

Confidence Building Measures for a Multinational Geological Repository

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Abstract

Many countries now have an interest in the possibility of sharing in the development of a multinational repository (MNR) for their higher activity radioactive wastes, or in using such a facility were one to be offered. Owing to its multi-state nature and potential multi-decade operational period, an MNR will bring with it a range of concerns about assurance of long-term nuclear security. These concerns, which will be felt not only by the user and provider countries but also by the wider international community, can be addressed in part by conventional technical monitoring, as used to ensure nuclear safeguards, but they also require additional 'confidence building measures' (CBMs) – a concept pioneered in the arena of multilateral arms control. This paper explores how CBMs might realistically be applied to an MNR project and suggests a range of CBMs that will strengthen commitment by users and providers, deal with third-party (including public) interests and address unlikely scenarios where user/provider responsibilities are not upheld. It concludes by suggesting that all of the proposed CBMs would be vastly enhanced, as would the MNR concept itself, were the IAEA to take a central and active role as champion and possibly owner of an MNR project.

Introduction

The international consensus is that all countries utilizing nuclear energy have a responsibility to dispose safely of radioactive materials for which there are no further uses. Highly active and long-lived wastes and spent nuclear fuel require emplacement in a deep geological repository (DGR). However, constructing such a repository is a complex, resource-intensive and politically sensitive undertaking that has so far proved an insurmountable challenge to almost every country that has sought to build one.

The financial and technical resources required to construct a DGR mean that some countries are now considering participation in an arrangement that could offer international or multinational regional disposal services and are interested in exploring possible routes to establishing a multinational repository (MNR). Such an arrangement could offer benefits over the development of national facilities: The parties could pool funding and technical expertise and identify additional siting options. One party would host a DGR with the other participants contributing funding and transporting their materials to that MNR facility for disposal. The clear financial and environmental economies of scale in repository implementation are beneficial to all parties.

The structure of an MNR project could range across a wide spectrum of relationships, from a fully inclusive, shared partnering project where all key decisions are taken by the group of countries and organisations developing the MNR, to a totally commercial arrangement where a single country carries out all the development work and then offers a full, profit-based service. In all cases, sensitive international negotiations between the parties involved will be necessary to satisfy each that necessary long-term commitments will be honoured by all. In this paper we begin by using a simple distinction between a 'provider country' and a 'user country', regardless of the manner in which the project is organised.

Perhaps most importantly, joint action by international partners might offer solutions to the political challenges that are the greatest obstacles to successfully disposing of spent nuclear fuel (SNF) and high-level waste (HLW).

A key element in addressing such challenges will be to provide confidence that an MNR adheres to criteria that have been established by a broad community. These criteria are based on the environmental, safety and security factors that are addressed by national regulations, legislation, and international agreements. International safeguards will certainly be one prerequisite for operation of the facility, but given the time frame over which the facility would operate, the assurance provided by safeguards agreements alone will likely be insufficient to satisfy all parties. Instead, specifically targeted confidence building measures (CBMs) should be expected to provide an essential complement to safeguards in an MNR project.

CBMs are broadly defined as actions that “*address, prevent, or resolve uncertainties among states, but do not in themselves provide certainty. Designed to prevent wanted and especially unwanted escalations of hostilities and build mutual trust, CBMs can be formal or informal, unilateral, bilateral, or multilateral, military or political, and can be state-to-state or non-governmental.*”¹

CBMs have traditionally been employed in a security framework, but have also been employed to address regional disputes involving environmental issues, political issues (e.g., election monitoring) and more recently cyber security. They have also been recognized as an important element in the use of nuclear energy for peaceful purposes. Examples of CBMs employed in various contexts include:

- Bilateral arms control (SALT and START treaties) – Parties have implemented hotlines and prenotification of certain missile launches, display disassembled bombers and open ballistic missile silos (ICBM and SLBM) to enable satellite monitoring, and conduct scheduled and short notice visits to each party’s facilities under an onsite inspection regime.²
- Multilateral arms control and nonproliferation (Treaty on Open Skies, the Comprehensive Nuclear Test Ban Treaty) – Parties to the treaty participate in overflights of signatories’ national territory and deploy global seismic and acoustic monitoring systems.³
- Environmental monitoring/management (Chesapeake Monitoring Cooperative, Nile Basin Initiative) – Regional monitoring and consultations on wildlife population changes in response to habitat loss, pollution and over-harvesting; water availability in the context of industrial and agricultural nutrient releases, chemical contaminants, water temperature and salinity, dissolved oxygen, and aquifer/groundwater recharge and depletion rates.⁴
- Cyber security (GFCE) – Sharing technical data on malware and other malicious indicators, establishing hotlines between national and international cyber security

¹<https://www.csis.org/programs/international-security-program/isp-archives/asia-division/cross-strait-security-initiative-1>

² <https://www.beyondintractability.org/essay/confidence-building-measures>

³ <https://www.armscontrol.org/factsheets/openskies>

⁴<https://www.chesapeakemonitoringcoop.org>, <https://www.chesapeakebay.net/what/programs/monitoring>; “Water Challenges and Cooperative Response in the Middle East and North Africa,” Michel, Pandya, Hasnain, Sticklor and Panuganti, Brookings Institution, 2012. “OSCE Guide on Non-military Confidence-Building Measures (CBMs),” OSCE, 2012.

officials to coordinate crisis response, joint training and education, shared updates on national cybersecurity efforts, exchange of best practices, etc.⁵

- Peaceful use of nuclear energy (ASEAN Regional Forum, NEA) – transparency and information sharing communication between facility operators and local governments and the public, transparency regarding safeguards/additional protocol implementation and disclosure of safety information, adherence to international treaties and conventions, implementing measures to develop and maintain competence, participation in international cooperative activities.⁶

It is clear from the foregoing that CBMs could contribute to stakeholder confidence in the safe and secure operation of an MNR. However, other important issues must be addressed before a country will agree to disposal of its radioactive material abroad, including the confidence held by potential MNR users and the larger international community that material will not be used for purposes to which the user has not agreed.

Aside from issues of the operator's intent, new approaches may be needed to address the issue of facility operation (which could last over many decades) and the early post-closure period over a period of centuries or thousands of years. Long before an MNR has completed operations, circumstances may well have changed regarding the operator, nearby communities, the government and the political boundaries of the country in which the facility is located. Even the environment in which the facility is located may undergo changes over the long timescales considered, particularly in response to evolving land-use practices and climate and demographic changes. So, what CBMs might provide confidence that the parties involved in this project will adhere to all applicable requirements in preparing their respective materials for transportation, emplacement and the long early period of isolation in the repository – the first thousands of years over which HLW and SF have their highest hazard potential?

First, there needs to be confidence in the guarantees of safety and security for an MNR between the provider and user countries and between them and 'third-party' stakeholders, which include all other countries concerned with these issues (in particular, any country with a third-party interest in the materials being disposed – for example, flagged fuels) and the national and global publics. International safeguards can provide immediate assurance of the location and status of material emplaced in the MNR but, as occurred in the case of North Korea, safeguards measures and assurances can be quickly defeated and the previously safeguarded material diverted to a weapons program or other end use to which stakeholders did not agree.

Accepting that safeguards only provide the bare minimum of assurances for the larger community, both the service user and service provider will need to demonstrate through guarantees and actions their commitment to the terms by which SNF and HLW are authorized for inclusion in an MNR.

The country contracting for disposal services will seek a range of guarantees from the provider country. These will include formal guarantees of:

- Provision of service for the designated user country inventory.
 - MNR will accept all of the agreed waste types/quantities dispatched.
 - Provider will not withdraw service.

⁵"Overview of Existing Confidence Building Measures As Applied to Cyberspace," Global Forum for Cyber Expertise's Task Force on CBM and Norms Implementation and Cyber Diplomacy, Ciglic and Ott, GFCE, 2020; "OSCE Guide on Non-military Confidence-Building Measures (CBMs)," OSCE, 2012.

⁶"Confidence Building in Peaceful Use of Nuclear Energy: Transparency and Human Resource Development in Asia Pacific Region," Yusuke Kuno, University of Tokyo, 2008; "Brazilian Nuclear Program: Confidence Building Measures," Marcos Nunes, CNEN, 2018.

- Cost and financial arrangements.
 - Provider will develop a mechanism to fund any costs not covered by payments from users.
 - Provider will obtain insurance to ensure funds availability for all eventualities.
- Radiological and environmental safety that meet national and international standards.
 - Provider adheres to all national regulatory requirements.
 - Provider has state-of-the-art facility and operation.
 - Remediation procedures agreed.
- Safeguards that meet international standards.
 - MNR provider doesn't misuse fissile material
 - Long term monitoring is arranged.
- Security of materials once accepted by the provider and up to the point of MNR closure.
- Termination of responsibilities for disposed materials at some point in the future.

The discussion in this paper focusses on the last three of these guarantees: safeguards, security and responsibilities. Of course, guarantees work in both directions, and the provider country will seek guarantees that the user will

- Dispatch only materials that are agreed upon and disposable.
 - User will not under-declare fissile content and divert the difference
 - User will condition, characterise and encapsulate material appropriately
- Meet the costs of disposal at all times.
 - User will develop a mechanism/national waste fund to cover payments to the provider as agreed.
 - User will commit to sending and paying for the types and amounts of waste agreed
- Commit to accepting its agreed share of responsibilities for materials at different locations (in transport, buffer storage etc) and at different points in time through to post closure.

Again, this paper focusses on only the last point: shared commitments to responsibilities.

The aim of this paper is to identify how arrangements between MNR user and provider countries can be made so as to include the types of confidence building measures (CBM) that may have previously been associated with bilateral and multilateral agreements as indicated above and specifically with the management of fissile materials. An opening assertion to be discussed below is that, on the timescales of operation of a DGR, CBMs for an MNR are concerned less with technology (monitoring) and are mostly about sustained trustworthiness.

The role of governments

Essentially, CBMs are intended to establish and maintain appropriate levels of trust between countries. An immediate question is thus who is talking to whom to establish this trust? Whilst governments will be subject to any international agreements into which they have entered (e.g., the IAEA Joint Convention), it is not a foregone conclusion that they must be directly involved in the implementation of an MNR project. The primary role of governments is to provide an environment in which the development of an MNR can be facilitated. The

responsibility of governments involves seeking and establishing intergovernmental agreements, the inclusion of appropriate waste import/export provisions and objectives in their national radioactive waste management policy and the assignment of organisational responsibilities for implementing policy.

In a favourable environment, an MNR might be developed in a provider country by a national agency, fully or partly owned by the government, by a private company, by a regional governmental entity (e.g., state level) that is one-step removed from central (e.g., federal) government, or by a consortium of any or all of these organisations, from both the provider and the user countries. The organisational entity in a user country might be a national agency (waste management organisation) or a private company owning wastes, but may not represent either regional or central government. In principle, this means that a user might not necessarily require the active involvement of its government, provided it can demonstrably meet its own national laws and regulations. Of course, all organisations, in both user and provider country, will be subject to their own national laws and regulations with respect to management of wastes, which often include stipulations about their export and import.

This complexity suggests that, in whatever way an MNR project is initiated and whomever the promoting participants are, then some level of initial intergovernmental agreement would be essential, to frame the project, if trust is to be established. As discussed further below, such agreements must address a further role of government in the period after the end of an MNR project. For this indefinite period, some or all of the future responsibility for the MNR must effectively revert to the provider country and its government – unless the MNR location is designated by treaty as territory under international control.

What makes a country trustworthy?

Intergovernmental agreements are hedged in diplomatic terms and of necessity based upon the assumption that the parties will adhere to them. That this does not always work with respect to nuclear materials is evidenced by the currently fluid and unresolved situation with Iran's nuclear program and previously with the North Korean withdrawal from the international safeguards regime: Both situations arose over a period of relatively few years. One of the attributes of a DGR project is that it might last anywhere between 20 and 100 years before the DGR is completed and sealed. Emplaced materials might be relatively readily accessible over the whole of this period, depending on design concept.

History tells us that much can happen to a country, or a continent, over such long time periods. A government signing an agreement today can change within months to years and the political systems of a country can evolve or change completely over decadal time periods. For example, there are few countries in Europe that have consistently retained stable political institutions during the 20th and 21st centuries and several have been subject to periods of despotic government.

As a thought exercise, imagine the sustained reliability of provider country guarantees for a hypothetical MNR built in central or southern Europe one hundred years ago – a time at which some present European countries did not even exist, and since when others have disappeared from the map, or been invaded or subject to despotic, militaristic regimes. Whilst we might find such considerations odious, the reality of disreputable regimes or anarchic conditions arising in previously reputable nations cannot be ignored.

The conclusion must be that any intergovernmental agreements made today (no matter by whom) cannot be regarded as irrevocable guarantees that can be assuredly vouchsafed for the full duration of an MNR project, or, with respect to continuous safeguards, for ever.

Strengthening commitments to an MNR project

Backing up intergovernmental agreements with international oversight and transparency could provide a significant contribution to bolstering confidence in an MNR project. Of course, wide participation in a shared, partnering MNR potentially brings the interests of many nations to a single focus, which is beneficial. The more countries that are involved and have signed intergovernmental agreements the better, in this respect. This suggests two CBMs to be aimed at:

- *partnering projects rather than single provider projects.*
- *projects involving many participating countries.*

The principle being that the more countries that are exercising oversight and protecting their own close interests, the more likely it is that the required standards of MNR safety and security will be maintained by the provider, although this of course cannot be guaranteed.

If the user countries have a close economic and political relationship with the provider country, then it seems more likely that they will be able to exert sustained influence on the MNR host country over longer periods. This suggests a further CBM:

- *regional projects with like-minded and inter-dependent countries, and/or countries with close economic, historical and cultural ties.*

Oversight by the IAEA (that goes beyond safeguards measures alone) currently represents the most obvious feasible third-party option, and together with safeguards could be viewed as a highly credible measure for any multinational project to take. To make this a reasonable proposition for the IAEA, it would need to be actively involved in the project and it would need to adopt both an inward facing role for the MNR provider and users, focussed on ensuring their safety and security, and an outward facing role for non-involved (third-party) Member States, providing assurances of MNR adherence to IAEA standards.

The IAEA could even go so far as to own the project in some sense – an international facility on sovereign soil in a provider country, which would require the highest-level agreements, perhaps at United Nations level. The CBMs that could be envisaged are:

- *involvement of the IAEA as a project member from the outset*
- *multinational intergovernmental agreements that involve the IAEA and or the United Nations*
- *the MNR to be a United Nations, IAEA managed and/or owned facility.*

Dealing with third-party interests

International oversight, such as discussed above with respect to the role of the IAEA, is arguably the most durable and independent means of addressing the concerns of the wider global community – i.e., countries with no direct interest in the materials being disposed but wishing to be reassured about their lasting safety and security. It is also one means of addressing the separate agreements made by the USA with respect to the handling and fate of fuel supplied to certain countries – flagged fuel. Suggested CBMs might include:

- *IAEA to work closely with the USA and other fuel suppliers to develop a protocol for removal of flagging for approved MNR projects that have IAEA oversight*
- *Open publication of licensing requirements for MNR and of the safety cases submitted*
- *Environmental monitoring data provided to the international community.*
- *Transparent reporting on funds available to MNR operator.*
- *Transparency in communicating insurance arrangements and status.*

- *Participation by the operator in an international liability regime*⁷

Surveillance and physical CBMs

Trust is good, control is better. In its broadest sense, the word control signifies checking and monitoring, not just jurisdiction or manipulation, and the ability to validate agreements when possible by using physically derived data is an essential aspect of any guarantees made between MNR providers, users and third-party stakeholders.

We live in a surveillance world. It has been estimated that there are now close to a billion surveillance cameras operating globally. Combined with artificial intelligence data acquisition, interpretation and response systems, the ability to watch, identify and react to behaviour is growing at an extraordinary rate. These capabilities can be used in a benign or a malevolent manner.

There can be no doubt that any MNR project would be required by all parties (provider, user, third-party) to implement the most stringent safeguards and security measures, using the most advanced and effective technology available at all times during its operational period. Surface based, underground and aerial/space-based platforms will all be deployed. This paper does not look further into this topic because it is clear that the technical requirements that will be placed on an MNR in these respects do not differ from those that will apply to any national DGR and the topic has been well rehearsed elsewhere. However, it is likely that surveillance data from an MNR would be made available to provide transparency to a larger community, so a secure system to share data would be necessary.

How does an MNR differ from a national DGR?

The previous points raise the question of where an MNR differs from a national DGR. Once waste arrives at the point of disposal there is no difference in the safety and security related requirements. This applies both during operations and post-closure. The only additional aspect for an MNR is the need for total transparency in all safety-related evaluations using approaches that are tailored specifically for and aimed at an international audience – but this is already widely adopted in national programmes, in any case.

The most significant difference lies in the responsibilities of the various parties at each stage of the project, and this is an area where CBMs will need to be developed with great clarity. A key issue will be to develop mechanisms to give all parties confidence that all potential disruption scenarios are manageable – that safety and security will be maintained regardless of what happens to any of the parties involved. These guarantees will need to address negative outcomes that would potentially generate legal minefields, such as:

- **Shedding of Responsibility:** a user delivers waste and accepts no subsequent responsibility if the provider is unable to complete disposal, leaving an outstanding security and environmental problem.
- **Defaulting Partner:** a shared, multi-partner project encounters problems because one of the partners cannot meet its financial or technical obligations.
- **Accept and Misuse:** the provider accepts waste but fails to dispose of it as and when agreed, later using some of the material for other purposes (commercial or military).

⁷ Liability agreements (Convention on Supplementary Compensation, Vienna Convention on Civil Liability for Nuclear Damage, Paris Convention on Third Party Liability) attempt to establish some minimum standards to provide financial protection against damage resulting from certain peaceful uses of nuclear energy.

- **Project Collapse:** at a late stage, an MNR project fails to succeed for technical or financial reasons, leaving user countries that have become dependent on it stranded, with no solution for their wastes, thus reducing global security and safety.
- **System Failure:** a completed MNR suffers a major failure as a result of natural events or malign human intervention, with significant consequences, raising the question of which country and/or organisation the waste belongs to now and who was responsible for preventing this happening (*NB:* this is also a problem for any national DGR, but the liability would not be international).

Clarity on where responsibilities begin and end is essential to avoid such scenarios happening, even just as a result of misunderstandings. At each stage of a project, all parties need to agree where the physical and financial responsibilities for materials lie and to agree and provide for mitigation solutions.

The most robust CBMs to avoid such scenarios occurring could be:

- *Agreements on ownership and liability for all materials at all times (during transport, delivery, buffer storage, emplacement, operations and post closure), including precise hand-over points.*
- *Up-front agreements between user and provider organisations to jointly handle the case where one party withdraws*
- *Sovereign agreements between both user and provider governments to ensure that resources are available for proper project completion should any party default on their responsibilities. It can be seen that there may be many ways that this type of agreement would need to be drawn up in order to cater for the wide range of organisational entities that might be involved in an MNR project.*
- *Establishment of a 'waste bank', analogous to the IAEA fuel bank, with the IAEA (as a project member or project owner) taking responsibility for the wastes upon delivery and responsibility for ensuring their eventual disposal.*
- *Adherence to international agreements defining waste disposal standards (e.g., Joint Convention).*
- *Membership in an international liability regime (e.g., the Convention on Supplementary Compensation).*

What is the end point?

The end point of an MNR, which contains spent fuel and other fissile materials, is no different in terms of lasting safeguards considerations from the termination of any national DGR. All of the uncertainties that surround if and how post-closure safeguards can be managed reliably, and for how long, apply in both cases.

However, as noted above, the difference lies in allocation of very long-term responsibilities after the MNR has been completed and sealed, the project has ended successfully, funds have been used up and implementing organisations run down or disbanded. As with a national DGR, responsibility for the disposed materials then devolves to a single national government in the host country. Intergovernmental agreement involving shared responsibility may be conceivable for some limited defined period after closure but indefinite sharing of responsibility seems unlikely. In this case the CBMs could be:

- *Declaration by the host country government of sole responsibility for post-closure management of the MNR site and the materials it contains.*
- *In the case of IAEA involvement or ownership of the project and/or MNR site, devolution of responsibility to that organisation.*

- *Designation of the location of the MNR as international territory, with uses and responsibilities controlled by treaty under the auspices of an international organisation.*

The latter two models of course raise the question of the longevity of international organisations. In this area, as in any area of global security, the only feasible response must be one of optimism combined with energetic promotion of powerful international organisations.

Public confidence in an MNR

Implementation of geological disposal has been a long, uphill struggle that few countries have yet managed to bring anywhere near the starting line. The principal problem has been local public opposition combined with an overall lack of trust in the nuclear industry and/or the government, both of which have led to lack of political will and support to move projects forward. Today, stored nuclear wastes nowhere present an immediate public hazard, disposal can be postponed, and there are therefore no strong incentives for politicians to be pro-active in moving repository projects ahead. But the nuclear industry has developed much better outreach and engagement with the public over recent years and the CBMs that it now uses are slowly proving more effective in building public trust in some countries. Nevertheless, undeniably, disasters such as Fukushima, combined with management culture problems in nuclear industry organisations, have nullified the effects of any previous CBMs.

As with any national DGR project, an MNR project will need to build public trust and must develop extensive engagement platforms that function as CBMs. These can be as simple as local liaison groups and information centres, but with an MNR there is a greater need to engage with the public at a national level in order to address the issue of import of foreign waste. One suggestion has been to identify a site for an MNR using a community-led approach, whereby a community understands and wishes to benefit from hosting an MNR and is prepared to act as champion to move the project forward – of course, with the technical support of national and international agencies. This requires there to be very significant benefits, but enthusiastic support of the host community, region and nation might be the most effective form of CBM that could be envisaged. Whether the involvement and possible ownership of an MNR project by the IAEA would significantly build confidence and trust is an unknown. In principle, this ought to be a positive step.

Public CBMs might thus involve:

- *Primary focus from the outset on national and regional public engagement incorporating complete openness about how an MNR project is to be structured and run.*
- *Endeavouring to make the MNR a community-led project, rather than an industry led project, which will mean directing significant resources to the project, even at the outset.*
- *Involvement of the IAEA in the project as independent global guarantors of good faith and good practice.*

Conclusions

In several aspects where CBMs might be employed there is no difference between a national DGR and an MNR. Operational and long-term safeguards and operational nuclear security involve managing essentially the same issues with the same organisational and technical solutions. These topics have already been widely debated internationally and mechanisms proposed for handling them and have not been covered in this paper.

The critical perceived difference with an MNR is in establishing confidence in the competence and trustworthiness of the host country and implementing organization. Again, it could be said

that there is nothing new here, as any country likely to host an MNR is also likely to be considering developing its own national DGR anyway. If it is considered by the international community to be trustworthy to handle its own nuclear materials, then it should also be trusted to handle those of other countries. Considerably more negotiations and a more extensive list of CBMs might, however, be required if a country with no nuclear fuel cycle wastes offers itself as host and accepts considerable quantities of safeguards and security sensitive materials from user countries.

Possibly the only realistic CBM that addresses trust in a provider country is to ensure that it is at the heart of the international nuclear community, taking an active and open role in international activities, and receiving continuous support and encouragement from the global community. Accepting an MNR is a laudable action from the perspective of global nuclear security and this should be fostered and given recognition, rather than treated with suspicion. It would enhance global security considerably if countries with recognised triple-A credentials in openness, economic strength, technological achievement, regulatory standards and involvement in nuclear affairs were to be actively encouraged to consider acting as MNR hosts.

In this paper we have suggested a range of CBMs that would help MNR projects to develop – some of them minor and some requiring significant political effort to set in place. We suggest that all of these CBMs would be vastly enhanced, as would the MNR concept itself, were the IAEA to take a central and active role as champion and possibly even owner of an MNR project. This means shifting from the passive (but welcome) support currently being offered, to further development of the MNR concept. This might well mean high-level agreement to changes in the Agency's operating practices, but we feel that, with the current surge in interest in MNR solutions, the time is now ripe for the IAEA to step forward.