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Back-end to the Future: Some Safeguards Considerations for Multinational Geological Repositories

Cindy Vestergaard, Director of the Nuclear Safeguard & Blockchain in Practice Programs

James Casterton, Nonresident Fellow

Abstract

The responsibility of countries to manage and dispose of their own spent fuel and radioactive waste does not preclude a collaborative approach. The economies of scale of multinational geological repositories (MGRs) would benefit not only countries without suitable geological conditions or those with small waste volumes but also the nuclear non-proliferation regime given material would be consolidated at fewer sites. Existing nuclear cooperation agreements (NCAs) may be sufficient for participation in an MGR but there may be a few elements that would require further clarification. Additionally, new NCAs for MGRs may have to be negotiated among participants in line with international, multilateral and bilateral treaty obligations while addressing complexities specific to shared geological facilities, such as transport and transfer of ownership. The long timelines of underground disposal also require the forecasting of several 'what ifs' regarding the future global political landscape and its nuclear risks. Raising more questions than answers, this working paper considers some safeguards implications for MGRs, particularly focusing on potential scenarios where safeguards agreements may no longer apply; but also, how they may be shifted, and the potential for the current (and future) nuclear non-proliferation regime to respond.

Introduction

Geological repositories have long been considered the safest option for long-term isolation and permanent disposal of nuclear waste. Although it is recognized that States are responsible for their own waste management and disposal, the principle does not preclude multilateral collaboration, particularly for countries without suitable geological conditions or those with waste volumes too small for national repositories to be practical. Over the past forty years, a variety of models for multinational geological repositories (MGRs) have emerged, each underscoring how consolidating nuclear waste at fewer sites globally would benefit not only economies of scale and size, but also non-proliferation and international security. At the same time, there has been little study on the non-proliferation obligations that would accompany MGRs, particularly those arising from the network of bilateral nuclear cooperation agreements (NCAs) that have evolved over time and are in addition to international treaty requirements which shape global nuclear trade. These treaty-level mechanisms are additional to IAEA

safeguards and provide further assurances of peaceful uses and could have wide-ranging implications for a multinational repository.

This working paper is a part of the Stimson Center's 'Back-end to the Future' project and the second in a series considering non-proliferation approaches for MGRs. The long timelines of underground disposal require the forecasting of several "what ifs" regarding the future global political landscape and its nuclear risks. It will particularly focus on potential scenarios where safeguards agreements may no longer apply, but also how they may be shifted, and the potential for the current (and future) nuclear non-proliferation regime to respond.

Multinational Geological Repositories

Over the past forty years, various scenarios for shared repositories have been put forward by a number of studies and initiatives, whether international, multinational or national. In each, repositories could be located on national territory or in an extraterritorial area, but they diverge in management and ownership structures. Multinational geological repositories (MGRs) could be characterised by participating (partner) countries that jointly develop a repository framework with or without a host country.[1] Whether a host would be identified at an early or later stage, all financial and administrative responsibilities could be placed in a multinational group with participation restricted to a select group of States or on a commercial basis from other countries.[2] Alternatively, an 'add-on scenario' could be envisioned where a host country developing its own national repository accepts nuclear material from other countries at a later stage.[3] In this case, the host country would drive the process and would require a national framework to receive nuclear waste from abroad.[4]

Whether nationally or multilaterally driven, MGRs would allow for the sharing of technology and may provide greater degree of supply assurances. At the same time, they would reduce proliferation and security risks by consolidating nuclear material at fewer sites and harmonising approaches to waste management. MGRs would also offer benefits in economies of scale (both capital and operating costs) and would provide more transparency than their national counterparts, but they also face greater administrative challenges, taking them longer to establish.[5]

MGRs could be specifically designed, sited and constructed to create high levels of security that would benefit the host country, partner countries, and international security. One of the challenges however

[1] IAEA, Framework and Challenges for Initiating Multinational Cooperation for the Development of a Radioactive Waste Repository, IAEA Nuclear Energy Series, No. NW-T-1.5, Vienna, 2016, p. 7.
[2] IAEA, "Waste Management and Disposal: Report of INFCE Working Group 7," International Fuel Cycle Evaluation (INFCE), Vienna, 1980, p. 112.
[3] IAEA, Developing multinational radioactive waste repositories: Infrastructural framework and scenarios of cooperation, IAEA-TECDOC-1413, October 2004, p. 16-17.
[4] IAEA, Developing multinational radioactive waste repositories: Infrastructural framework and scenarios of cooperation, IAEA-TECDOC-1413, October 2004, p. 19.
[5] IAEA, "Waste Management and Disposal: Report of INFCE Working Group 7," International Fuel Cycle Evaluation (INFCE), Vienna, 1980, p. 113.

will be the harmonisation of bilateral safeguards requirements and how they relate to material subject to existing or new bilateral nuclear cooperation agreements (NCAs).

Nuclear Cooperation Agreements

Nuclear cooperation agreements (NCAs) are generally bilaterally negotiated agreements that are additional to IAEA safeguards agreements and which provide further assurances of peaceful uses for items transferred pursuant to the agreement as well as items derived from transferred items. Given IAEA safeguards are generally not concerned with origin attribution, several suppliers employ NCAs to account for, and add controls to, the use of all the nuclear material, nuclear facilities, equipment and technology that they export, including on any nuclear material generated through the use of exported items. Although not all suppliers have legal or policy requirements for NCAs, countries such as Australia, Canada, Japan and the United States require them to be in place before nuclear trade is permitted. Others, such as Russia, Japan and South Korea, do not have legal requirements for NCAs but have entered bilateral NCAs with other countries to govern the exports of nuclear and nuclear-related materials.[6]

With respect to nuclear material, NCAs include information-sharing measures to track material, essentially attaching bilateral reporting obligations or 'flags' to material as it moves globally through the nuclear supply chain. These obligations can begin with the export of yellow cake and continue to cover produced plutonium which is in spent fuel or recovered from it. The fact that many countries require an NCA as a condition of supply has led to a situation whereby obligations from several suppliers can apply to the same item. Natural uranium originating in one country, for example, may acquire additional obligations as it is subsequently processed in other countries. With progress slow in the development of final disposal facilities, it is perhaps not surprising that spent nuclear fuel is treated like any other item subject to NCAs. There are no special or additional requirements that must be met – whether the spent fuel is located in a spent fuel bay at the reactor site, in a dry storage facility above ground or in a deep geological repository.

Features common to all NCAs generally include:

- a peaceful, non-explosive use commitment;
- IAEA safeguards on items subject to the agreement;[7]
- fallback safeguards in the event that a situation arises where the IAEA is unable to administer its safeguards functions;
- controls on retransfers of items subject to the agreement;
- controls on reprocessing and enrichment; and

[6] Pillsbury, "Nuclear Export Controls: A Comparative Analysis of National Regimes for the Control of Nuclear Materials, Components and Technology," October 2012: https://www.nei.org/CorporateSite/media/filefolder/resources/reports-and-briefs/Nuclear-Export-Controls-Pillsbury-201210.pdf.

[7] For non-nuclear weapon States, there is generally a requirement for IAEA safeguards on the full scope of the State's nuclear activities. For nuclear weapon States the safeguards requirement is met by a voluntary offer pursuant to which the IAEA can implement safeguards at selected facilities.

- assurances of adequate physical protection

In addition, some NCAs include provisions for the right of suppliers to require the return of supplied items if there is a determination of non-compliance or repudiation of IAEA safeguards. This, however, would be almost impossible to implement once the emplacement of spent nuclear fuel or backfilling and closure of the repository has taken place.

The establishment of MGRs would not likely require a revision of these provisions, but it could be expected that they would need to be more expressly clarified and strengthened, particularly when considering the following two scenarios.

Scenario 1: The IAEA is unable to implement safeguards

In this scenario, the IAEA may be unable to implement safeguards in the event: 1) a State withdraws from the NPT; 2) the NPT falls into disrepute or; 3) the IAEA ceases to exist. The commitment to the peaceful uses of nuclear energy for supplied and derived items would remain in effect for countries with NCAs in force, but the removal of international oversight may undermine confidence that the commitment is upheld. NCAs address this potential scenario by including the provision for the continuity of safeguards, or 'fallback safeguards.'

Currently, the provision for fallback safeguards generally requires parties to promptly conclude an agreement equivalent to the Agency's safeguards system in the event the IAEA is not able to carry through its mandate. Australia's NCAs require "other safeguards arrangements" that will replace those applied by the Agency to "provide safeguards equivalent in scope and effect to those provided by a NPT safeguards agreement."[8] Japan and the United States stipulate fallback arrangements "which conform to the Agency's safeguards principles and procedures."[9] Canada's agreements with Kazakhstan, Mexico and the UAE similarly apply equivalency if the IAEA is not administering safeguards "for any reason or at any time." These agreements state that the parties shall conclude an agreement equivalent in scope

[8] See Article VI of the *Agreement between the Government of Australia and the Government of the Czech Republic on Cooperation in Peaceful Uses of Nuclear Energy and the Transfer of Nuclear Material*, Prague 27 July 2001 (Entry into force 17 May 2002): http://www.austlii.edu.au/au/other/dfat/treaties/2002/8.html and Article V of the *Agreement between the Government of Australia and the Government of Canada Concerning the Peaceful Uses of Nuclear Energy*, Ottawa, 9 March 1981 (Entry into force 9 March 1981).

[9] Article XI of the US-Canada agreement states: "effective continuity of safeguards…which conform to the Agency's safeguards principles and procedures…which provide assurances equivalent to that intended to be secured by the safeguards system they replace." Agreement for Cooperation Concerning Civil Uses of Atomic Energy Between the Government of the United States of America and the Government of Canada, July 1955 (as amended). Article 8 (3) of the Japan-Euratom agreement states that if rectifying measures are absent, the parties "shall immediately enter into arrangements which conform to safeguards principles and procedures of the Agency and provide effectiveness and coverage equivalent to that intended to be provided by the safeguards of the Agency." Agreement Between the Government of Japan and the European Atomic Energy Community for co-operation in the peaceful uses of nuclear energy: http://ec.europa.eu/world/agreements/downloadFile.do?fullText=yes&treatyTransId=5281

and effect to IAEA safeguards being replaced or a safeguards system conforming to the principles and procedures set out in the IAEA document INFCIRC/66 (and its subsequent amendments).[10]

India, a country that also requires an NCA before nuclear trade but is not a party to the NPT, is less concerned with equivalency. Its agreements with Australia, Canada, Japan and the United States all state that if the IAEA decides the application of its safeguards are no longer possible, the parties "should" (or "shall" in the case of the agreements with Japan and Australia) "consult and agree on appropriate verification measures." [11] [12] [13]

While a separate study would be needed on the framework and risks associated with MGRs in States that possess nuclear weapons, the current system of NCAs demonstrates how provisions for fallback safeguards should be negotiated and clarified once a decision has been taken to create an MGR.

Negotiations could involve the host State, the multinational body administering the MGR and stakeholder countries. One could imagine provisions that would allow for inspections by a State attaching obligations to nuclear material in the repository, by the multinational body, and/or by other countries participating in the MGR.[14] If fallback safeguards were left unclarified until after a situation led to the IAEA being unable to implement safeguards, the host State (and/or MGR administrative body) would have to undertake parallel and lengthy negotiations with partners and potentially with several other States that have obligated material in the host country. It would also leave room for disagreement and lack of consensus that could result in safeguards coverage at the lowest common denominator (and therefore not likely considered equivalent to IAEA safeguards). It could also result in a mixed safeguards regime for the repository where negotiations with one country results in explicit measures and higher assurances for peaceful uses than another.

To address this possible development, the legal framework establishing the MGR could be strengthened by including a commitment by the host country and the partner countries to undertake measures at the facility designed to verify the peaceful use commitment and to provide credible assurance of non-diversion and absence of any undeclared activities. These measures could be supported financially and logistically by the host country and all partner countries. The host country, particularly if it is a nuclear weapon State (NWS), may undertake to bear a disproportionate share of the costs involved. Such measures would be in addition to those undertaken by the IAEA as part of the requirements between

[10] See: Article 7 (3), Agreement Between the Government of Canada and the Government of the Republic of Kazakhstan for Co-operation in the Peaceful Uses of Nuclear Energy, E105212 and Article 9 (3), Agreement Between the Government of Canada and the Government of the United Arab Emirates for Cooperation in the Peaceful Uses of Nuclear Energy, E105360, and Article VI (3) (b) of NCA with Mexico and Canada.

[11] Article 8 (6), Agreement between the Government of Canada and the Government of the Republic of India for Co-operation in the Peaceful Uses of Nuclear Energy, **E105192,** https://www.treaty-accord.gc.ca/text-texte.aspx?id=105192

[12] Article 4 (3), Agreement Between the Government of Japan and the Government of the Republic of India for Cooperation in the Peaceful Uses of Nuclear Energy, https://www.mofa.go.jp/mofaj/files/000202920.pdf

[13] Article VII (5), Agreement between the Government of Australia and the Government of India on Cooperation in the Peaceful Uses of Nuclear Energy, http://www.austlii.edu.au/au/other/dfat/treaties/ATS/2015/9.pdf

[14] It was common for NCAs to include bilateral inspections before the NPT was established. For example, Canada's Atomic Energy Control Board (AECB) carried out inspections in the late 1960s in France, Federal Republic of Germany, India, Japan, Pakistan, Switzerland, United States and United Kingdom to verify that materials of Canadian origin supplied abroad were used for peaceful purposes only. See: Cindy Vestergaard, *Governing Uranium in Canada*, DIIS Report 2015:12, p. 41.

the host country and the Agency. They could involve cost sharing with the Agency to purchase, use and maintain safeguards equipment required by the IAEA pursuant to its safeguards approach for the MGR and relevant to the MGR's independent verification programme. However, they could also include measures additional to those required by a safeguards agreement designed to give enhanced assurance on the location of the nuclear material in the repository and on the continued non-proliferation, security, safety and environment aspects after the repository has been completely back-filled and closed. These measures could include ongoing geophysical, radiological and environmental monitoring.

Scenario 2: What if the host state withdraws from the NPT or the NPT ceases to exist?

Like the first scenario, a host State withdrawing from the NPT or the NPT ceasing to exist could lead to the situation whereby the IAEA is unable to administer safeguards. However, equally important, this situation would remove the host State's international commitment to the peaceful, non-explosive use of nuclear energy, leaving only the peaceful use commitment vested in various bilateral NCAs. NPT withdrawal would negatively impact relations between the host country, the multinational body administering the MGR and/or participating countries. Even if the previous safeguards regime remained in place on items subject to an NCA in the host country, it may no longer be considered effective given the lack of peaceful non-explosive use commitment vested in the NPT. Furthermore, political and public pressures would likely preclude any further cooperative endeavours with the host country, including the continued participation in the MGR.

To help address the lack of an internationally agreed commitment to peaceful use, similar to the proposal regarding safeguards noted previously, such a commitment could be vested in the MGR arrangement itself. According, in establishing the institutional, legal and financial framework necessary to support the MGR, provisions in the legal documentation could include a commitment to peaceful, non-explosive use for the facility and the nuclear material consigned to the facility. The commitment would pertain most particularly to the host country (whether a possessor of nuclear weapons or not) and to all MGR partners. The commitment would cover the lifetime of the repository, including after it had been backfilled and closed.

Finally, it is worth noting that while existing IAEA safeguards policy considers that safeguards will continue to be applied when the repository is backfilled and closed; i.e., safeguards will not be terminated, such material could be removed from the inventory of an NCA if both Parties could agree to the terms and conditions for such removal. Although maintaining inventories of obligated nuclear material in a closed repository may be seen as having little value, the agreement to remove the material from the inventory would certainly have to take account of public concerns in each country party to the agreement. The question is how could those concerns be addressed in whole or in part?

If either of the scenarios noted above play out as suggested the overall non-proliferation framework provided by an NCA would be weakened. It could result in a less desirable commitment to nuclear non-proliferation by the host country and less safeguards coverage on the items transferred to the repository.

The existence of provisions dealing with a commitment to peaceful, non-explosive use and with a mechanism to verify that commitment in the institutional, legal and financial framework establishing the MGR would be significant in addressing the requirements of NCAs pertaining to: (1) the peaceful, non-explosive use of items consigned to the repository; and (2) the agreement for a fallback safeguards regime should the IAEA be unable to implement safeguards at the facility. This MGR framework may also be useful for justifying the removal of material from NCA obligations when the repository is closed.

For Further Consideration

The development of MGRs is complex in their need for foresight of potential political and proliferation risks that may arise. This draft briefly describes two potential scenarios which raise further questions and scenarios such as: what types of safeguards requirements should be applied to transit/transhipment States? What are the different considerations for safeguards if an MGR is located in a nuclear weapons State (NWS) or a non-nuclear-weapon State (NNWS)?

The long timelines of MGRs present a higher risk for disposal facilities outliving international treaties and institutions than for other nuclear facilities. Assuming MGRs are built during the non-proliferation regime in place today and in a host State with a strong record on non-proliferation, the continuity and equivalency of IAEA safeguards would remain a priority – even more so when considering that IAEA policy has long considered spent fuel as 'inherently retrievable', even after emplacement in a geological repository.[15] The safeguards architecture of an MGR and the NCAs that would support it would provide a collaborative approach to ensuring a strong, clarified and enforceable commitment to peaceful, non-explosive use in the management and disposal of spent fuel and radioactive waste.

[15] Permanent SNF disposal therefore means the permanence of IAEA safeguards for as long as the safeguards agreement with a State is in force.