ACHIEVING NUCLEAR SUSTAINABILITY THROUGH INNOVATION

In 2000, the IAEA Member States recognized that concerted and coordinated research and development is needed to drive innovation that ensures that nuclear energy can help meet energy needs sustainably in the 21st century. Following an IAEA General Conference resolution, an international 'think tank' and dialogue forum were established. The resulting organization, the IAEA's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), helps nuclear technology holders and users coordinate the national and international studies, research and other activities needed to achieve innovations in nuclear reactor designs and fuel cycles. Currently, 38 countries plus the European Commission are participating in the project. This group includes both developing and developed economies that represent more than 75% of the world's population and 85% of its gross domestic product.

INPRO undertakes collaborative projects among IAEA Member States, which analyse development scenarios and examine how nuclear energy can support the United Nations' goals for sustainable development in the 21st century. The results of these projects can be applied by IAEA Member States in their national nuclear energy strategies and can lead to international cooperation resulting in beneficial innovations in nuclear energy technology and its deployment. For example, INPRO studies the 'back end' of the fuel cycle, including recycling of spent fuel to increase resource use efficiency and to reduce the waste disposal burdens.

National nuclear energy planners and IAEA INPRO experts also work together to conduct national Nuclear Energy System Assessments (NESAs) that help planners make informed decisions regarding the sustainability of their strategic deployment plans. This assessment work is performed using the INPRO methodology, a tool developed through extensive cooperation with Member State experts, to determine whether a nuclear energy system strategy, including specific technology choices, can sustainably meet energy needs in the years to come. Several key areas are taken into account, such as competitive energy economics; national legal, institutional and industrial infrastructures; the environmental impact; proliferation resistance; physical protection; and the inherent safety of the reactors and nuclear fuel cycles.

The INPRO project also studies current innovations in reactor technology. For example, case studies have been developed and analysed to gain a better understanding of the performance of passive safety features in the advanced pressurized heavy water reactor in India and the advanced power reactor plus (APR+) in the Republic of Korea. INPRO members have jointly investigated the technological challenges of cooling reactor cores that operate at high-temperatures in advanced fast reactors, high temperature reactors and accelerator driven systems that use liquid metals and molten salts as coolants. An INPRO study also addressed legal and institutional issues related to the introduction of transportable nuclear power plants. The results of INPRO's studies aim to help technology developers learn about innovative technologies that could simplify the introduction and deployment of next generation nuclear power plants and related infrastructure issues that must be addressed.

Since the Fukushima Daiichi accident, increased attention is being given to finding ways to prevent severe accidents and to mitigate their consequences, including the release of radioactive material to the environment. A new INPRO study will examine the safety requirements and related technical and institutional innovations that could prevent radioactive releases that require relocation or evacuation of people from the vicinity of a nuclear power plant in case of an accident. INPRO and the Generation IV International Forum (GIF) are the only multilateral international cooperative groups that are supporting research and development for the next-generation of nuclear reactors. GIF coordinates research activities on six next generation nuclear energy systems: sodium fast reactors, lead fast reactors, gas fast reactors, molten salt reactors, supercritical water reactors, and very high-temperature reactors. INPRO and GIF experts cooperate and exchange information on projects of mutual interest. GIF regularly presents the technical development status of each of the reactors under development within the participating GIF Member States. INPRO and GIF collaborate mainly in the areas of safety, proliferation resistance and the economics of innovative nuclear reactors.

In 2010, INPRO established a formal Dialogue Forum on Global Nuclear Energy Sustainability. Since then, all IAEA Member States and qualified stakeholder groups have been invited to participate in a broad technical exchange on topics of mutual interest related to nuclear sustainability in the 21st century.