairs*, 9, 1, 114 (1995).
4. M. KITAMURA, "Japan's plutonium program: A proliferation threat?," *The Nonproliferation Review*, 3, 2, 1 (1996).
5. W. D. TURNER, "Japanese plutonium stockpiles: a transportation, storage, and public relations challenge," *The Journal of Environment & Development*, 12, 1, 99 (2003).
6. J. M. ACTON, "Wagging the Plutonium Dog: Japanese Domestic Politics and Its International Security Implications," Vol. 29, Carnegie Endowment for International Peace (Sep. 2015).
7. Kyushu Electric Power Company: http://www.kyuden.co.jp/nuclear_outline_index.html (current as of Oct. 31, 2018).
8. THE FEDERATION OF ELECTRIC POWER COMPANIES OF JAPAN, *Nuclear 2010 [The Consensus]*, FEPC, Tokyo, Japan (2010).
9. NUCLEAR POLICY OFFICE, *The 27th Japan Atomic Energy Commission: Plutonium Management in Japan*, Cabinet Office, Tokyo, Japan (2018).
10. Nuclear Regulation Authority of Japan: http://www.nsr.go.jp/english/index.html (current as of Dec. 30, 2018)

Attachment 3

The Basic Principles on Japan's Utilization of Plutonium

July 31, 2018
Japan Atomic Energy Commission

Japan has been using nuclear energy exclusively for peaceful purposes and upholding the principle of not possessing plutonium without specific purposes under the Atomic Energy Basic Act. While taking into account recent circumstances surrounding the use of nuclear energy not only in Japan but also in the world, Japan, cooperating with the international community and attaching greatest importance to nuclear non-proliferation, follows the policies below as it promotes the utilization of plutonium, in order to enhance transparency of its peaceful use.

Based on the above-mentioned views, Japan will reduce the size of its plutonium stockpile. Based upon the realization of the following measures, the stockpile is not to increase from the current level:

1. Approve reprocessing plans under the Spent Nuclear Fuel Reprocessing Implementation Act so that reprocessing is to be carried out only to an extent necessary for steady pluthermal power generation, reflecting the operational situation of the Rokkasho Reprocessing Plant (RRP), the MOX Fuel Fabrication Plant,* and MOX-burning reactors; Instruct the operators and confirm that the produced MOX fuel is to be fully consumed in a timely manner;
2. Instruct the operators so as to secure a balance between demand and supply of plutonium, minimize the feedstock throughout the process between reprocessing and irradiation, and reduce the feedstock to a level necessary for proper operation of the RRP and other facilities;
3. Work on reducing Japan's plutonium stockpile stored overseas through measures including promoting collaboration and cooperation among the operators;
4. Examine all options such as use and disposal of plutonium that is associated with research and development purposes, if there is no concrete plan for its immediate use, while ensuring flexibility depending on the situations; and
5. Steadily promote efforts toward expanding storage capacity for spent fuel.

In addition, in order to enhance transparency, electric utilities and Japan Atomic Energy Agency (JAEA) are expected to develop plutonium utilization plans anew, which describes owners, the amount of plutonium in possession and the purposes of plutonium utilization, and then release them every fiscal year.

*The Japan Nuclear Fuel Limited (JNFL) plans to complete the construction of the RRP and the MOX Fuel Fabrication Plant in the first half of FY2021 and FY2022 respectively.


SASAKAWA PEACE FOUNDATION