Major finding of the INPRO Dialogue Forum 10
“Cooperative Approaches to the Back End of Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments”

Alexey GRIGORIEV
INPRO Section
Division of Nuclear Power, Department of Nuclear Energy

INPRO Dialogue Forum on Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems
20-23 October 2015, IAEA Headquarters, Vienna
INPRO Task 2: Innovations

Objective:

- The objective is to investigate innovations in selected nuclear energy technologies, related R&D and innovative institutional arrangements for deployment of innovative NESs in the 21st century.

INPRO focuses on specific innovations, recommended by Member States as well as on subjects that are complementary to activities in the areas of INPRO Methodology and Global Scenarios.

For example, INPRO Action Plan 2014-2015 provides new projects on Nuclear Fuel and Fuel Cycle analysis for future NES (FANES) and Waste from Innovative Types of Reactors and Fuel Cycles (WIRAF) that are complementary to both activities.
2.1. Disseminate good practices in enhancing collaboration in innovations to support sustainable NES.

2.2. CP Review of Innovative Reactor concepts for prevention of Severe accidents and mitigation of their Consequences (RISC).

2.3. CP on Transportable NPP phase II: case study for the deployment of factory fuelled small sized reactor (resumed and renamed to CP “Case study for the Deployment of a Factory fuelled SMR”).


2.5. Collaborative Project Waste from Innovative types of Reactors and Fuel Cycles (WIRAF).

2.6 Dialogue Forum on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments).
INPRO and Nuclear Fuel Cycle

• The utilization of innovative fuels and fuel cycles can contribute directly to the development of sustainable nuclear energy systems (NESs), for technical reasons as well as in terms of enhancing public acceptance.

• Innovations in the back end of nuclear fuel cycle have the potential to make a significant contribution to the growth of nuclear power.

• The sustainability of NESs at the regional and at global levels requires cooperation in the fuel cycle, particularly for issues involving the back end, including the end-point for high-level waste.

• Furthermore, legal and institutional impediments for international cooperation in the back-end of fuel cycle were also noted at a number of INPRO meetings (INPRO 4th Dialogue Forum, TMs on CPs SYNERGIES, FANES, WIRAF).

• Re-examining the drivers and looking in more detail at the impediments, understanding the issues, and outlining the possible pathways for their resolution are important near term steps to ensure effective cooperation toward long term sustainable nuclear energy.
The INPRO Steering Committee decided to organize the “Dialogue Forum on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments”.

The INPRO Dialogue Forums offer a platform for technology holders, technology users and other stakeholders to share information, perspectives and knowledge on issues related to sustainable nuclear energy development. The Dialogue Forums focus on topics and issues relevant to global nuclear energy sustainability in the 21st century, long term nuclear energy strategies and the role of nuclear technology innovations.

INPRO 10th Dialogue Forum was held in Vienna from May 26th to 29th. 48 participants from 25 Member States and International organizations, 20 officials from various Departments and Offices of the IAEA took part in the meeting.
INPRO Dialogue Forum Objectives

- To better understand **the value of cooperation** in the back end of the nuclear fuel cycle and **the implications of such cooperation** for the management of spent nuclear fuel (SNF).

- To **analyse drivers for cooperation**, as well as to **identify and analyse impediments**, including a discussion on ways of overcoming some of the impediments identified.

- To **discuss in more detail the impediments** which may arise due to the diversity of national legislative frameworks, public perception/acceptance and views on the urgency (or lack thereof) of implementing end points for SNF or HLW.

- To **point out potential technological developments** that may impact on the pros and cons of SNF management through cooperation.
INPRO Dialogue Forum Overall Agenda

INPRO Dialogue Forum will consisted of:

- Two plenary sessions on:
  - Need for cooperation in the Back-End of the Nuclear Fuel Cycle, and
  - Drivers and Impediments for cooperation in this area of Nuclear Fuel Cycle’s Back End

- Three topic-specific sessions on:
  - International conventions and national laws/regulations for SNF-transfer of responsibilities, trans-boundary transport.
  - Time frames and public acceptance related to cooperation for SNF management.
  - Impacts of development of advanced reactors and fuel cycles to SNF management.
Topic-specific sessions

✓ International conventions and national laws/regulations for SNF-transfer of responsibilities, trans-boundary transport

Key question to be addressed: *Can the generating country enter into agreements that transfer full responsibility to the country receiving the spent fuel?*

Specific questions for discussion:

- If yes, what should be the pre-requisites for transferring responsibility? For example, what must the generating county do to assure that the receiving country has the necessary capability to manage the spent fuel?
- If no, what responsibility could not be transferred? How would such residual responsibility be managed if possession and control of the spent fuel were transferred to a receiving country? Does the element of time affect the answers to this question?
- Do existing arrangements for the reprocessing of spent fuel provide any relevant guidance regarding how the transfer of responsibility should be addressed?
Topic-specific sessions

✓ **Time frames and public acceptance related to cooperation for SNF management**

Specific questions for discussion:

- How do you manage time frames from the point of view of public acceptance?
  - Is the involvement of other countries productive or counterproductive?
  - How does multilateral cooperation accept public acceptance? Does successful storage contribute to postponing action towards the repository?
  - Can urgency or lack of urgency be justified?
  - What is the impact of R&D on advanced fuel cycles and end-points?

- What can be done to promote/accept international cooperation?
  - Will the successful implementation of repository for SNF in a foreign country change the public attitude?
  - Does the existence of multilateral initiatives contribute to justifying a wait and see policy?
Topic-specific sessions

✅ Impacts of development of advanced reactors and fuel cycles to SNF management

Specific questions for discussion:

➢ Innovative reactors and recycling systems.
➢ Combined approaches of innovative reactors, innovative fuels and fuel cycle back end options
➢ Synergies between countries.
➢ Interest to cooperate in this area.

![Diagram showing technologies and timelines for 2025, 2040, and 2050.](image)
Results

INPRO 10\textsuperscript{th} Dialogue Forum
“Cooperative Approaches to the Back End of Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments”
Need for cooperation in the Back-End of the Nuclear Fuel Cycle

Chairman: Mr Tariq RAUF

Overview of the session subject’s history
Overview of the approaches and the results of international efforts

- Presentations given provided an excellent and detailed overview of different past initiatives related to multilateral cooperation in nuclear fuel cycle back end indicating why these initiatives were not successful.

- It pointed out on the success of various multi-cooperative initiatives on the nuclear fuel cycle front end which is today fully regulated and successful well established industrial business.

- Presentations also provided analysis of current technical challenges towards sustainability of the back end and detailed analysis of former practices of USSR on spent fuel take-back policy.
Need for cooperation in the Back-End of the Nuclear Fuel Cycle

Chairman: Mr Tariq RAUF

The discussions during session pointed out on three major possibilities for cooperation in the back end that could be pursued multilaterally:

- storage and/or disposition of spent fuel could be a suitable candidate for a multilateral approach, primarily at the regional level
- final disposal of spent fuel and high level radioactive waste may be a candidate for a multilateral approach
- bundled fuel cycle services >>> NPP, nuclear fuel, SNF take-back provide assurance of supply at both: the front-end and the back-end
Session 2 - Discussions

*International conventions and national laws/regulations for SNF-transfer of responsibilities, trans-boundary transport*

*Chairman: Mr Alan BROWNSTEIN*

- Session outlined the potential need for a multinational repository and posed the question of whether and under what conditions a generating country could transfer full responsibility to a country accepting the SNF for disposal.

- There were differing views on the question of whether responsibility for SNF management can be fully transferred. There is a need for a harmonized framework in which trust must be a key component of any arrangement.

- Presentation highlighted some of the practical and commercial issues associated with multinational approaches and provided information about certain countries’ national regulatory and legislative approaches to spent fuel transfers.
International conventions and national laws/regulations for SNF-transfer of responsibilities, trans-boundary transport

Chairman: Mr Alan BROWNSTEIN

- Addressing issues now that are associated with transfer of responsibility is important so that it does not become an impediment in the future to progress on multinational repositories.

- There is important work that can and should proceed now to address the many policy, technical, legal, and economic issues. INPRO could make valuable contributions in addressing some of these questions.

- Small fleet and emerging countries are watching very closely the interplay between the policies of the established countries relative to the back end and should be involved in INPRO activities on back end.
Drivers and Impediments for cooperation in area of Nuclear Fuel Cycle Back End

Chairman: Mr Leonid YANKO

Presentations provided information on national strategies and international cooperative activities in the area of NFC back end in Bulgaria, Vietnam, Egypt, Indonesia, Romania, Russia and Ukraine. The following findings were noted:

- Strategies adopted depend on view of SNF as resource or as waste. Newcomer countries pointed out on the complexity of the back end infrastructure and the need of cooperation with vendors.

- Leasing of nuclear fuel is attractive for newcomers and could be well more acceptable to the public in newcomer countries; currently, however the demand exceeds the supply. There are currently few or no service providers offering a full back end solution, i.e. take-back of take-away with no return of HLW..

- Keeping national and multinational options open is a common strategy – but to be credible effort must be invested then in both approaches.
Drivers and Impediments for cooperation in area of Nuclear Fuel Cycle Back End

Chairman: Mr Leonid YANKO

- The international community has invested much effort on multinational cooperation for repositories. These actions give some positive results, but further efforts are still necessary.

- Furthermore, there are too few international cooperative actions in other areas of Back End. A broader approach including storage, conditioning etc. could be useful.

- International bodies should play a leading role in supporting and enhancing international cooperation in the back end area.

- Nuclear vendors provide support to newcomers in their efforts to develop a credible, safe and secure back end strategy. However, a bottom-up approach in which those countries interested in potentially being users (and/or hosts) of a multinational facility directly interact with one another is crucial.
Time frames and public acceptance

Chairman: Mr Charles Antoine LOUET

Presentations during the session provided overview of spent nuclear fuel and radioactive waste management programmes in different countries and at different stages.

- Presentations pointed out on role of public participation in these programmes, in particular during the repository siting process, times frames related with R&D, repository siting, operation and closure, and long-term planning and scenarios and on role of international cooperation in these topics.

- International cooperation in back end is already in place for spent fuel (reprocessing, spent fuel take-back). Such cooperation in reprocessing is reducing time-scales for final disposal, which could affect acceptability positively.
Time frames and public acceptance

Chairman: Mr Charles Antoine LOUET

Presentation and follow up discussions offered the following summary:

- Time frames: R&D, siting and licensing take ~30/40 years so staged approach towards the repository solution is necessary. Having a national strategy, that covers all the steps until disposal in an open, transparent manner is essential.

- Effective participation of the public in the decision-making process is necessary especially in case of multilateral repository solution. Economic benefits for the host country have to be clearly defined as well as long term availability of repository that has to be guaranteed.

- The existence of a successful national programme would be a positive factor for the acceptability of an international repository.
Impacts of development of advanced reactors and fuel cycles to SNF management

Chairman: Mr Zoran DRACE

Session outlined that if nuclear power is to be sustainable as a global source of emission-free energy, the fuel cycle should remain sustainable.

- A number of complex technological system works for realization of NFC back end including current and innovative reactors and recycling systems (France, Russia, India, etc.)
- New combined approaches of innovative reactors, innovative fuels and fuel cycle back end options are under detail consideration.
- The current recycling strategy is providing saving of uranium resources, safe & secure ultimate waste form without Pu and control over growth of Pu inventory.
- Systematic U & Pu recycle in fast neutron reactors could provide for sustainable management of nuclear materials and waste.
Impacts of development of advanced reactors and fuel cycles to SNF management

Chairman: Mr Zoran DRACE

✓ Synergistic collaborations among countries in the NFC BE offer higher rates of capacity growth and larger-capacity centralized NFC enterprises.

✓ Models for collaboration among counties already exist. The initial phase of the cooperation are use of recycling strategies and minimizing NFC infrastructure among interested partners.

✓ Potentially, PWR/SFR NES is capable to reduce Pu inventory to operational needs and radically save natural U, even in conditions of no-growth in nuclear energy demand.

✓ Using the system by cooperative countries could help to contribute to solving the problems at the global level.

✓ Understanding of institutional and legal issues in interested technology holders, technology users and newcomer countries is necessary to foster global cooperation in the NFC BE.
Consideration of cooperative (multilateral) approaches and tools in area of fuel cycle is essential for further development and implementation of nuclear power.

- Continue the efforts started by the 10th Dialog Forum.
- Modeling synergies in Back-End NFC including institutional/legal aspects.
- Detail studies on drivers and impediments should be based on systematic INPRO methodology.
INPRO DIALOGUE FORUM
ON COOPERATIVE APPROACHES TO THE BACK END OF THE NUCLEAR FUEL CYCLE

Thank you!
Alexey GRIGORIEV
INPRO Section
inpro@iaea.org