Development of Multinational Repository Concept:
Exploring Alternative Approaches to Financing Multinational Repository

Tomaž Žagar\(^{(1,2)}\), Sean Tyson \(^{(1,3)}\), Robert Mussler \(^{(4)}\)

(1) International Framework for Nuclear Energy Cooperation RNFSWG Group Co-Chairs
(2) Head of Planning and Control, GEN energija d.o.o., Slovenia,
(3) Office of International Nuclear Energy, Office of Nuclear Energy, U.S. DOE, USA
(4) Nuclear waste policy consultant, USA
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International Framework for Nuclear Energy Cooperation

Reliable Nuclear Fuel Services Working Group Co-Chairs

dr. Tomaž Žagar
Head of Planning and Control, GEN energija d.o.o., Slovenia

Sean Tyson
Office of Nuclear Energy, U.S. DOE, USA
Content

• Introduction & IFNEC
• Why multinational and what is an MNR?
• Exploring approaches to financing MNR
• Conclusions
International Framework for Nuclear Energy Cooperation

IFNEC - Intergovernmental organisation
34 Participant countries
31 Observer countries
4 Observer organisations
  NEA OECD
  IAEA
  GIF
  EURATOM

Greater energy security in a cleaner, safer world

WWW.IFNEC.ORG
Reliable Nuclear Fuel Services Working Group

IFNEC addressed multinational repository subject since 2009. In 2011 it dedicated this subject to RNFSWG. In the recent years the focus of our working group is the back end of the fuel cycle, particularly disposal.

Membership
IFNEC Participants and Observers
19 Countries and three international organizations
  Argentina, Armenia, Australia, Bahrain, Bulgaria, Canada, China, France, Italy, Hungary, Japan, Jordan, Korea, Russia, Mexico, Singapore, Slovenia, Ukraine and United States
  EURATOM, IAEA and OECD NEA
Spent Fuel Stored by Country

Many countries have small nuclear programs and small amounts of spent fuel. MNR could have safety, security and environmental benefits.

19 countries currently store less than 3,000 MTU

There are over 250,000 MTU of used fuel in storage worldwide. This used fuel is currently stored in 33 countries awaiting reprocessing or disposal. Both numbers are growing (new reactors and new countries).

MTU – metric tones of uranium, THM – tones of heavy metal

Source: US DOE data
Economies of Scale

Because of high fixed costs (siting, licensing, etc.) per unit disposal costs are much higher for a smaller repository.

The shared solution of an MNR has clear economic benefits.

Sources:
SF/HLW Disposal in Small Programs: Current Situation

Many countries have small nuclear power programs, with small amounts of SF and/or HLW and for these disposal will eventually be needed.

- **geological and societal requirements** may be difficult to fulfill,
- required **human resources are daunting** for small (nuclear) countries,
- financial requirements (with large fixed costs) **may be prohibitive**.

For these reasons many countries with small nuclear power programs may:

- opt for no disposal plan, i.e., extended in-country storage of the SF/HLW (with related safety and security implications),
- be in highly challenging position of seeking to build and operate a national geologic repository,
- be interested in the option of moving their SF/HLW to another country for some combination of management/reprocessing/disposal.
Multinational Repository Concept

Disposal in **deep geological repository** recognized as **safe endpoint** for SF and/or HLW.

The term “multinational repository” (MNR) refers to arrangements where **customer countries** enter into agreements to have their SF/HLW disposed of in a country that has disposal capability, the **service provider country**.

Back in 2004 IAEA postulated three major MNR development scenarios:

- ‘add-on’ (a large program accepts waste from smaller ones),
- ‘supra-national concept’ (facility with international management and control),
- ‘partnering scenarios’ (countries collaborate in a multinational repository).

Source:
IAEA-TECDOC-1413 Developing multinational radioactive waste repositories: Infrastructural framework and scenarios of cooperation, 2004
“Dual Track approach” - Assume **national responsibility** for spent fuel and pursue **multinational/shared approaches** to disposal **in parallel**.

**“Practical Considerations to Begin Resolving the Final Spent Fuel Disposal Pathway for Countries with Small Nuclear Programs”**

RNFSWG 2016 position Paper on the Dual Track approach and activities to consider to pursue that approach.

- The paper based on previous efforts including ERDO-WG and Arius as well as from existing US studies and studies done by NEA and IAEA.
- The Paper represents a collaborative and inclusive process of development.
The 2016 “Dual Track approach” Paper suggests five topical areas and identifies practical activities for policy makers to pursue relevant to this issue.

Five areas of exploration are organized by topic:

1. Policy and Regulation
2. Costing and Financing
3. National Technical Issues
4. Initiating or Enhancing Cooperation with Other Countries
5. Program Development

The document is available online [http://www.ifnec.org/](http://www.ifnec.org/).
EXPLORING APPROACHES TO FINANCING MNR
General Characteristic of a DGR Project & How to Finance a Hypothetical MNR?

IFNEC organized a workshop in Paris in December 2018, to begin a dialogue on the various approaches that might be used to finance an MNR.

Workshop used information from advanced national programs to build hypothetical MNR scenario:

• Deep geologic repository phases and spending profiles
• Estimated cost of a DGR
  • Fixed (site selection, permitting, surface facilities, access shafts, closure, monitoring, …)
  • Variable (emplacements tunnels, boreholes, encapsulation and disposal operation, …)
• Risks (legal limitations, public acceptance, liabilities, safe-guards, …)
• Project planning issues and other lessons learned
Despite differences in the planned regulatory sizes and costs, current examples of projected spending profiles analysed show common features.
Hypothetical Repository Phases and Costs

Notational MNR project was prepared and financing experts were asked to prepare alternative ways to finance its development and operation.
Alternative MNR Financing Approaches were Developed and Discoursed on Conceptual Levels

Approach 1: Financing several MNRs might be easier than financing one
Approach 2: Government lead with and without customer investment
Approach 3: Sell shares in the repository project with return on investment from fees collected during operation
Approach 4: Financing with a staged interim storage/repository approach

The experts that developed the four financing approaches were:
George Borovas, Shearman and Sterling LLP
Timothy A. Frazier, Nuclear Economics Consulting Group
Edward Kee, Nuclear Economics Consulting Group
Paul Murphy, Murphy Energy & Infrastructure Consulting LLC
Xavier Rollat, Alet Business Services Limited
Robert Sloan, Tulane Center for Energy Law
Elina Teplinsky, Pillsbury Winthrop Shaw Pittman LLP
Elise Zoli, Jones Day
CONCLUSIONS
Conclusions

• National repository projects are key to demonstrate a fully managed and affordable fuel cycle globally.
• Multinational repository is likely not ripe for development today. Actions taken now will influence the likelihood of its future development.
• Concept of Multinational repository can help develop sustainable and safer back-end globally and support new build in smaller countries.
• Collaboration and coordination amongst the various bodies examining the multinational approach should be maintained and strengthened and international organizations should continue to support efforts of small programs (coordination, exchange of information, …)
Conclusions

• Countries that generate spent nuclear fuel set aside funds to support disposal.
• The collection and protection of such funds is done pursuant to national authorizations, and if those authorizations allowed, those funds could be used for developing a national disposal capability, or purchasing an international disposal service.
• Funding for an MNR exists today. The challenge lies in identifying the financing arrangements that are attractive for all stakeholders.
• IFNEC will continue to work on approaches to bringing service provider and customers together to successfully develop a multinational repository concept.
THANK YOU