

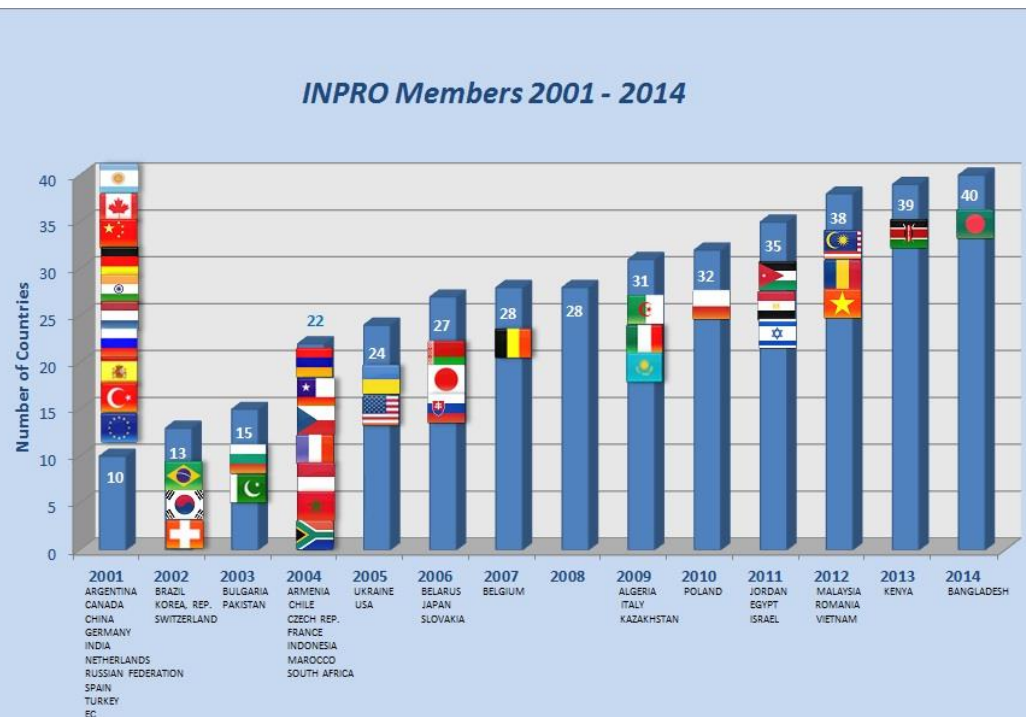
# **INPRO Dialogue Forum on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments.**

Alexander Bychkov, chairman of INPRO 10<sup>th</sup> Dialogue Forum

*ATOMEXPO 2015, Moscow, June 1-3, 2015*

# IAEA INPRO project

- ▶ The International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) was launched in 2000 based on resolution of the IAEA General Conference.
- ▶ INPRO's objective is to help ensure that nuclear energy is available in the 21st century in a sustainable manner.
- ▶ INPRO seeks to bring together all interested Member States, including technology holders and users, to consider actions to achieve desired innovations.



# Nuclear Energy System (NES)

## Strategic Planning: 3 linked Parts

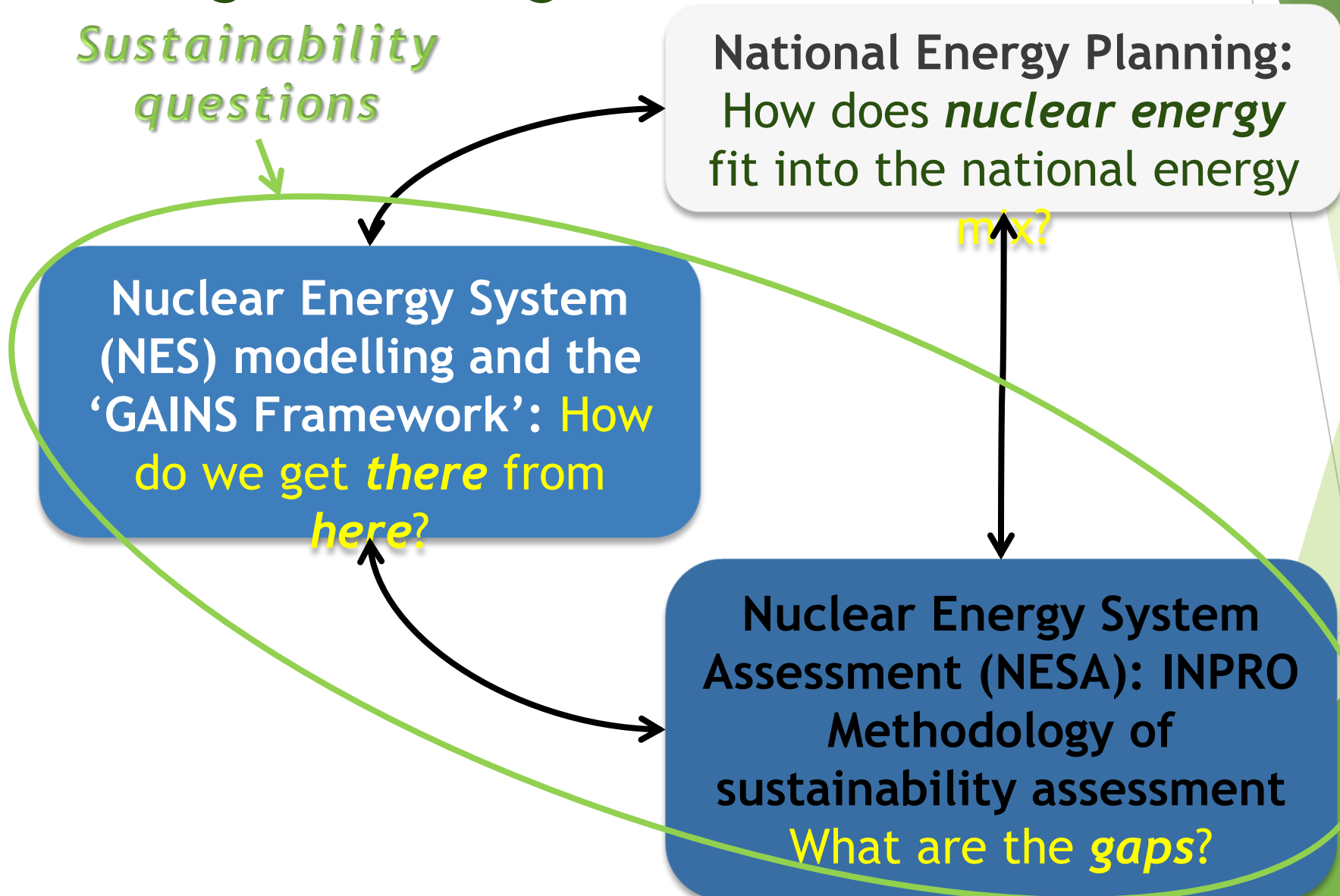
*Sustainability questions*

National Energy Planning:  
How does *nuclear energy* fit into the national energy

Nuclear Energy System (NES) modelling and the 'GAINS Framework': How do we get *there* from *here*?

Nuclear Energy System Assessment (NESA): INPRO Methodology of sustainability assessment  
What are the *gaps*?

mx?



# INPRO example: GAINS Project Organization

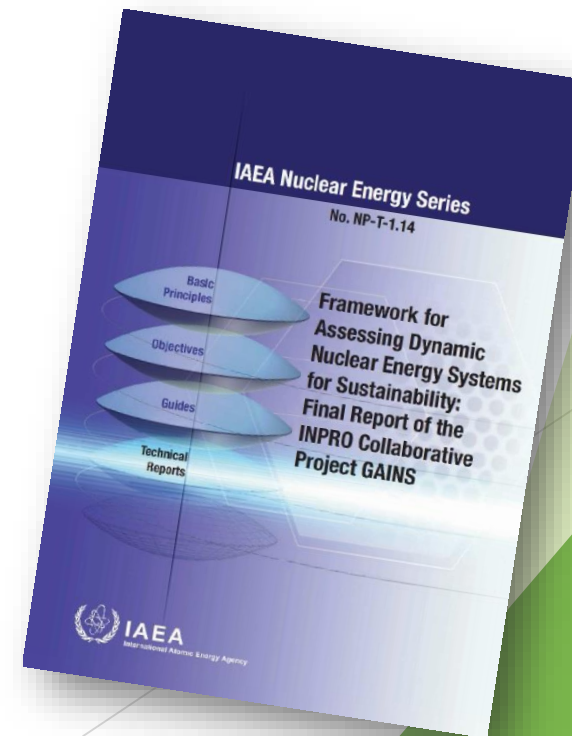
## ► Strengths

- *15 Member States participated, including large supplier States - Belgium, Canada, China, Czech Republic, France, India, Italy, Japan, Republic of Korea, Russian Federation, Slovakia, Spain, Ukraine, USA, EC, and Argentina as an observer*
- Thermal and fast reactor MS ‘communities’ working together
- Unified criteria of sustainability *based on the INPRO Methodology*

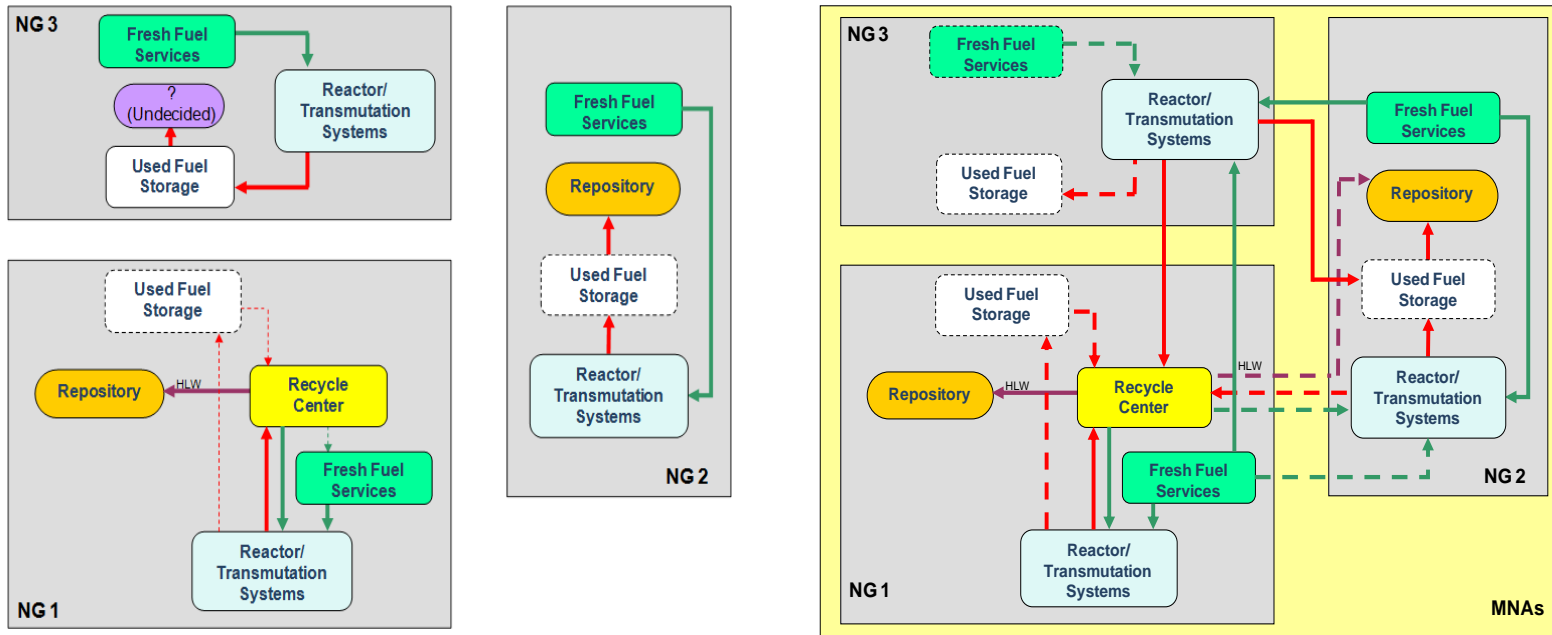
## ► History

- Project start: July 2008
- Two meetings each year during 2009-2010
- Last meeting: April 2011
- Final report published in 2013: **NP-T-1.14**

[http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1598\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1598_web.pdf)



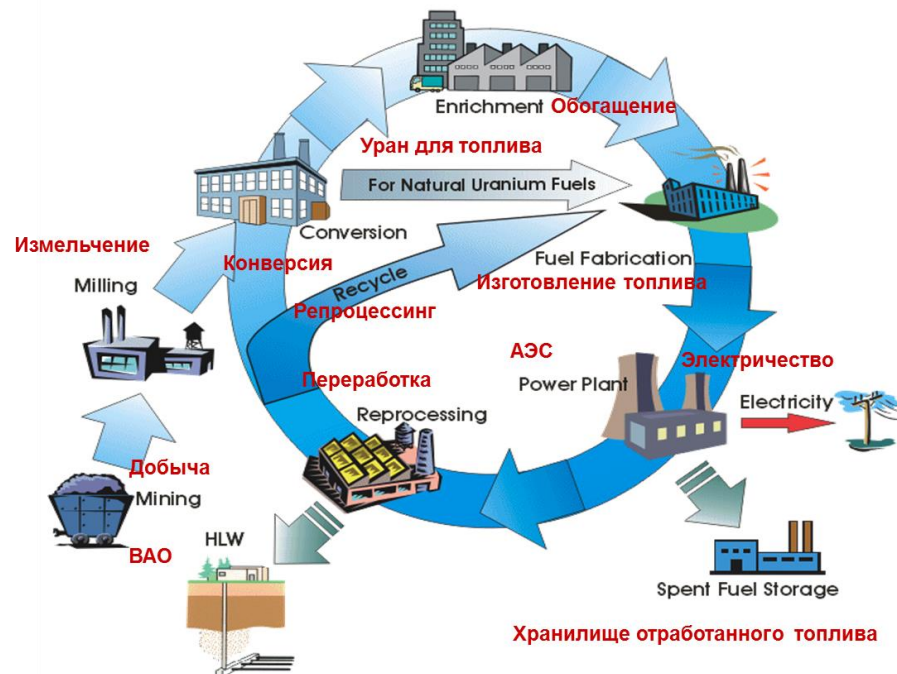
# Possible Story Lines of Long-term Nuclear Energy Evolution



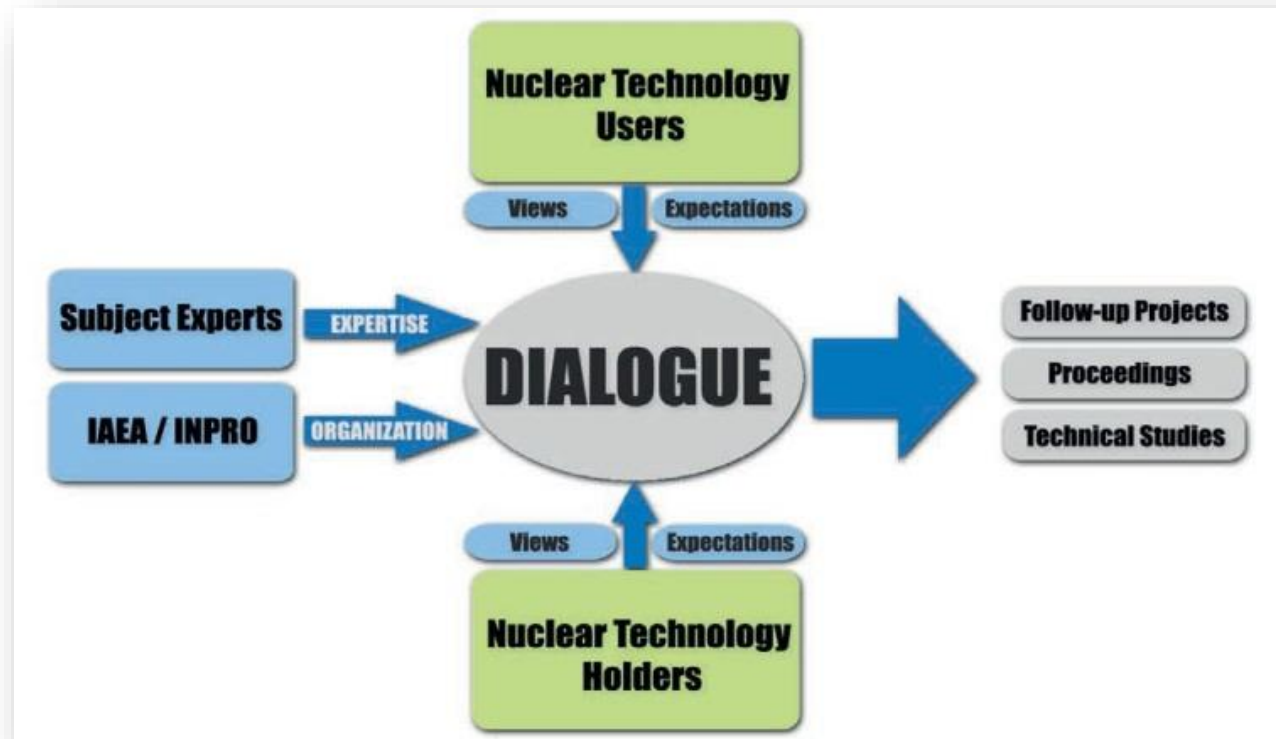
- **Heterogeneous non-synergistic world** based on self-reliance and national/regional systems with limited cooperation
- **Heterogeneous synergistic world** with rapid changes toward regional and global solutions and fully open cooperation
- **The real world** is a mixture of these ‘bounding storylines’ – the extent of cooperation will have impacts on sustainable development

# INPRO and Closed 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.



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



# The objectives of the Dialogue Forum 10<sup>th</sup>

- ▶ 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;
- ▶ To analyze drivers for cooperation, as well as to identify and analyze 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 High Level Waste;
- ▶ To point out potential technological developments that may impact on the pros and cons of SNF management through cooperation.



# Session 1: Need for cooperation in the Back-End of the Nuclear Fuel Cycle

Detail overview of different past initiatives related to multilateral cooperation in nuclear fuel cycle back end indicating why these initiatives were not successful.

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.

Analysis of current technical challenges towards sustainability of the back end and detail analysis of former practices of USSR on spent fuel take-back policy.

Three major possibilities for cooperation in the back end that could be pursued multilaterally:

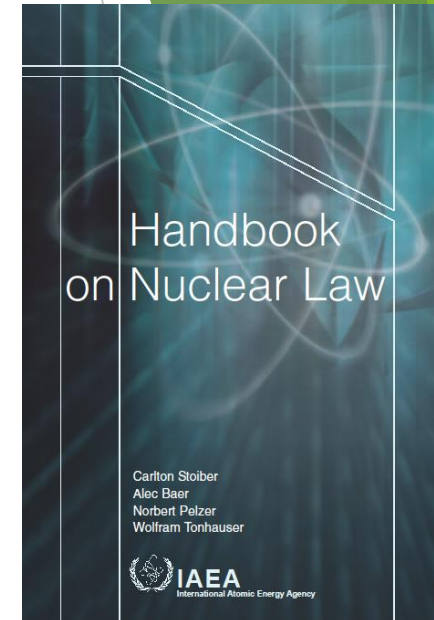
- ▶ storage and/or disposition of spent fuel may be a suitable candidate for a multilateral approach, primarily at the regional level
- ▶ final disposal of spent fuel and high level radioactive waste may be a candidate for a multilateral approach
- ▶ bundled fuel cycle services for nuclear fuel of NPP including take-back of spent nuclear fuel by vendors may provide assurance of fuel supply at both: the front end and the back end of NFC.



# **Session 2: International conventions and national laws/regulations for SNF-transfer of responsibilities, trans-boundary transport**

Conclusions of the session:

- ▶ Over time there appears to be a growing need for a multinational repository. 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.
- ▶ Many forums exist that can and should play a prominent role in some of the key questions (e.g., the Joint Convention is planning to hold a topical meeting on multilateral coordination on the back end and will be addressing and clarifying legal and regulatory issues). INPRO could make valuable contributions in addressing some of the technical, policy, and economic issues.
- ▶ Small fleet and emerging countries are watching very closely the interplay between the policies of the established countries relative to the back end. Those policies have key differences and those differences are sending a message that in some cases does not contribute to progress.



# **Session 3: Drivers and Impediments for cooperation in area of Nuclear Fuel Cycle Back End**

Information on national strategies and international cooperative activities in the area of Nuclear Fuel Cycle back end in Bulgaria, Vietnam, Egypt, Indonesia, Romania, Russia and Ukraine.

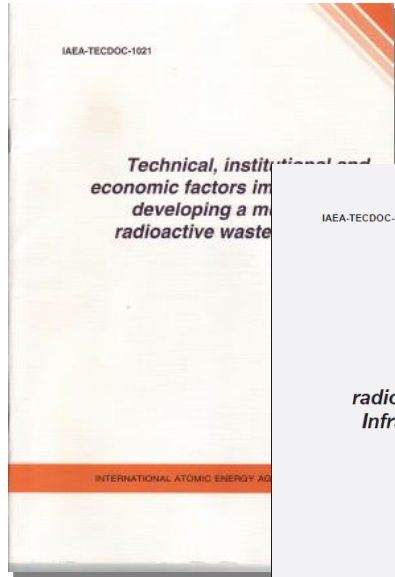
The following findings were noted:

- ▶ 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.
- ▶ Keeping national and multinational options open is a common strategy - but to be credible effort must be invested then in both approaches.

Conclusions:

- ▶ 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 of NFC; 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 vendor nations should provide support to newcomers in their efforts to develop a credible, safe and secure back end strategy.

# IAEA documents addressing multilateral issues



1998



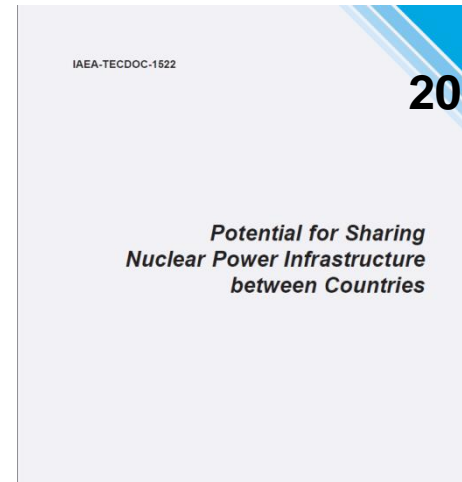
2004



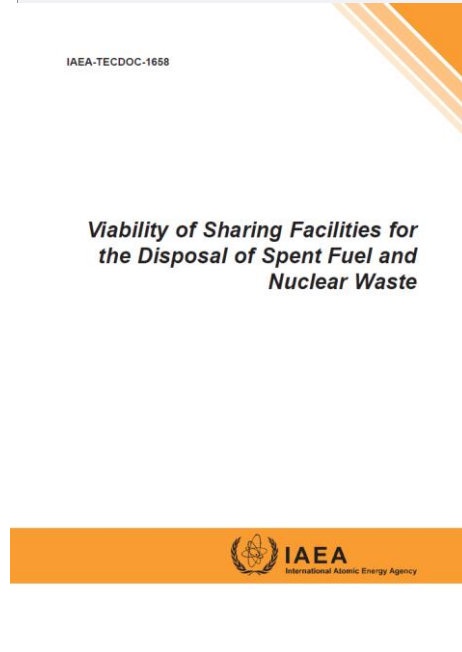
2005



2005



2006



2011

# Session 4: Time frames and public acceptance

Overview of spent nuclear fuel and radioactive waste management programmes in different countries and at different stages,

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

Role of international cooperation in these topics.

Summary:

- ▶ Time frames: R&D, siting and licensing take ~30/40 years so staged approach towards the repository solution is necessary. Importance of having a national strategy, that covers all the steps until disposal in an open, transparent manner is essential as well as existence of a successful national programme.
- ▶ 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.
- ▶ International cooperation in back end is already in place for spent fuel (reprocessing, fuel take-back). Such cooperation in reprocessing is reducing time-scales for final disposal.

# **Session 5: Impacts of development of advanced reactors and fuel cycles to SNF management**

A number of complex technological system works for realization of back end NFC including current and innovative reactors and recycling systems (France, Russia, India, etc.) are underway. 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 plutonium and control over growth of plutonium inventory. Systematic U & Pu recycle in fast neutron reactors will provide for sustainable management of nuclear materials and waste, avoiding increasing of Pu-bearing stockpiles, opening the way to a drastic extension of the use of U resource and full transition to sustainable use of nuclear power.

Synergistic collaborations among countries in the fuel cycle back end may offer higher rates of capacity growth and larger-capacity centralized fuel cycle enterprises. Models for collaboration among counties already exist. The initial phase of the cooperation is use of recycling strategies and minimizing NFC infrastructure among interested partners

Potentially, LWR/FR nuclear energy system 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 legal and institutional issues in interested technology holders, technology users and newcomer countries is necessary to foster global cooperation in the back end of nuclear fuel cycle.

# *The DF conclusions*

- ▶ Global nuclear capacity is expected to increase significantly by 2030 which means that availability of the deep geological repository capacity will remain a scarce resource. Optimizing the use of scarce resources is critical for the sustainability of nuclear power. Options for management of spent nuclear fuel are sustainable if they cover all the steps of spent fuel management until final disposal, in accordance with an acceptable, practical plan that prove to be feasible with an acceptable impact level and include a realistic and balanced financing plan.
- ▶ Direct disposal and recycling are not competitive solutions. The geological disposal is an unavoidable step in nuclear waste management. SNF management can be based on recycling and on combination of recycling and direct disposal, as per decision of particular country. Multilateral cooperation will foster choosing path forward on nuclear fuel cycle back end.
- ▶ Discussions following each presentation and the panel discussion demonstrated the high level of interest in the topic. This type of dialogue is important in promoting multilateral cooperation on the back end. Progress in addressing the issues associated with the back end will depend on opportunities that promote discussion, such as this Dialogue Forum.

# The Dialogue Forum provided for

- ▶ Understanding the value of cooperation in the back end of the nuclear fuel cycle and the implications of such cooperation for SNF management.
- ▶ Identification of drivers and impediments for cooperation on the back end of the nuclear fuel cycle, including proposed solutions to overcome some of the impediments identified.
- ▶ Identification of potential technological developments that may impact on the pros and cons of SNF management through cooperation.
- ▶ Clarification of high Member States' interest in participating in a future study on cooperative approaches to the back end of the nuclear fuel cycle, and development of recommendations to the IAEA on possible future activities in this area.

## The following are recommendations of Dialogue Forum:

- ▶ Continue the efforts started by the Dialog Forum and modeling synergies in back end of nuclear fuel cycle including legal/institutional aspects.
- ▶ Detail studies on institutional, economic and legal 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

*(This presentation based on the author's participation in the Dialogue Forum as Chairman. The IAEA provided the information only.)*