

November 5, 2003

MEMORANDUM TO: Farouk Eltawila, Director  
Division of Systems Analysis and Regulatory Effectiveness  
Office of Nuclear Regulatory Research

FROM: John H. Flack, Branch Chief **/RA/**  
Regulatory Effectiveness and Human Factors Branch  
Office of Nuclear Regulatory Research

SUBJECT: FOREIGN TRIP REPORT - SEPTEMBER 15 - 20, 2003,  
INTERNATIONAL CONFERENCE ON GLOBAL ENVIRONMENT AND  
ADVANCED NUCLEAR POWER PLANTS (GENES4/ANP2003)

The purpose of this memorandum is to inform you on my trip report to Kyoto, Japan, and participation in the GENES4/ANP2003 international conference. The GENES4/ANP2003 Conference brought together international experts to exchange views and information on the status and future prospects of advanced nuclear power systems and their role in improving the environment. Atomic Energy Society of Japan (AESJ) hosted the Conference, the second in a series of meetings sponsored by AESJ and the American Nuclear Society. Co-sponsors included the Canadian Nuclear Society, European Nuclear Society, Korean Nuclear Society, in cooperation with the International Atomic Energy Agency (IAEA), and the Organization of Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA). On the last day of the trip I joined a technical tour that visited the Monju prototype liquid metal fast breeder reactor, and the Tsuruga pressurized water reactor.

My subject trip report and significant items of interest from associated presentations and pursuant discussions is attached.

Attachment: As stated

cc w/ att.:

A. Thadani  
J. Strosnider  
A. Szukiewicz  
J. Dunn Lee  
W. Dean

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**Subject:** Participation in the International Conference on Global Environment and Advanced Nuclear Power Plants GENES4/ANP2003

**Dates of Travel and Countries/Organization Visited:** September 15-20, 2003  
Kyoto, Japan

**Author/Title/Agency Affiliation:** John H. Flack, Branch Chief  
Regulatory Effectiveness and Human Factors Branch  
Office of Nuclear Regulatory Research

**Sensitivity:** Material distributed and meeting discussions are not sensitive and can be released to the public.

**Background/Purpose:** The overall objective of the GENES4/ANP2003 meeting was to bring together international experts to exchange views and information on the status and future prospects of advanced nuclear power systems and their role in improving the environment. The organizing committee co-chairs were Gail H. Marcus (DOE) and Yoshiaki Oka (University of Tokyo); co-chairs of the technical program committee were Alan E. Levin (NRC) and Hisashi Ninokata (Tokyo Institute of Technology).

**Abstract: Summary of Pertinent Points/Issues:** The conference was held over a four-day period (September 14-19, 2003), and consisted of four invited plenary sessions and 37 technical sessions. Attachment 1 provides the final program. The conference was a success in that it brought together 325 participants from 20 countries (see Attachment 2 for List of Participants) to discuss various aspects of advanced nuclear technology. The plenary sessions included: "Opening Plenary," "Business Climate Plenary," "Public Information and Outreach Plenary," and "Role of Nuclear Energy in the 21<sup>st</sup> Century Plenary." Attachments 3-6 contain viewgraphs on each of the plenary sessions and are discussed below.

The technical sessions covered a number of advanced designs including the Advanced Boiling Water Reactor (ABWR), Liquid Metal Fast Breeder Reactors (LMFBR), Supercritical-Water Cooled Reactor (SCR), International Reactor Innovative System (IRIS), High Temperature Gas Reactor (HTGR), the SMART and Integral Pressurized Water Reactor, and Advanced CANDU reactor. Hydrogen production using HTGR for high temperature process heat, and the technology used in hydrogen production were introduced as relatively new areas of interest and challenges for advanced reactor designs. Technical sessions also included supporting technology that cover a spectrum of topics including instrumentation and control, thermal-hydraulics, fuel and core performance, severe accident analysis, and structural design.

For detailed information on the technical sessions, I have a copy of the CD-rom of the proceedings which is also available from AESJ at JYen 15000 (Contact Ms. Nishimura, [satnishi@aesj.or.jp](mailto:satnishi@aesj.or.jp) .) The presentation of plenary and keynote speakers in pdf file are displayed on the home page <http://genes4-anp2003.nuclear.jp>

## **Discussion:**

The Opening Plenary focused on the increase of world-wide commercial nuclear power generation. Mamoru Akiyama (IAE, Japan) chaired the session, and speakers and topics included the following:

- Japan's Ways to Promote R&D of Innovated Nuclear Systems in the Future, Tetsuo Takeuchi (AEC of Japan)
- Nuclear Energy: Advancing Toward a Bright Future, Scott Peterson (NEI)
- Challenge and Future Prospects of Nuclear Power in Korea, Joong-jae Lee (KHNP, Korea)
- Future Development and Applications of Nuclear Power, Dave Torgerson (AECL, Canada)
- Nuclear Power in Japan, Yoshihiko Sumi (JAPC, Japan)
- Nuclear Power - A Solution to Energy Security and Environmental Problems, Bill Martin (DOE/NERAC, USA)
- European Perspectives of the State of the Nuclear Industry and Future Prospects, Sue Ion (BNFL, UK)

The discussions focused on various challenges, prospects, developments, and solutions to energy security and solving environmental problems through the use of nuclear energy. There are now 436 nuclear units world-wide providing 16% of the world energy supply. Many of the speakers were upbeat about the future of nuclear power. The increase in the world-wide capacity factor from 58.4% in 1979 to 78.9% in 2002 and other economic successes supported this optimism. The average U.S. capacity factor was reported to be about 91%, well above the world average. This is primarily due to the extended fuel cycles and increase in on-line maintenance activities resulting in shorter planned maintenance outages in the U.S. Yoshihiko Sumi (JAPC, Japan) noted that Japan's nuclear power generation (34% nuclear) had been limited to a 81% capacity factor. Differences primarily stemmed from Japan's 403 day extended fuel cycle as compared to 530 day for US plants, and Japan's 81-day average maintenance outage as compared to 40 days for US plants. Joong-Jae Lee (Korea Hydro & Nuclear Power Company) reported Korea's average capacity factor in 2002 of 92%. Korea has 18 units producing 39% of the country's power generation, with eight additional units which are presently under various stages of construction.

NEI's Scott Peterson (presenting for Joe Colvin) discussed preparing the US markets for new nuclear plants. He noted that NRC's design certification process and the one-step licensing process provided the industry with regulatory certainty. He also noted that following the 1990s deregulation initiative and segmentation of the electricity marketplace into generation, marketing, transmission, and distribution, utilities no longer plan long-term but rely on the use of gas-fired capacity for a quick fix. [This observation is consistent with insights from Bill Raughley's investigation of the grid]. He expects the August 14<sup>th</sup> blackout event will prompt corrective action. Other comments indicated that there has been a shift towards public acceptance of new nuclear power plants in the U.S., especially following the California energy crisis. The goal of the Bush Administration to build a new nuclear unit by 2010 also supported the shift.

Dave Torgerson's presentation on future development and applications of nuclear power in Canada addressed the use of nuclear to extract oil from Canada's oil sands, and use of ACR-700 to provide hydrogen for Canadian vehicles. He mentioned that one of Canada's goals is to phase out coal as a source of electricity production by 2015, increasing the future demand for nuclear. He also presented a longer-term project (CANDU X) considered to be a Gen IV super Critical Water Reactor, that is being entertained and is expected to lower costs and operate at the higher temperatures necessary for hydrogen production.

Bill Martin (incoming Chairperson of DOE's Nuclear Energy Research Advisory Committee) noted that NRC is responding and making many improvements in the regulatory framework, e.g., moving to risk-informed regulation, approving plant life extensions, supporting "early site permits," and responding to post 9/11 terrorists threat environment. On the other hand, he noted that deregulation has led to focusing only on the short term which again reinforces Bill Raughley's grid study conclusion that following electrical deregulation industry lacks long term goals and planning. This is also reflected in industry's increase reliance on gas for energy production. (See Dan Keuter's viewgraph entitled "We Cannot Keep On Like This," that reinforces this perspective).

Sue Ion (BNFL) provided a European Union (EU) perspective of the state of the nuclear industry and future prospects. Three main areas closely related to nuclear power generation included security of supply, carbon target, and future energy demands. EU is the second largest energy consumer, and consumption continues to rise at 2% per year.

Regis Matzie (Westinghouse) chaired the second plenary on "Business Climate." Presentations and speakers included:

- A Vendor's Perspective on the Business Climate for Advanced Nuclear Power Plants, Regis Matzie
- The Promise of New Nuclear, Dan Keuter (Entergy)
- ACR Program Status, Ken Hedges (AECL, Canada)
- Development of APWR and Next Generation Plant, Yutaka Nakahara (Mitsubishi Heavy Industries, Ltd, Japan)
- Business Environment of Nuclear Power Industry in Korea, Yoon Young Lee (Doosan Heavy Industry Co., Korea)

Overall, the presentations projected a positive outlook with modest growth mostly concentrated in Asia, and a positive changing attitude towards nuclear in the U.S. The tie of nuclear to carbon free electrical generation and hydrogen generation supported the positive outlook. Capital cost and perceived risk of a new construction projects, however, still remained critical issues for new plant builds.

Yasumasa Tanaka (Gakushuin University , Japan) and Ann Bisconti (Bisconti Research Inc. USA) chaired the third plenary entitled "Public Information and Outreach." This session was open to the public. Presentations and speakers included:

- Is the NIMBY Syndrome Real and Remediable? A case for Complex Decision Making, - Yasumasa Tanaka

- Communicating between People living in Electricity-Producing Rural Areas and People Living in Electricity-Consuming Urban Areas, Etsuko Akiba (ASCA Energy Forum, Japan)
- Energy Think Together: Story-Telling in Energy Education, Sumiko Masano (Fukui-Prefecture Women's Energy Association, Japan)
- U.S. Nuclear Industry- Winning Public Approval, Scott Peterson (NEI)
- U.S. Public Opinion and Nuclear Energy, Ann Bisconti

Five innate factors were identified for assessing communication:

1. The source (credibility)
2. The message (clear objective, easily understandable)
3. The destination (audience - receiver which are not homogenous)
4. The channel (face-to-face being more effective)
5. Feedback and the effect of communication

The session focused on the current state of affairs in public attitudes toward nuclear energy, and conflict between stakeholders living in electricity-consuming rural areas, and people living in electricity-consuming urban areas. Communication and the use of story telling in energy education were important initiatives that reduced tension between stakeholders in Japan. Scott Peterson indicated that the NRC did a good job as a credible regulator on security which helped build public confidence in the U.S., however, most U.S. citizens were unfamiliar with the NRC and did not know whether the NRC, for example, was a public or private institution.

Shunsuke Kondo (Univ. Tokyo, Japan) and Gail H. Marcus (DOE, USA) chaired the final plenary entitled "Role of Nuclear Energy in the 21<sup>st</sup> Century." This session focused on the role and prospects of nuclear energy in Thailand, Vietnam, Indonesia and Myanmar. Presentations and speakers included:

- Role of Nuclear Energy in Thailand, Somporn Chongkum (Nuclear Society Thailand, Thailand)
- Role of Nuclear Energy in Vietnam, Hoang Anh Tuan (Atomic Energy Commission, Vietnam)
- The Prospect of Nuclear Energy in Indonesia, Zaki Su'ud (Bandan Institute of Technology, Indonesia)
- the Role of Nuclear Energy in Myanmar, Tin Hlaing (Atomic Energy Department, Myanmar)

The presentations indicated that there is a serious need for new investments in electrical power generation to overcome energy deficits in these countries. Heavy reliance on firewood is rapidly depleting forests, which has become a major concern. Additionally, the need (by over 2 billion people) for potable water is likewise a serious concern. These countries are seeking international cooperation on nuclear power in order to diversify energy sources in order to meet economic and social development demands.

The technical sessions were organized along 37 specific technical areas. The theme was on advanced nuclear power plants and their role in protecting the environment. The program covered several types of advanced designs and technology, including Advanced Boiling Water Reactor (ABWR), Liquid Metal Fast Breeder Reactors (LMFBR), Supercritical-Water Cooled

Reactor (SCR), International Reactor Innovative System (IRIS), High Temperature Gas Reactor (HTGR), the SMART and Integral Pressurized Water Reactor, and Advanced CANDU reactor. The application of nuclear energy to hydrogen production drew much of the attention. Points from these sessions are discussed below.

#### **Additional Points Issues from Plenary and Technical Sessions:**

- The session on the use of nuclear in production of hydrogen was well attended. Discussions mostly focused on the use of HTGRs to produce hydrogen using a thermochemical processes to convert high temperature process heat to hydrogen. DOE is currently working with public and private organizations to develop a national Hydrogen Energy Technology Roadmap. The "Roadmap" is expected to layout the research and development steps necessary to make a transition to a hydrogen economy. Hydrogen production, handling, and storage will introduce new risk elements at nuclear stations, and policy issues will likely evolve because of the risk implications. Because policy decisions could impact technology development, discussion between NRC and DOE should begin within the next two years.
- Plans are being developed that will extend the IRIS fuel cycle to 3-4 years. This will require that many maintenance activities be performed on-line rather than during shut down. It will be important to assess these activities as part of pre-application review. There are approximately 3700 routine maintenance task for the IRIS design, 1206 on-line (expected to increase to 1831) and 2537 tasks off-line (expected to decrease to 1858). Of these, Westinghouse is trying to reduce 54 maintenance tasks that do not currently fit into their currently envisioned 48 month fuel cycle schedule. (See Alan Levin's trip report for additional information on IRIS).
- Mario Carelli (Westinghouse) indicated that IRIS preliminary design will be completed in Fall 2003, and be submitted for design for certification in 2005. A target date of 2012 has been established for the first module; three modules (at 335 Mwe/module) are expected to be built at a common site.
- A number of HTGR designs were presented, including Japan Atomic Energy Research Institute's (JAERI) High Temperature Engineering Test Reactor (HTTR) and the new - Gas Turbine High Temperature Reactor GTHTTR300. This particular design is utilizing a form of containment that would release helium early in an accident scenario, but maintain a barrier to fission product release later in the sequence. (I passed this information on to Stuart Rubin for his use in addressing the Commission's policy issue in this area).
- Japan's goal of being free from fossil fuel has set 2020 as a target for 7% of their automobiles to be powered by fuel cells.
- Yassin Hassan (Texas A&M University, U.S.) presentation on turbulent transport of gas through gaps in Pebble Bed reactors may help explain hot spots and unresolved questions related to melt wire experiments performed by the Germans. We may want to consider this work further should interest in the Pebble Bed reactor rise once again.

**Pending Actions/Planned Next Steps for NRC**

None. Information is of general interest.

**Points for Commission Consideration/Items of Interest**

Hydrogen generation through the use of commercial nuclear reactors will be of interest to the Commission. Currently, the technology has not evolved to the point of being more than of general interest, although a potential policy issue will eventually evolve.

**Attachments:** As stated