

The 18th INPRO Dialogue Forum
on Partnerships for Nuclear
Development and Deployment

Chair's Summary

21 May 2021

Mr. Vladimir ARTISYUK



IAEA

International Atomic Energy Agency

International Project on Innovative Nuclear Reactors and Fuel Cycles

INPRO Tasks:

- #1: Global scenarios
- #2: Innovations
- #3: Sustainability
Assessment and
Strategies
- # 4: Dialogue & Outreach

Where is INPRO Innovation?

Innovation in the areas of

- Reactors
- Nuclear fuel cycles – front end and back end
- Institutional approaches to nuclear power
- Sustainable development
- National strategic and long-term planning
- Develop and provide tools and services

- **Bringing together technology holders and users to jointly consider international and national actions for achieving innovations in nuclear reactors and fuel cycles**
- **Supporting Member State efforts that keep nuclear energy available to contribute to meeting sustainable energy needs of the current century and beyond**

INPRO in the Resolutions of the IAEA General Conference



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Res(64), 12

Strengthening the Agency's activities related to nuclear science,
technology and applications

adopted on 25 September 2020

**#2. IAEA communication, cooperation with other agencies and
stakeholder involvement**

**#6. Agency activities in the development of innovative nuclear power
technology**

**#8. Small and medium-sized reactors or small modular reactors —
Development and deployment**

Resolutions GC(64)

Strengthening the Agency's activities related to nuclear science, technology and applications



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#2. IAEA communication, cooperation with other agencies and stakeholder involvement

The General Conference

10. Recommends that the Secretariat continue to explore opportunities for synergy between the Agency's activities (including the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)) and those pursued under other international initiatives in areas relating to international cooperation in peaceful uses of nuclear energy, safety, proliferation resistance and security issues and, in particular, supports collaboration among INPRO, the Generation IV International Forum (GIF), IFNEC, the European Sustainable Nuclear Industrial Initiative (ESNII) and the International Thermonuclear Experimental Reactor (ITER) with regard to innovative and advanced nuclear energy systems;

11. Takes note of the Secretariat's cooperation with IFNEC, in areas of nuclear infrastructure, the back end of the nuclear fuel cycle, and sustainable delivery chains, as well as small and medium or modular reactors (SMRs);

Dialog Forum in Res (64)/12



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Strengthening the Agency's activities related to nuclear science, technology and applications

#6. Agency activities in the development of innovative nuclear power technology

(g) Noting that the scope of INPRO includes activities to support interested Member States in developing national long-range sustainable nuclear energy strategies and related nuclear energy deployment decision making, including nuclear energy system assessments (NESAs) using INPRO methodology, the **INPRO Dialogue Forum**, and regional training on nuclear energy system modelling, including collaborative scenarios,

10. Notes the Agency's efforts in developing innovative infrastructure approaches for future nuclear energy systems and invites Member States and the Secretariat to **examine the role that technological and institutional innovations can play in improving nuclear power infrastructure and enhancing nuclear safety, security, and non-proliferation and to exchange information**, including through the **INPRO Dialogue Forum**;

#8. Small and medium-sized reactors or small modular reactors — Development and deployment

(e) Noting the outcomes of the 17th INPRO Dialogue Forum on Opportunities and Challenges in small modular reactors

Specifics of 18-th INPRO DF



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Title:

Partnerships for Nuclear Development and Deployment



Format:
Virtual



Participation:

MS/O

Persons

33/5

81



18th INPRO DF: Objectives & Structure



Main objectives:

- Provide a platform for Member States to discuss various aspects of multilateral or bilateral partnerships and strategic alliances;
- Discuss and share experiences, information and knowledge in partnerships from the nuclear and the other industries;
- Share the best practices and lessons learned from cases of success or failure; and
- Discuss how the IAEA can help Member States promote partnerships in nuclear development and deployment.

17 PARTNERSHIPS
FOR THE GOALS



Structure:

Day 1 Opening Session /

- 1 Session I: The Power of Partnership
- 2 Session II: Partnerships for Nuclear Infrastructure
- 3 Session III: Partnerships for the Embarking Countries
- 4 Session IV: Partnerships for Innovative Nuclear Technology

Session I: The Power of Partnership

4 presentations



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Options to Enhance Nuclear Energy Sustainability through Synergies in Technology and Collaboration among Countries. Major findings of the INPRO collaborative project SYNERGIES (IAEA/INPRO/V.Kuznetsov)

UNECE The Use of Nuclear Fuel Resources for Sustainable Development: Entry Pathways (WNA/Harmony Programme/ K.Lee)



International Framework for Nuclear Energy Cooperation (IFNEC) (IFNEC/IDWG/M.Goff)



Nuclear Partnerships for a Firm Low- Carbon Energy Future (Pen State Univ/ J.P.Allain)

Key findings:

- ✓ Synergy (magnifying effects) of efforts of various organizations in promoting nuclear power as a vital option for energy mix
- ✓ Important role of universities (in partnership with industry&governments) in promoting carbon-free energy sources (including nuclear).

Session II: Partnerships for Nuclear Infrastructure

7 presentations



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IAEA Support to Countries Embarking and Expanding Their Nuclear Power Programmes
(IAEA/NEDS/J.Bastos)

Role of Partnerships in Supporting the Tunisian NPP Project
(Tunisia/TEGC/C.Zamali)

RATEN ICN Contribution in international Partnerships for Nuclear Development
(Romania/C.Margenau)



SCC CEN Experience on the IAEA ICERR Platform
(Belgium/ M.Scibetta)

Information & Experience on Nuclear Research Network in ASEAN
(Thailand/TINT/W.Vechgama)

**Efficient use of
research facilities**



Partnership in Training in New Build Projects
(Russia/REIN/V.Zhuravleva)

Partnership in NPP Development and Deployment
– Experience from Sharing of the Krsko NPP Between Croatia and Slovenia
(Croatia/ Univ. of Zagreb/Z.Tomsic)



Session II: Partnerships for Nuclear Infrastructure (cont)



Key findings:

- ✓ Milestone approach is applied for new projects in the countries with well developed nuclear infrastructure (fast reactor ALFRED)
- ✓ University play a role of TSO in the countries with small power demands
- ✓ INPRO Methodology unites research networks (ASEAN)
- ✓ INPRO Methodology is the key to analysis of long-term solutions (solution of waste storage and decommissioning) in shaping National Position for the countries considering joint ownership of a NPP

Session III:

Partnerships for the Embarking Countries

4 presentations



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Technology holders

IGA

Collaboration of Countries Embarking on Their First NPP and/or RR Project, on Sustainable Nuclear Infrastructure Development
(Russia/RUSAS/Y. Chernyakhovskaya)

SMART Partnership Cooperation between Korea and Saudi Arabia
(Korea/KAERI/K.K.Kim)

IP Ownership Share



Embarking Countries

Partnership for 1-st NPP Deployment: Regulatory Body Experience
(Indonesia/BAPETEN/B.Aji)

Regulators

The Moroccan NPP Project and Partnership Perspective
(Morocco/ONEE/R.Sekkuri Alaoui)

Utilities

Key findings:

- ✓ Competence building is the heart of cooperation
- ✓ Key numbers of the staff needed estimated (hundreds for NI, dozens for TT option and RB)
- ✓ INPRO Methodology affects the National Position



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Session IV: Partnerships for Innovative Nuclear Technology



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INPRO-IAEA and GIF Collaboration & Current Activities
(GIF/ H.Kamide)

Russia-China Cooperation in Development Fast Reactor Technology and Closed Nuclear Fuel Cycle
(Russia /Rosatom/ V.Pershukov)

Strategic Alliances & Innovative Supply Chain, Key Aspects for Successful Deployment of a Compact Molten Salt SMR
(Denmark/ F.P.Espel)

International Project on MBIR Reactor as an Instrument for Justification of Innovative Nuclear Technologies
(Russia/Rosatom/ A.Zagornov)

Key findings:

- ✓ **R&D in the field of innovative technologies is considered as an attractive market**
- ✓ **Innovative reactors are at the stage of starting the market penetration;**
- ✓ **There is an evidence of reviving interest to Fast Reactor Technology on International Platforms and practical steps in commercialization of this technology in some advanced countries;**

Extra Session:

Power System Modelling & Analysis: A New Capability Developed with PESS & NPTDS (IAEA/INPRO/F.Ganda)



From Sonia to everyone: 2:34 PM

For the other speakers: In terms of energy matrix for each of the countries, are you working in defining the nuclear portion / renewables in medium / long terms forecasts? -- Can you elaborate in terms of activities and partnerships in the area of public acceptance?

INPRO is developing a computational model (FRAMES) together with other sections at the IAEA (PESS and NPTDS) that allows a defensible and robust identification of the optimal mix of nuclear and renewables, in the specific situation of each Country or region (e.g. including the actual historical and forecasted load, renewable potential at the hourly resolution etc.).

From Luis MANRIQUEZ to everyone: 2:50 PM

I would like to know if these IAEA economic tools consider renewable energy presence in the energy matrix.

IAEA-FRAMES is specifically designed to look at the full complexity of future energy systems, including not only detailed renewable representations, but various types of storage, hydro, demand side management etc. Additionally, we are developing the capability to include non-electric applications of nuclear energy, i.e. thermal hydrogen generation, district heating, desalination and other direct uses of nuclear heat. This should really allow to quantify the value that nuclear can bring to future systems with high renewable penetration and large issues associated with intermittency.

From Artem Petrosyan to everyone: 2:54 PM

I would like to ask have you ever analyze the influence of renewable energy sources (PV station) to the grid in general and to the safe operation of SMRs, this is became more important for the countries with small grid. Thank you.

At the IAEA (and in INPRO in particular) we are developing a specific model (FRAMES) to look exactly into this issue, among others. FRAMES has the granularity to include specific features of SMRs (besides their smaller scale), such as faster ramping in some cases, high temperature heat etc. Also, by utilizing a discrete formulation (even though computationally much more difficult to solve), it allows to really see the effect of discrete additions of unit of different sizes to smaller grids (which obviously would highlight the benefit of SMRs for smaller grids). This would not be possible with models that do not allow a discrete formulation, but only allow a continuous formulation.

Key findings:

FRAMES modelling capability provides detailed energy system modelling that can show the relative benefits of renewables and nuclear energy in a national or regional power grid system and energy use scenarios. The DF#18 showed that the participants found this modelling capability desirable. To use this modelling capability within the restrictions of the Agency building a centre of excellence in energy modelling could be done with Nuclear Energy Dept. (INPRO, NPTDS, PESS) working with member states to provide guidance, training and results with FRAMES to use in energy system evaluation.

Coming Back to Main Objectives



Main objectives:

- Provide a platform for Member States to discuss various aspects of multilateral or bilateral partnerships and strategic alliances;
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- Share the best practices and lessons learned from cases of success [or failure](#); and
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Main Conclusion 18-th DF

on Partnerships for Nuclear Development and Deployment



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- Reaffirms its viable role as an viable platform to discuss innovations in nuclear reactors and fuel cycles, sustainable energy needs of the current century and beyond;
- Highlights the importance of the INPRO methodology in shaping National Position towards nuclear option;
- Invites for cooperation in developing new modelling tool FRAMES to provide scientifically based approach in supporting the National Position towards nuclear option;
- Emphasizes role of the universities in promoting innovations in approaching sustainability

...Thank you for your attention



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