INPRO International Project on Innovative Nuclear Reactors and Fuel Cycles

SUSTAINABLE NUCLEAR ENERGY FOR THE 21st CENTURY

Concerns over energy resource availability, energy security and climate change suggest an important role for nuclear power in supplying sustainable energy in the 21st century. The International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) was initiated in 2000 by a resolution of the IAEA General Conference to help ensure that nuclear energy is available to contribute to meeting global energy needs of the 21st century in a sustainable manner. It is a mechanism for IAEA Member States that have joined the project as INPRO members to collaborate on topics of joint interest. By 2010, INPRO membership had grown to 30 countries and the European Commission. The results of INPRO's activities, however, are made available to all IAEA Member States.

Joining Forces

To achieve its objectives, INPRO brings together nuclear technology holders and users to jointly consider international and national actions that would result in desired innovations in nuclear reactors, fuel cycles or institutional approaches.

INPRO plays an important role in understanding:

- The future development of nuclear energy systems from a national, regional and global perspective;
- The role of innovation in technologies and institutional arrangements in support of this development.

Discussing and Cooperating

INPRO provides a forum for discussion and cooperation for experts and policy makers from industrialized and developing countries on sustainable nuclear energy planning, development and deployment.

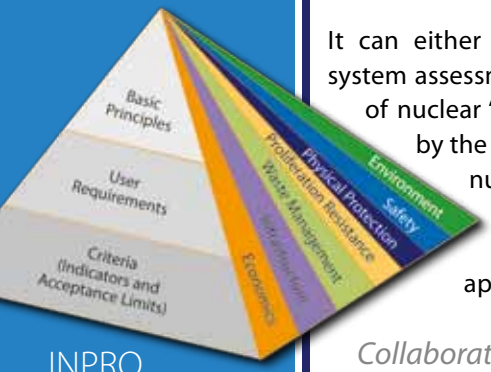
INPRO promotes a mutually beneficial dialogue between countries with nuclear technology and countries considering these technologies to develop new nuclear energy capacity.

INPRO supports national strategic and long range planning and decision making, and an awareness of technology innovation options for the future. All INPRO activities are undertaken in close cooperation with Member States.

Making Things Work

INPRO is a membership based project, led by a Steering Committee in which all INPRO members are represented. The INPRO Group in the IAEA Department of Nuclear Energy coordinates activities with and in Member States that have joined the project. INPRO is funded mainly by extra-budgetary resources.

INPRO has been strongly supported by the IAEA General Conference, which each year requests a report about the status of the project and results achieved and, at the same time, invites IAEA Member States to contribute to INPRO in the form of financial support, human resources and expertise through participation in INPRO studies and projects.



INPRO Methodology

INPRO Programme Areas

INPRO's activities are organized and implemented in several main programme areas. Eleven ongoing collaborative projects support these activities with the active participation of INPRO members.

Long Range Strategies for Nuclear Energy Systems Using the INPRO Methodology

The IAEA supports Member States in their long range and strategic planning and decision making on nuclear power programmes through the application of the INPRO methodology. This methodology is an internationally validated tool for assessing a nuclear energy system for its long range sustainability in all key areas, from economics to proliferation resistance to the environment.

It can either be applied in a nuclear energy system assessment (NESA) or to build awareness of nuclear 'newcomers'. NESAs are supported by the IAEA as an integral part of national nuclear power planning, along with IAEA energy system planning models and the IAEA 'milestones' approach.

Collaborative Projects

- Proliferation Resistance: Acquisition/Diversion Pathway Analysis (PRADA)
- Environmental Impact Benchmarking Applicable for Nuclear Energy Systems under Normal Operation (ENV)

Global Vision, Scenarios and Pathways to Sustainable Nuclear Development

By formulating scenarios and harmonizing visions for long term global nuclear development and deployment, INPRO helps newcomers and 'mature' nuclear countries alike to understand the potential of technical innovations as well as new institutional and legal approaches for developing and building a sustainable nuclear 'architecture' in the 21st century, including possible transition scenarios.

Collaborative Projects

- Global Architecture of Innovative Nuclear Systems based on Thermal and Fast Reactors including Closed Fuel Cycles (GAINS)
- Investigations of the ^{233}U/Th Fuel Cycle (ThFC)
- Fuel Cycles for Innovative Nuclear Systems through Integration of Technologies (FINITE)
- Meeting Energy Needs in the Period of Raw Material Insufficiency during the 21st Century (RMI)

Innovations in Nuclear Technology and in Institutional Arrangements

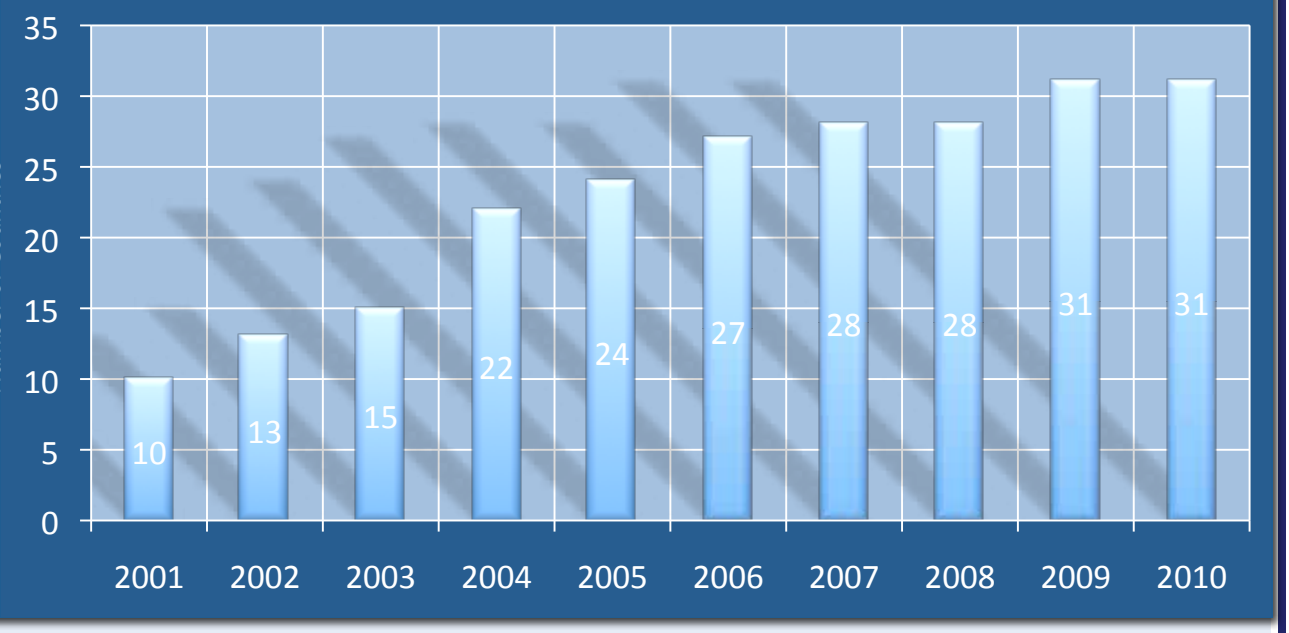
Fostering collaboration among INPRO members on selected innovative nuclear technologies and related R&D, which contribute to sustainable nuclear energy, is a key activity in this area. Institutional arrangements are also part of the nuclear energy system, including agreements, treaties, legal frameworks or regimes, and conventions. Deploying new reactor designs may require innovative approaches to institutional measures, in particular for non-stationary, small and medium-sized reactors. INPRO fosters collaboration in this area and supports countries in developing and implementing innovative arrangements.

Collaborative Projects

- Investigation of Technological Challenges related to the Removal of Heat by Liquid Metal and Molten Salt Coolants from Reactor Cores Operating at High Temperatures (COOL)
- Decay Heat Removal System for Liquid Metal Cooled Reactors (DHR)
- Advanced Water Cooled Reactors (AWR)
- Performance Assessment of Passive Gaseous Provisions (PGAP)
- Implementation Issues for the Use of Nuclear Power in Small Grid Countries (SMALL)

INPRO Dialogue Forum on Nuclear Energy Innovations

This cross-cutting area aims at fostering information exchange between nuclear technology holders and technology users to ensure that future technical and institutional innovations meet the expectations of both. The forum also addresses national long term nuclear planning and the global nuclear energy system.



2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ARGENTINA	BRAZIL	BULGARIA	ARMENIA	UKRAINE	BELARUS	BELGIUM		ALGERIA	
CANADA	KOREA, REP.	PAKISTAN	CHILE	USA	JAPAN			ITALY	
CHINA	SWITZERLAND		CZECH REP.		SLOVAKIA			KAZAKHSTAN	
GERMANY			FRANCE						
INDIA			INDONESIA						
NETHERLANDS			MOROCCO						
RUSSIAN FEDERATION			SOUTH AFRICA						
SPAIN									
TURKEY									
EC									

INPRO Members 2001–2010

Membership in INPRO

Since its establishment, membership in INPRO has grown to 31 members, representing 75 percent of the world's GDP and 65 percent of the world population. Several other countries have observer status as they consider membership or are participating on a working level.

Benefits of INPRO Membership

Developing and developed countries with nuclear energy programmes or those considering building nuclear power plants will benefit from international cooperation facilitated by INPRO.

They will be able to use the tools, models, publications and expertise offered through the project in support of sustainable nuclear energy deployment and technology innovations, participate in the dialogue between technology holders and users, and take advantage of the results and findings of INPRO studies.

INPRO members also have the right to nominate a representative to the INPRO Steering Committee, thus being able to influence the planning of activities and bringing their own expertise to the project.

How to Become an INPRO Member

IAEA Member States and recognized international organizations can take advantage of these benefits by joining INPRO as members.

In the first step, a letter is to be sent to the IAEA and addressed to the INPRO Project Manager, announcing the wish of a Member State or organization to join INPRO as a member or as an observer.

The INPRO Manager will respond to this request, offering the following possible modes of participation:

- Providing a direct monetary contribution (extrabudgetary funds);
- Providing cost-free experts to work with the INPRO Group at the IAEA;
- Performing agreed nuclear energy system assessment studies using the INPRO methodology;
- Participating in INPRO collaborative projects.

When agreement is reached on the mode of participation, the Member State will be officially recognized as a member of INPRO.

Observers are not required to provide major contributions to INPRO. However, they are invited to finance their attendance at INPRO meetings by their own means.

For more information: *www.iaea.org/INPRO*

INPRO

International Project on Innovative Nuclear Reactors and Fuel Cycles

INPRO The First Ten Years 2000–2010

A BRIEF HISTORY OF EVENTS

2000 The 44th IAEA General Conference passes a resolution which leads to the initiation of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO).

2001 Phase 1 of INPRO is launched to develop and validate a holistic approach for the assessment of innovative nuclear energy systems — the INPRO methodology; Phase 1 ends in 2006.

2003 The first publication on the INPRO methodology, *Guidance for the Evaluation of Innovative Nuclear Reactors and Fuel Cycles* (IAEA-TECDOC-1362), is issued.

2004 Six national and eight individual case studies on specific nuclear installations test the INPRO methodology; a revised version is published: *Methodology for the Assessment of Innovative Nuclear Reactors and Fuel Cycles* (IAEA-TECDOC-1434).

2005 Argentina, Armenia, Brazil, India, the Republic of Korea and Ukraine assess different nuclear energy systems using the INPRO methodology. Another eight countries undertake a joint study on an innovative nuclear energy system based on closed nuclear fuel cycles with fast reactors. The studies are concluded in 2007 and contribute to improving the INPRO methodology.

2006 World leaders meeting at the G8 Summit in St. Petersburg, Russian Federation, acknowledge the efforts of INPRO and the Generation IV International Forum (GIF).

Phase 2 of INPRO is launched, focusing on the INPRO methodology and assessment studies, infrastructure and institutional related activities and collaborative projects.

2007 A study on common user considerations to identify commonalities in the expectations of developing countries considering the introduction of nuclear power is launched; results are published in 2009.

2008 The report of an independent commission on *Reinforcing the Global Nuclear Order for Peace and Prosperity: The Role of the IAEA to 2020 and Beyond*, requested by the IAEA Director General, recognizes INPRO's role in bringing together "many states ... to consider approaches to safer, cheaper, more secure, and more proliferation-resistant nuclear systems, with effective management of nuclear waste."

The INPRO manual *Guidance for the Application of an Assessment Methodology for Innovative Nuclear Energy Systems* is published in 9 volumes (IAEA-TECDOC-1575 Rev. 1).

2009 INPRO's activities are reorganized into several major areas: Long Range Strategies for Nuclear Energy Systems Using the INPRO Methodology; Global Vision, Scenarios and Pathways to Sustainable Nuclear Development; Innovations in Nuclear Technology and in Institutional Arrangements; and INPRO Dialogue Forum on Nuclear Energy Innovations.

Eleven INPRO collaborative projects are under way, covering different issues concerning innovative nuclear reactors and fuel cycles; they support national and international R&D activities.

Belarus applies the INPRO methodology in a nuclear energy system assessment.

2010 INPRO and GIF strengthen their cooperation. Two workshops of the INPRO Dialogue Forum are held.

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