

March 11, 2002

MEMORANDUM TO: William D. Travers
Executive Director for Operations

FROM: Ashok Thadani, Director **/RA/**
Office of Nuclear Regulatory Research

SUBJECT: TRIP REPORT FOR OECD/NEA WORKSHOP ON ADVANCED
NUCLEAR REACTOR SAFETY ISSUES AND RESEARCH NEEDS

The purpose of this memorandum is to inform you on the subject foreign trip. The objective of the OECD/NEA Workshop was to bring together a broad cross-section of parties with a potential stake in the development and deployment of advanced nuclear power plants to facilitate early identification and resolution of safety issues, the scope of research needed to address these issues and potential approaches to their resolution. The attached details the significant items of interest from the presentations and the pursuant discussions. Presentation material from these meetings can be made available upon request to Charles Ader (415-0135) or James Lyons (415-1126).

Attachments: As stated

cc w/att:
J. Craig, OEDO
J. Dunn Lee, OIP
T. Rothschild, OGC
C. Paperiello, OEDO
S. Collins, NRR

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NRC FOREIGN TRIP REPORT

Subject: OECD/NEA WORKSHOP - ADVANCED NUCLEAR REACTOR SAFETY ISSUES AND RESEARCH NEEDS

Date: February 18–20, 2002

Place: OECD, Paris, France

Authors: Ashok Thadani, Director, RES
Charles Ader, Deputy Director, RES/DSARE
James Lyons, Director, NRR/NRLPO

Sensitivity: None

Background/Purpose:

The purpose of the trip was to participate in the OECD NEA Workshop on Advanced Nuclear Reactor Safety Issues and Research Needs. This Workshop was organized by OECD Nuclear Energy Agency (NEA) in collaboration with the Commission of the European Communities (CEC) and was cosponsored by the International Atomic Energy Agency (IAEA) with the purpose of promoting an early consensus among Member countries on the identification of advanced reactor safety issues.

Abstract: Summary of Pertinent Points/Issues:

The OECD NEA Workshop on Advanced Nuclear Reactor Safety Issues and Research Needs provided a valuable forum for discussions on advanced reactor concepts being studied internationally and for identification of safety issues and research needs. However, because of the broad coverage of a number of diverse concepts, it provided only limited opportunity for detailed discussions on specific concepts of immediate interest to the NRC (i.e., HTGR, IRIS). One area that did receive considerable discussion throughout the workshop was the role of defense-in-depth and PSAs in the design and review of advanced reactors.

Discussion:

On February 18-20, 2002, the OECD NEA held its Workshop on Advanced Nuclear Reactor Safety Issues and Research Needs in Paris, France. This Workshop was organized under the auspices of the Committee on the Safety of Nuclear Installations (CSNI) of the OECD NEA in collaboration with the CEC and was cosponsored by the IAEA. The objective of the Workshop was to bring together a broad cross-section of parties with a potential stake in the development and deployment of advanced nuclear power plants to:

- facilitate early identification and resolution of safety issues by developing a consensus among Member countries on the identification of safety issues, the scope of research needed to address these issues and a potential approach to their resolution,

- promote the preservation of knowledge and expertise on advanced reactor technology, and
- provide input to the U.S. DOE Generation IV Technology Roadmap development.

The Workshop was attended by more than eighty participants, representing 18 countries and 4 international organizations. Twenty-six papers were presented on topics ranging from safety approaches for advanced reactors, including the role of defense-in-depth, to detailed presentations on specific advanced reactor designs. A copy of the Workshop Program is attached (Attachment 1) and copies of individual papers are available upon request. Mr. Ashok Thadani, as Chairman, NEA CSNI, along with Ms. C. Kessler, Deputy Director General, OECD NEA and Ms. A. Carnino, Director, IAEA Division of Nuclear Installation Safety provided welcoming remarks for the Workshop and Mr. Thadani also served as Chairman of the closing session. Mr. Charles Ader presented a paper entitled "Building a Safety Case for Advanced Reactor Designs" (Attachment 2) and served as Co-Chair of Session 1 with Dr. Mario Bonaca, ACRS. Mr. James Lyons presented a paper entitled "Licensing of Future LWRs" (Attachment 3) and served as Co-Chair of Session 3.

The advanced reactor concepts discussed were mostly limited to Advanced Light Water Reactors (ALWRs), High-Temperature Gas-Cooled Reactors (HTGRs) and Liquid-Metal Cooled Reactors (LMR), although one paper from Russia discussed the SVBR-75/100, a lead/bismuth reactor. Highlights of those presentations most directly related to the current NRC activities are as follows:

- M. Gasparini (IAEA) and M. Bonaca (ACRS) both presented papers on the role of defense-in-depth (DID) in the design and review of advanced reactor concepts and provided two approaches to DID, including the role of probabilistic safety assessments (PSA). Of interest was Dr. Bonaca's paper, which provide an excellent summary of two possible approaches for DID that often have been proposed. The first approach maintains the traditional DID approach, but PSA insights are used to evaluate and confirm the effectiveness of DID. The second approach retains the DID philosophy at the high level, but utilizes the insights from PSAs directly in the implementation of DID decisions, with PSA as the primary decisionmaking tool. DID is a result of decisions made to compensate for uncertainties. These two papers generated considerable discussion, particular focused around the participants differing views regarding the appropriateness of the use of PSAs as a key decisionmaking tool in DID decisions when considering the lack of operating experience for advanced reactors.
- K. Kugeler (Germany) presented an overview of the conceptual design of the HTR, a 300MWth high-temperature gas-cooled reactor. This design uses coated fuel particles in spherical graphite balls similar to the PBMR. In his presentation he indicated that the safety behavior of the HTR concept was very well supported by the safety research programs on gas cooled reactors conducted over the past few decades. However, he did indicate that there were areas of research that warrant further study, including fuel quality and qualification, air/water ingress to primary circuit and integrity of components at high

temperature. Of note, in response to a question, he indicated that shake table testing had been conducted in Germany to investigate the compaction of pebbles under seismic conditions and the potential for reactivity insertion (an issue Dr. Tom Murley raised in his letter to T. King dated November 12, 2001, following the RES Workshop on HTGRs). Dr. Kugeler indicated that the test program showed that there was little reactivity insertion from this type of event.

- Dr. M. Carelli (Westinghouse) presented an overview of the AP600, AP1000 and IRIS ALWR designs although his focus was on the IRIS design. Regarding research needs for IRIS, Dr. Carelli indicated that Westinghouse will take advantage of the extensive testing program for the AP600/1000, but he also discussed testing programs that will be needed to test the significant differences from the loop PWRs. Westinghouse will also be looking to implement a risk-informed regulatory process, using PSA as “an over-arching evaluation and decision-making tool.”
- Dr. J. Hyvärinen (STUK, Finland) provided an overview of the Finnish safety requirements for future LWRs. (Finland is currently considering whether to construct new nuclear power plants.) Three key elements of their safety requirements include: a requirement that the most crucial safety systems be able to carry out their functions assuming a single failure and another component out for maintenance (N+2 failure criterion); explicit consideration of severe accidents with key systems designed for a single failure (N+1); and a requirement to design against a possible aircraft crash.
- Dr. Yuliang Sun (INET, China) presented an overview of the HTR-10, the 10 MWth pebble bed HTGR. He encouraged international cooperation in the sharing and preservation of knowledge gained on the gas-cooled technology and noted that a series of accident simulation tests is also planned on the HTR-10 that can contribute to the knowledge of pebble bed designs. Areas he identified for additional research include development of verified codes for core physics and analysis of accident scenarios such as water or air ingress and the behavior of the coated fuel particles. Unfortunately, no new information was presented on the ongoing testing of the HTR-10 fuel pebbles in Russia. In a separate discussion, Dr. Sun indicated that the HTR-10 is still awaiting a replacement electrical penetration from a French vendor before it will be able to proceed toward full power operation.
- Other papers on the gas-cooled technology included papers by: J. Sugimoto (JAERI, Japan), who provided a summary of the work to design on the GT-HTR300 design and indicated that no containment vessel is necessary due to fuel performance; A. Mysen (NNR, South Africa), who provide an update on the review of the PBMR in South Africa; and B. Ballot (Framatome, France) who discussed the research program being conducted by the European Union. A presentation on the GT-MHR was originally planned, but GA withdrew the paper shortly before the workshop.

It was recognized that this workshop provided a broad overview of the advance reactor designs being considered worldwide. Future workshops were suggested to focus on those concepts most likely to be deployed in the near term in order to better focus

CSNI's efforts and to allow more in-depth discussion of the safety issues and necessary research. The importance of international cooperation in these research programs was also emphasized. The results of the Workshop will be documented as proceedings, to be published by NEA.

Pending Action/Planned Next Steps for NRC:

No new actions were identified from this workshop. However, the ongoing discussions with those organizations with HTGR research programs should continue in order to share knowledge and data available worldwide.

Points for Commission Consideration or Items of Interest:

Trip report is believed to be of general interest to the Commission.

Attachments: As statement