

Generation IV and the NEA

In the previous edition of *NEA News*, W. D. Magwood of the US Department of Energy (DOE) outlined the future of nuclear energy in the context of the new US national energy policy. He cited the Generation IV initiative as a mechanism to implement a longer-term aspect of this policy. Although initiated in the US, the Generation IV initiative has quickly become an international effort and today ten countries¹ are participating in the Generation IV International Forum (GIF). This article briefly reviews the context of Generation IV and describes NEA involvement in the Generation IV process.

What is “Generation IV”? In short, the Generation IV initiative concerns the identification, development and demonstration of one or more new nuclear energy systems that offer advantages in the areas of economics, safety and reliability, and sustainability, and could be deployed commercially by 2030. The driving force behind this initiative is the strong belief shared among the participating countries that the future of nuclear energy will depend upon or at least be strengthened by increased international co-operation. The rationale lies not only in the need to share the development costs of new nuclear technologies in the context of international, deregulated electricity markets, but also in the need to obtain better public acceptance of nuclear energy.

Eight goals have been developed for Generation IV nuclear energy systems. In the area of **economics**, Generation IV nuclear energy systems will:

1. have a clear life-cycle cost advantage over other energy sources;
2. have a level of financial risk comparable to other energy products.

In competitive markets, this is an absolute necessity. The risks associated with construction

(cost and duration) are not the only ones to be considered, as external factors such as public acceptance and licensing may be even more important.

Life-cycle costs include capital costs, operation and maintenance costs, fuel cycle costs and decommissioning and dismantling costs. Contrary to other energy sources, nuclear energy already includes decommissioning and dismantling costs in overall production costs in OECD countries. Currently, capital costs and length of construction, including considerable interest payments before any income is earned, seem to be the main obstacles new nuclear energy systems face.

Regarding **safety and reliability**, Generation IV nuclear energy systems will:

3. excel in both of these areas;
4. reduce the likelihood and severity of reactor core damage and enable the rapid return to plant operation;
5. eliminate the need for off-site emergency response.

Existing nuclear power plants in GIF countries are currently achieving a high level of safety and reliability. These three goals aim to extend and further improve this current level. Reducing the number of events that can initiate accidents, reducing the probability of severe core damages and mitigating their consequences, notably potential

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off-site radioactive releases, should be able to be achieved by using future technological advances. It is anticipated that these technologies will also benefit the performance and the economics of Generation IV nuclear energy systems as well as protect the owner's investment and increase local public confidence.

In terms of **sustainability**, Generation IV nuclear energy systems and fuel cycles will:

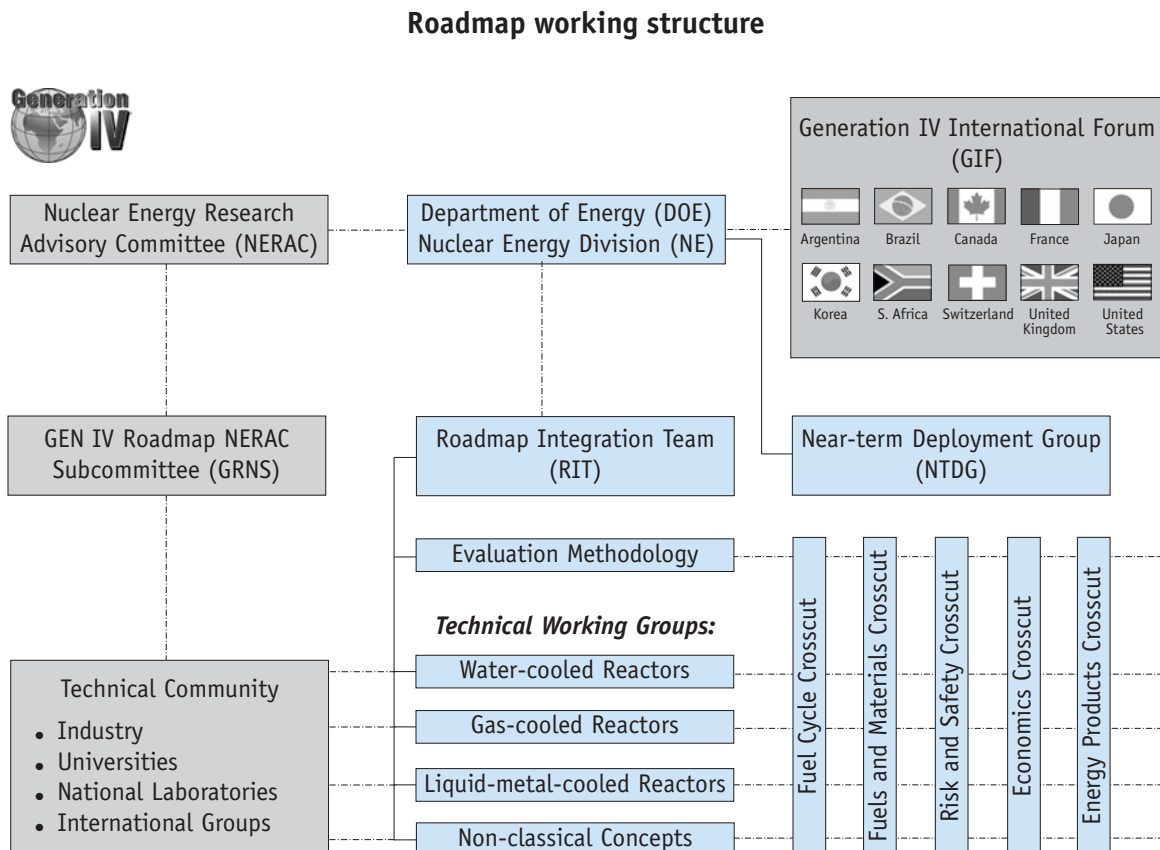
6. provide sustainable energy generation through long-term availability of systems and effective fuel utilisation for worldwide energy production;
7. minimise and manage their nuclear waste, enabling them to surpass current levels of protection for public health and the environment, and notably reduce the long-term stewardship burden in the future;
8. increase the assurance that they are very unattractive and the least-desirable route for the diversion or theft of weapons-usable materials.

Elaborated in the late 1980s, the concept of sustainable development was defined as “development

that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Producing energy in accordance with sustainable development requires the conservation of natural resources, protection of the environment and avoiding, to the greatest extent possible, transmitting burdens on to future generations. Internationally, and especially in the context of the preparation of the World Summit on Sustainable Development to be held in Johannesburg in August 2002, sustainable development is usually examined from three points of view: economic, environmental and social. In the Generation IV context, the “sustainability” category includes aspects related to the above definitions and not previously covered under the economics and safety and reliability goals.

The Roadmap process

In a first phase, the Generation IV technology “Roadmap” is being prepared by GIF members to identify:



- the six to eight most promising reactor systems and fuel cycle concepts;
- the R&D necessary to develop these concepts for potential commercialisation.

A request for information on innovative concepts was issued by the US DOE in March 2001. Nearly 100 concepts were proposed and were subsequently put together in sets of concepts to be analysed by four technical working groups classified by reactor coolant type:

- water-cooled reactors;
- gas-cooled reactors;
- liquid-metal-cooled reactors;
- non-classical concepts.

A methodology has been developed to provide a consistent basis for evaluating the potential of each concept or set of concepts to meet the Generation IV goals. In addition, several “crosscut” groups have been formed to work on horizontal issues that are common to two or more classes of reactors (see figure).

Roughly 100 international experts, half of them American, have contributed to the Roadmap. Initiated in October 2000, the Roadmap is scheduled for completion in September 2002.

NEA involvement in the Generation IV Roadmap

The NEA participated as an observer in the first meetings of the GIF. The NEA experience and expertise that were made evident during these meetings led the GIF members to request NEA support. In particular, the GIF was interested in taking advantage of NEA capability to support international technical working groups and organise joint R&D projects involving voluntary participation by national authorities and organisations. Taking into account the synergy between the NEA programme of work and the studies needed to achieve the technology Roadmap, at its May 2001 meeting the NEA Steering Committee endorsed NEA involvement along the following lines:

- participation of an NEA expert in the evaluation methodology group and in the fuel cycle crosscut group. These two experts were to make NEA experience available for such cross-cutting issues as methodologies for evaluating performance, defining evaluation criteria and metrics (quantitative indicators), and questions related to the nuclear fuel cycle; and

- designation of two NEA experts to perform a secretariat function for two technical working groups, namely the gas-cooled reactors group and the liquid-metal-cooled reactors group.

Following the later setting up of new crosscut groups, NEA experts also participated in the economics; fuels and materials; and risk and safety crosscut groups. In order to finance this participation given that GIF membership is different from NEA membership, NEA activities during the Roadmap phase are being covered by a voluntary contribution from the US DOE.

The NEA is thus actively participating in the different phases of the Roadmap, and its involvement has been recognised by the other participants as highly effective. Many NEA studies were used as input to the Roadmap process. For instance, data and evaluations on partitioning and transmutation, and information on trends in the nuclear fuel cycle proved to be very helpful in implementing the Roadmap screening process. Results of the Roadmap will be communicated by the GIF in due course.

What’s next?

Once the selection process of the reactor concepts has been carried out, the main product of the Roadmap will be a recommended R&D programme to develop those chosen.

As part of the NEA mission to promote international co-operation through the organisation of joint R&D projects among countries wishing to participate, and as noted by the NEA Steering Committee, the ultimate goal of NEA participation in the Roadmap phase has been to offer a robust international framework for the joint R&D projects to be developed in the subsequent phase. GIF members have acknowledged the NEA’s valuable experience in co-ordinating such projects and have specified in their Charter that methods to facilitate the collaborative research to be conducted “will include co-ordination through international organisations such as the OECD/NEA”.

Following GIF agreement on the concepts to be developed, which is likely to be achieved in the coming months, detailed discussions will be held on the R&D to be undertaken. In this context, the NEA is ready to develop its offer to co-ordinate the joint R&D projects that the GIF members decide to undertake. ■

Note

1. Argentina, Brazil, Canada, France, Japan, Korea, South Africa, Switzerland, the United Kingdom and the United States.