INTERNATIONAL PROJECT ON INNOVATIVE NUCLEAR REACTORS AND FUEL CYCLES (INPRO)

Assessing Transition to Sustainable Nuclear Energy Systems

INPRO Project 2

"GLOBAL NUCLEAR ENERGY SCENARIOS"

Presented by Vladimir KUZNETSOV

INPRO Dialogue Forum "Drivers and Impediments for Regional Cooperation on the Way to Sustainable Nuclear Energy Systems"

IAEA, Vienna, 30 July – 3 August 2012

IAEA

International Atomic Energy Agency

INPRO Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on
Innovative Nuclear Reactors
and Fuel Cycles

- Objective:

- -To develop global and regional nuclear energy scenarios, on the basis of a scientific-technical analysis, that lead to a global vision on sustainable nuclear energy development in the 21st century.

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

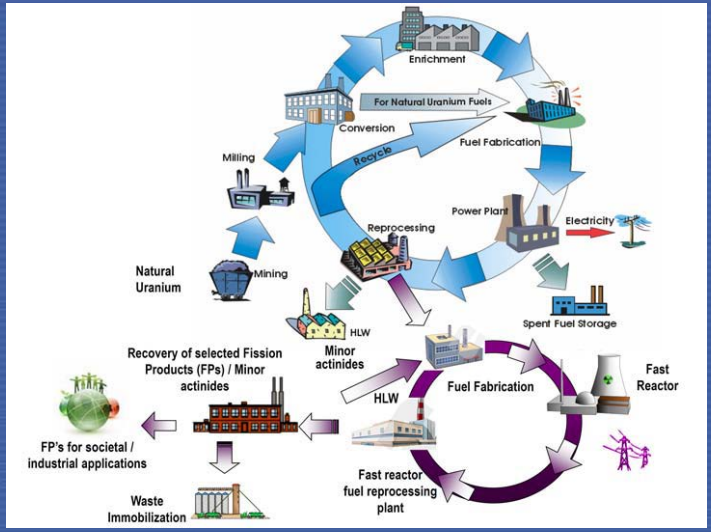
IAEA

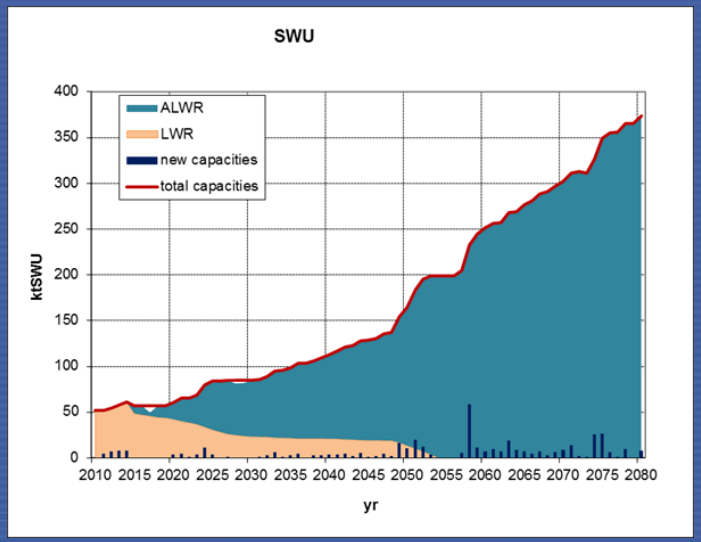
INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

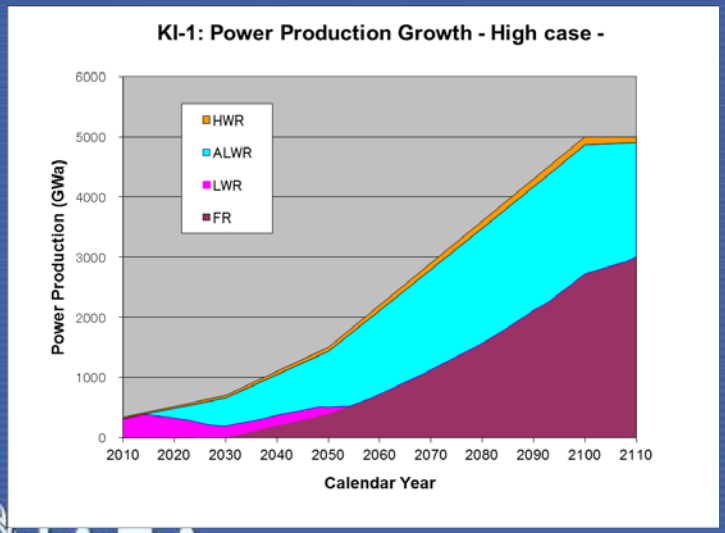
- Project 2 helps participating countries define *realistic* long-term national energy strategies by providing a framework for the analysis and assessment of :
- - how to make a transition from the current fleet of reactors and nuclear fuel cycles to a sustainable nuclear energy system
- - how national energy system could contribute to, and benefit from, sustainability of a regional and global nuclear energy system
- - the role of collaboration with other countries on the way to sustainable nuclear energy systems

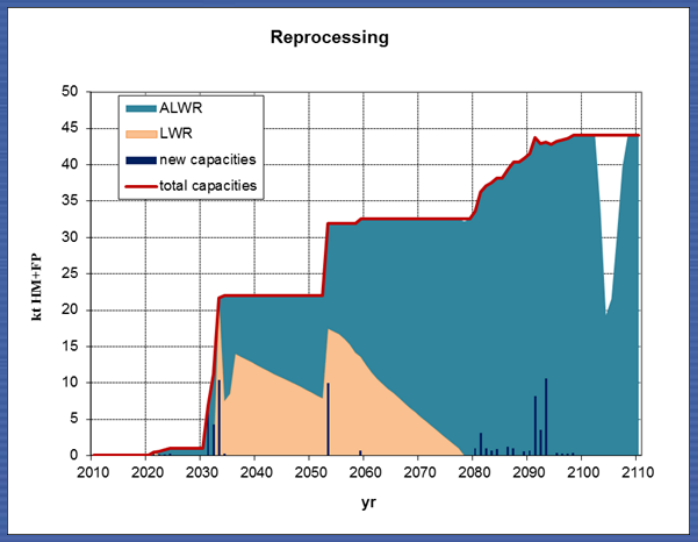
More details in a lecture "Towards Sustainable Nuclear Energy Systems: A Collective Approach" by Mr Luc Van Den Durpel (AREVA, France)

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS









Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Ongoing activities:

- Collaborative Project SYNERGIES *(Predecessors: VISION. GAINS, ThFC)*

- Collaborative Project FINITE (from Action Plan 2010-2011)

- Future activities:

- ROADMAPS (for Transition to Globally Sustainable Nuclear Energy Systems)

- Global Nuclear Energy Sustainability Report

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Activity: Collaborative Project SYNERGIES *(Synergistic Nuclear Energy Regional Group Interactions Evaluated for Sustainability)*
  Presentation by Mr V. Kuznetsov
- Predecessors:
- - Activity "Nuclear Energy Development in the 21st Century: Global Scenarios and Regional Trends" (2008-2010)
  Lecture by Mr A. Gagarinskiy
- - Collaborative project GAINS (Global Architectures of Innovative Nuclear Energy Systems with Thermal and Fast Reactors and Closed Nuclear Fuel Cycle) (2008-2011)
  Lectures by Mr V. Usanov and Mr B. Dixon
- - Collaborative project ThFC (Further Investigation of the ^{233}U/Th Fuel Cycle) (2009-2010) *IAEA Nuclear Energy Series No. NF-T-2.4 (2012)*

IAEA

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Predecessor 1:
- Activity on “Nuclear Energy Development in the 21st Century: Global Scenarios and Regional Trends” (2008-2010), Nuclear Energy Series report No. NP-T-1.8 published in 2010

- - Illustrated , using idealized examples, the potential contribution that innovative nuclear energy systems employing fast reactors and closed fuel cycles can make in meeting the global and regional demand for nuclear energy

- - Illustrated, for a range of possible demand scenarios, how nuclear materials might flow among different regions of the world in the 21st century;

- - Next logical step was to touch upon issues of world heterogeneity, different policies of countries regarding nuclear fuel cycle and the role of collaboration among different countries in making a transition to sustainable NES

IAEA

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Predecessor 2:
- Collaborative project GAINS (2008-2011), Final project report submitted to IAEA Publications Committee

- - developed an internationally verified framework for the assessment of transition scenarios to future sustainable nuclear energy systems (approach, assumptions, scenarios, codes, data)

- - considered heterogeneous world model and introduced a notion of non-personified groups of countries with different policy regarding nuclear fuel cycle (NG1, NG2, NG3)

- - introduced “Key indicators” and “Evaluation parameters” to assess whether NES evolution scenarios lead to sustainable nuclear energy systems

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Predecessor 2:
- Collaborative project GAINS (2008-2011)

- - examined possible scenarios with collaboration among different groups of countries and outlined possible benefits and issues of such collaboration

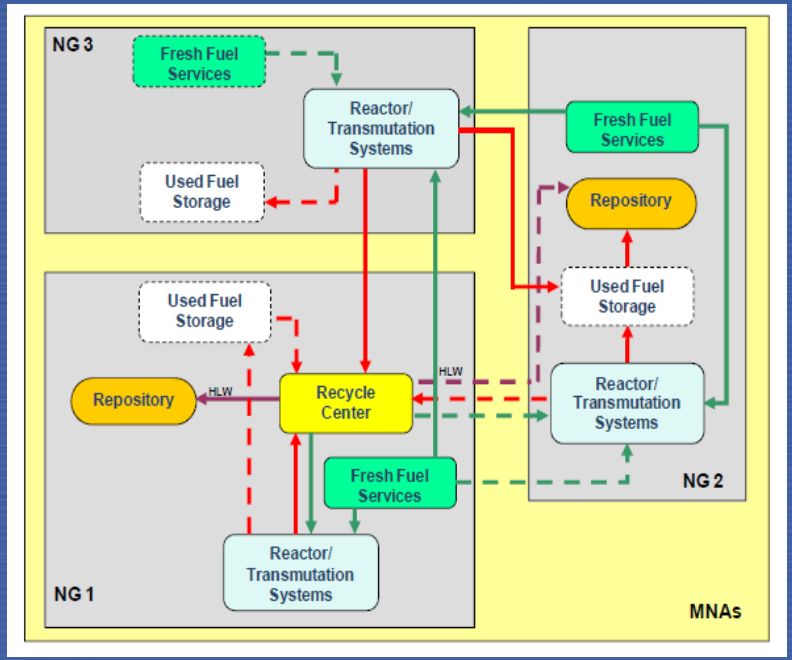
- - concluded that sustainability of a Global NES in the 21st would be easier to achieve if technology holders and technology users collaborate in the back-end of the nuclear fuel cycle

- - Next logical step was to touch upon drivers and impediments for collaboration and to identify 'win-win' strategies for collaboration among technology holders and users (SYNERGIES project)
-

IAEA

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

- Predecessor 2:
- Collaborative project GAINS (2008-2011)
-



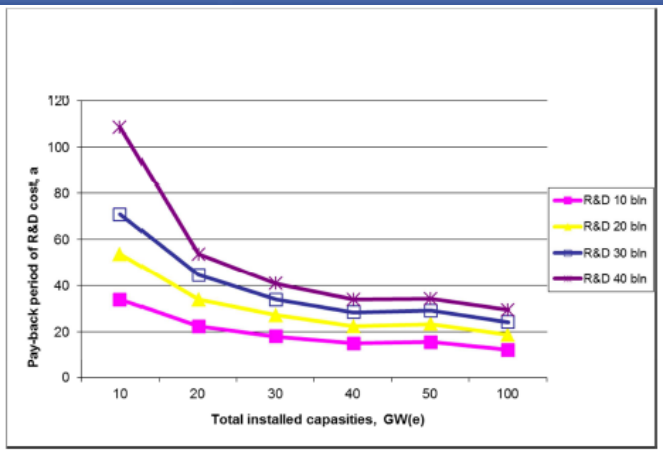


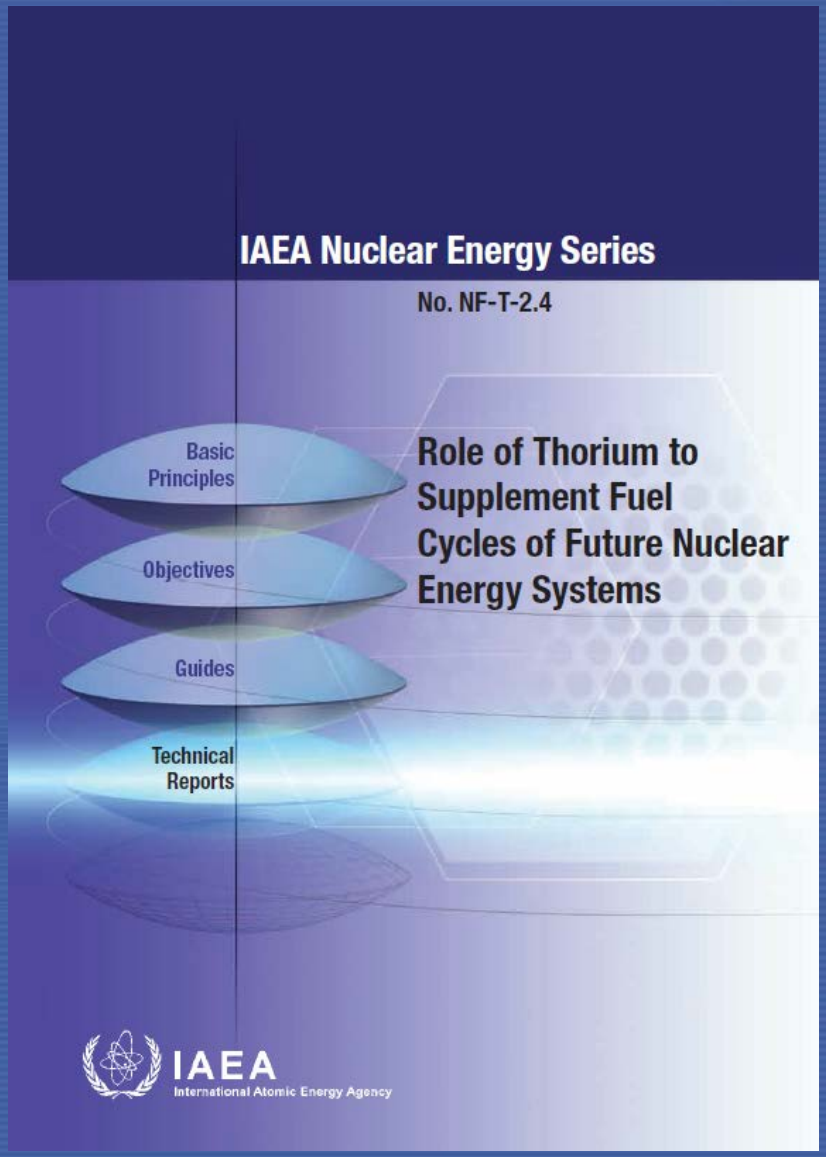
FIG. 9.57. Pay-back period for RD&D investments for the INS of different installed capacities.

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

- Predecessor 3:
- Collaborative project ThFC (2009-2010)
- Nuclear Energy Series No. NF-T-2.4 published in 2012:

http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1540_web.pdf

- - considered the potential role of thorium to supplement the uranium–plutonium fuel cycle in scenarios with a significant increase in the use of nuclear energy in the world



Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Activity: Collaborative Project SYNERGIES(2011–2014)
- Based on the analytical framework developed in GAINS

- - will identify and evaluate mutually beneficial collaborative strategies *('win-win' strategies*) and the driving forces and impediments for achieving globally sustainable nuclear energy systems in the 21st century through collaboration among countries
- - will identify short-term and medium-term collaborative actions capable to develop pathways to long term sustainability
- - will examine NES evolution scenarios additional to those already examined in the predecessor projects
- - Next logical step would be to identify *"who could do what where and when"* to achieve sustainable NES

IAEA

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Activity: Collaborative Project FINITE (Fuel Cycles for Innovative Nuclear Energy Systems based on Integrated Technologies)
- (extended from the budget cycle of 2010-2011)

  - Task 1: Adopt NE supply scenarios for 21st Century. *(Completed by India. Significantly developed by Argentina, China and Russian Federation).*
  - Task 2: Description of the nuclear energy systems (NES) constituting the closed fuel cycle (CFC) strategy, including deployment considerations. *(Significantly developed by India and the Russian Federation).*
  - Task 3: Modeling of the NES established on CFC, by using existing analytical tools and agreed matrix of parameters for each AINFCO considered. *(General calculations performed showing tools' capabilities)*
  - Task 4: Assessment of the CFC strategies on sustainability using INPRO Methodology.
  - Task 5: Identification of key innovations and recommendations for international cooperation.

Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on Innovative Nuclear Reactors and Fuel Cycles

- Future activity: ROADMAPS for a transition to globally sustainable nuclear energy systems (2013–2015)

Roadmap – flowchart of structured sets of actions, scope of work and timeframes for particular stakeholders in a collaborative scenario of transition to sustainable NES *(who does what where when)*

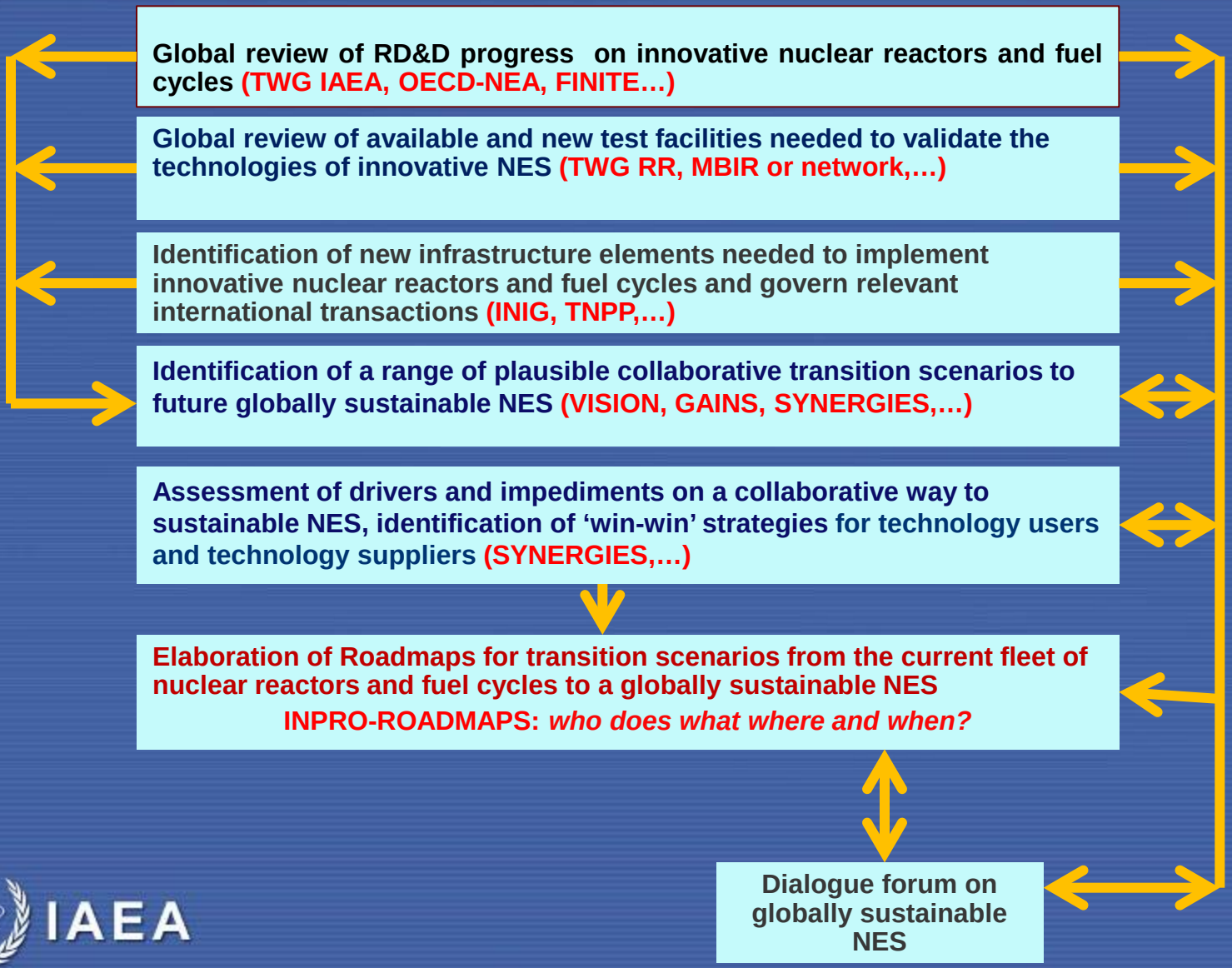
- This "umbrella" activity will integrate the outputs of a number of INPRO and IAEA projects to develop roadmaps for a transition to globally sustainable NES

- "What if" approach will be used to produce a number of variants

- Roadmaps will be updated on a periodic basis

IAEA

ROADMAPS - Structure



Project 2: GLOBAL NUCLEAR ENERGY SCENARIOS

IAEA

INPRO
International Project on
Innovative Nuclear Reactors
and Fuel Cycles

- Activity: Global Nuclear Energy Sustainability Report

- A policy level guidance publication summarizing the outputs of all activities of INPRO Project 2 “Global Nuclear Energy Scenarios”

- Generically, should be a follow-up to all projects presented on previous slides

THANK YOU!

Vladimir KUZNETSOV
V.Kuznetsov@iaea.org

IAEA
International Atomic Energy Agency