

October 11, 2000

MEMORANDUM TO: Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

FROM: John H. Flack, Acting Chief **/RA/**
Safety Margins and Safety Analysis Branch
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

SUBJECT: GENERATION IV TRIP REPORT

This memorandum reports on the second Generation IV (Gen IV) Nuclear Power Systems meeting held on August 29-September 2, 2000 in Seoul, Republic of Korea. The U.S. Department of Energy's (DOE) Office of Nuclear Energy, Science and Technology, in conjunction with the Republic of Korea's Ministry of Science and Technology hosted the meeting. Eight of the nine member countries which make up the Generation IV International Forum (GIVIF) - as it is now known - were represented, including Argentina, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, the United Kingdom, and the United States. (Brazil was the only member country not represented). Attachment 1 provides a list of meeting attendees. Additional information on the Generation IV can be found on DOE's Internet home page at <http://gen-iv.ne.doe.gov>. Minutes from the meeting will soon be available through the Gen IV program manager Dr. Rob M. Versluis (email:rob.versluis@hq.doe.gov).

As a way of background, Gen IV is an initiative first suggested by DOE's Office of Nuclear Energy in June 1999, with the expectation that the next generation of nuclear energy systems would become a viable option for meeting future (30+ years) energy needs. To help meet this objective, a Generation IV International Forum (GIVIF) has been created to institute a world-wide platform from which to discuss and share research information on advanced nuclear power systems. GIVIF itself consists of two groups of members: the Policy Group and the Experts Group. The Policy Group is responsible for the framework that establishes international cooperation on advanced research activities, whereas the Experts Group's focuses on necessary research and development that would make Generation IV designs a reality.

The Policy Group held their meetings on the first two days, and provided direction and guidance to the Expert Group which immediately followed with technical discussions. Attachment 2 contains the Policy and Expert Group agendas, and Attachment 3 contains the handouts of the view graphs presented at the meetings. William D. Magwood, Director of the Office of Nuclear Energy, Science and Technology, DOE, led the Policy Group meeting. The meeting primarily centered on a drafted charter and joint statement (Attachment 4) needed to establish an international research alliance (later named framework), and to share information and link cooperative research on advanced nuclear power systems. Although not formally included in the charter, discussions also centered on a matrix of Gen IV research topics that represented members' interest which had been drafted following an earlier workshop (May 2000). The matrix identifies potential areas of multi-lateral collaborations for ongoing and future work. (The

matrix became the focal point of interest in the subsequent meetings held by the Expert Group). Also noted and recommended as a potential model for developing a Gen IV research agreement, was NRC's Cooperative Severe Accident Research Programs (CSARP). (As a follow-on item, I transmitted DOE a sample CSARP written agreement for potential use in developing Generation IV research agreements).

During the Policy Group meeting, only limited discussion focused on the role of the regulatory authority in the Gen IV initiative. The Policy Group, however, requested that a question regarding the role of the regulator in the process be presented (informally) to the International Nuclear Regulatory Association (INRA) during their next meeting. Because United Kingdom (UK) holds the INRA chair at this time, members Helen Leiser and Andrew Hall from UK volunteered to take on the action item. (I will keep you informed of the INRA response.)

Presentations to the Policy Group were also provided by observers from various European organizations including Luis E. Echavarri, OECD NEA; Juergen Kupitz, IAEA; Serge Crutzen, European Commission. (I have copies of their view graphs in my office.) These presentations provided information on the role and ability of their organizations to take on the Generation IV initiative should it be so desired. GIVIF members, however, indicated that DOE should maintain the lead of the Generation IV, although it is expected that several tasks will be assigned to various European organizations.

In addition to creating a process that would establish GIVIF as research collaboration, the Policy Group developed and concurred on a draft overall goal that was consistent with the Forum's objective (targeted for 30 years):

Design one or more advanced nuclear energy systems that can be licensed, constructed, and operated in a manner that will provide a competitively priced supply of energy while satisfactorily addressing safety, waste, proliferation, and public perception concerns of the countries in which it is deployed.

The goal and drafted charter developed by the Policy Group became the taking off point for the Experts Group. The Expert Group subsequently generated specific goals (see Attachment 5) for each area of importance: (1) economics, (2) sustainability, (3) safety, (4) waste, (5) proliferation resistance. From a regulatory perspective, the goals of most interest include (3) safety and (4) waste, which were drafted and expressed as follows:

Safety - Generation IV should produce robust designs that are extremely resistant to core damage accidents and support the demonstration of safety that enhances public confidence. Additionally, Generation IV reactor designs must afford ALARA radiation exposure over the total system lifetime.

Waste - Generation IV systems should have complete technical solutions that are politically and publicly acceptable for all waste systems.

As indicated, both goals consider public confidence as key to the success of Gen IV. Because public confidence is expressed and reflected through the regulatory authority associated with each member's country, it appears critical that regulators remain informed of ongoing initiatives,

and prepare for changes that may be forthcoming in the next generation nuclear power plant design. To reflect this interest (and based on our earlier discussions), the R&D Matrix used to establish collaborations has been updated to include a high level of interest for the US NRC in the area of regulatory requirements for advanced designs (Attachment 6). Although other countries also expressed a high level of interest in regulatory requirements for Gen IV as well, only a limited regulatory presence existed at the meetings. In addition to US NRC presence, observers from regulatory authorities included Dongkeuk Park and Jae-Hue Lee from the Korea Institute of Nuclear Safety (KINS), and Andrew Hall, HM Superintending Inspector, Nuclear Installation, (who also participated as a GIVIF member from the United Kingdom.)

Other presentations during the meetings included an overview of the Korean nuclear programs by KAERI, and the Pebble Bed Reactor program by Phumzile Tshelane of South Africa (ESKOM). DOE's program manager Rob Versluis closed the meeting with a presentation on DOE's plan to develop a Gen IV technology roadmap (Attachment 8). The roadmap current depicts only high-level performance targets, research paths and an overarching R&D plan. Ultimately, the roadmap is expected to help define and prioritize promising Gen IV concepts. Milestones and schedule were presented that establish targets dates out to Spring 2002.

Following the four days of meetings, Gen IV members and observers toured the Korea Atomic Energy Research Institute (KAERI) research facilities and included a visit to KAERI's High-flux Advanced Neutron Application Reactor (HANARO), Severe Accident Research Laboratory, and Integrated-Test Facility. Materials provided during the tour are available in my office. The next Generation IV Forum meeting is expected to be held in January 2001. The location is presently under discussion.

Aside from the meeting notes, it is generally believed that communication between and among regulatory authorities early in the process could help reduce regulatory uncertainty and increase efficiency of the regulatory process. Feedback to the GIVIF could also help designers think and address regulatory issues during the development stage, some of which could include:

- the technical basis for protection of public health and safety of the public with reduced levels of defense-in-depth, (e.g., elimination of containment structures and site evacuation planning given sufficient safety margin).
- development and validation of models to assess the robustness of advanced plant designs and associated safety margin,
- identification of a source of uncertainty, and effective means to consider them within the decision making process,
- formulation of test requirements and associated criteria to better predict plant response during off-normal conditions,
- identification of performance indicators to provide assurance that in-service performance reflects performance expectations,
- identification of inspection requirements which could include more up-front assessment and inspection and reduced or focused plant inspection during operation,

- resolving differences between safety goals that set criteria based on the low likelihood of core damage, with safety goal criteria that focus on risk to public health and safety.

Although it is important that regulatory authorities remain informed of potential regulatory issues that could evolve under Gen IV, it may be more appropriate to address these issues in a separate forum. An international workshop, for example, focusing on the regulatory implication associated with the next generation of nuclear reactors, could lead to a better understanding and enhanced regulatory philosophy necessary to address the next generation of nuclear energy systems. International collaboration on regulatory research issues within the framework of advancements in safety technology could evolve as well. For example, the R&D matrix (Attachment 6) contains a number of areas which may also be of interest from a regulatory perspective in the form of anticipatory research, e.g., smart sensors, remote monitoring. These advancements in new technology may also reduce risk and benefit both the regulator and operators of current generation plants years before Gen IV plants' reach the operating stage.

In addition to updating research areas of interest, the Expert Group also focused on ways to foster R&D collaborations among members. Meeting facilitators Bryan Parker and Ralph Bennett from INEEL provided the support that enabled the Expert Group to develop procedures that articulate the Experts Group role in fostering R&D collaborations. (Attachment 7).

In view of the significance of the Generation IV initiative, it is strongly recommended that NRC continue to maintain a presence at the GIVIF meetings, and remain abreast of initiative that may have future regulatory implications. Also recommended is that RES initiate early interaction with DOE and other parties interested in opening a channel of communication on advanced reactor technology. A modest level of effort upfront may be very beneficial in establishing future research activities and goals.

Attachments: As stated

cc: w/att.:

Chairman Meserve

Commissioner Diaz

Commissioner Dicus

Commissioner McGaffigan

Commissioner Merrifield

W. D. Travers, EDO

J. Dunn-Lee, OIP

- resolving differences between safety goals that set criteria based on the low likelihood of core damage, with safety goal criteria that focus on risk to public health and safety.

Although it is important that regulatory authorities remain informed of potential regulatory issues that could evolve under Gen IV, it may be more appropriate to address these issues in a separate forum. An international workshop, for example, focusing on the regulatory implication associated with the next generation of nuclear reactors, could lead to a better understanding and enhanced regulatory philosophy necessary to address the next generation of nuclear energy systems. International collaboration on regulatory research issues within the framework of advancements in safety technology could evolve as well. For example, the R&D matrix (Attachment 6) contains a number of areas which may also be of interest from a regulatory perspective in the form of anticipatory research, e.g., smart sensors, remote monitoring. These advancements in new technology may also reduce risk and benefit both the regulator and operators of current generation plants years before GEN IV plants' reach the operating stage.

In addition to updating research areas of interest, the Expert Group also focused on ways to foster R&D collaborations among members. Meeting facilitators Bryan Parker and Ralph Bennett from INEEL provided the support that enabled the Expert Group to develop procedures that articulate the Experts Group role in fostering R&D collaborations. (Attachment 7).

In view of the significance of the Generation IV initiative, it is strongly recommended that NRC continue to maintain a presence at the GIVIF meetings, and remain abreast of initiative that may have future regulatory implications. Also recommended is that RES initiate early interaction with DOE and other parties interested in opening a channel of communication on advanced reactor technology. A modest level of effort upfront may be very beneficial in establishing future research activities and goals.

Attachments: As stated

cc: w/att.:

- Chairman Meserve
- Commissioner Diaz
- Commissioner Dicus
- Commissioner McGaffigan
- Commissioner Merrifield
- W. D. Travers, EDO
- J. Dunn-Lee, OIP

Distribution: w/atts.: SMSAB R/F DSARE R/F JFlack R/F PNorian TKing
 C:\GenIV-TRPRPT.wpd Rversluis, DOE ALeVine, RES

OAD in ADAMS? (Y or N)	Y	Publicly Available? (Y or N)	Y
---------------------------	---	---------------------------------	---

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure
 "N" = No copy

OFFICE	AC:SMSAB		AD:DSARE		DD:RES	
NAME	JFlack:mb		FEltawila		MVFederline	
DATE	10/6/00		10/6/00		10/11/00	