In a remarkable and pleasant shift from the normal weather pattern, attendees to the EPRI summer advisory meetings in Washington, D.C., in August enjoyed a week of relatively cool weather. For those of us from points south, the break from 100-plus temperatures was invigorating. The tone and tenor of the advisory meetings was invigorating as well, reinforcing the need for unified nuclear research and development activities. Each of our Action Plan Working Groups met to take stock of their programs and to ensure program direction matches industry needs.

Holding the meetings in Washington also allowed EPRI to organize several ancillary meetings with research representatives from the U.S. Department of Energy and Nuclear Regulatory Commission.

As many of you know, the Nuclear Power Council (NPC), which provides technical guidance to EPRI’s Nuclear Sector research activities, welcomed a new chairman during the August meetings. Mano Nazar, chief nuclear officer and senior vice president with American Electric Power, succeeded Doug Gipson, chief nuclear officer of DTE Energy, who capably led the NPC for the past three years. Mano shared his philosophy with the Council, challenging the members to fully embrace their strategic role in supporting activities that target both future/latent issues and emerging/current issues. Mano also stressed the importance of “ownership,” calling on NPC members – and all EPRI utility advisors – to become champions of the approved EPRI programs and projects to ensure their success.

To assist the NPC in executing its strategic mission, EPRI will be pursuing several key action items over the next several months in association with the Action Plan Working Groups and underlying committees:

- **Nuclear Strategic Plan Review** – EPRI’s Nuclear Strategic Plan was developed six years ago with significant input and insight from the NPC, and with some subsequent minor modifications. To support strategic decision-making in light of changing and emerging industry issues, EPRI will take steps to ensure the goals and objectives in the Nuclear Strategic Plan remain relevant, are adjusted where necessary, and are clearly and fully communicated with NPC members.
- **Project Prioritization** – To inform program funding decisions, EPRI will investigate the development of a consistent process that can be used to assess the relative importance and benefits of research projects.
- **Emerging Issues (EI) Process** – The Nuclear Sector retains $1 million from core membership dues to address emerging issues. While these funds have supported critical industry events such as the evaluation of future plant designs against hypothetical aircraft impacts, process inefficiencies have been observed. EPRI will review its specific criteria defining emergent work and implement a streamlined process to ensure EI funds are effectively applied.
I want to take this opportunity to thank those of you who participated in the August advisory meetings, and those of you who contribute throughout the year to the EPRI research process. Your guidance validates the EPRI mission by ensuring that what we do is aligned with industry priorities and provides exceptional value for your investment.

Dave Modeen, Vice President and Chief Nuclear Officer, EPRI Nuclear Sector.

**TECHNICAL HIGHLIGHTS**

**EPRI Leads Evolution of Fuel Reliability Guidelines**

To support the nuclear power industry’s 2010 zero fuel failure goal, EPRI is engaging multiple stakeholders to devise effective reliability guidelines.

The nuclear power industry has invested significant resources into achieving the Institute of Nuclear Power Operations’ goal of zero fuel failures by 2010. Industry teams consisting of EPRI, utility (U.S. and international), fuel vendor, INPO and other experts have been collaborating since Fall 2006 to identify critical issues and define appropriate remediation mechanisms. With the completion of INPO’s “Guidelines for Achieving Excellence in Nuclear Fuel Performance” in June, the industry teams have shifted their attention to completing a set of specific fuel reliability technical guidelines. These efforts address a number of known technical gaps, with a separate guideline focused on each of the key fuel failure mechanisms:

- Fuel Surveillance and Inspection Guidelines (February ’08)
- PWR Fuel Corrosion and Crud Technical Guidelines (April ’08)
- BWR Fuel Corrosion and Crud Technical Guidelines (April ’08)
- Fuel Reliability Guidelines for Avoiding Pellet Cladding Interaction (July ’08)
- Fuel Reliability Guidelines for Avoiding PWR Grid-to-Rod Fretting (August ’08)

One additional area of significance, based on the number of fuel manufacturing-related failures in recent months, is fuel fabrication oversight. Although no EPRI guideline is planned for this initial phase of guideline development, the teams are looking to see how this area can be strengthened. The Fuel Reliability Program’s Executive Committee reviewed progress for all guidelines in August and adjusted the strategy for each to maximize the industry’s ability to reach the zero failure goal.

To raise awareness on foreign material exclusion (FME), EPRI recently produced a training video called “Foreign Material Exclusion: Striving for Industry Excellence.” Foreign material remains the primary cause of failure in BWRs and potentially an increasingly important mechanism in PWRs as the number of maintenance and modification activities increase. The video (EPRI product #014962), which is now available on the EPRI web, was the most widely ordered EPRI product in the month of August, with more than 250 copies requested. Nuclear utilities planning outage work should seriously consider incorporating this video into training activities.

For more information on EPRI’s fuel reliability efforts, contact Kurt Edsinger at 650.855.2271 or kedsinger@epri.com.
EPRI Provides Ongoing Support to Japanese Utilities

From rapid analysis of earthquake impacts on nuclear plants to long-term support of advanced maintenance programs, Japanese utilities are engaging a wide range of EPRI applications and services.

The recent earthquake in Japan has had a major impact on Tokyo Electric Power Co. (TEPCO), one of EPRI’s Japanese member utilities. Initial analyses by TEPCO and the International Atomic Energy Agency (IAEA) indicate that the plants at Kashiwazaki-Kariwa performed exceptionally well for an earthquake of this magnitude. EPRI has been in extensive dialogue with TEPCO, and Senior Project Manager Dr. Bob Kassawara has been to Japan to identify ways that EPRI can assist TEPCO in evaluating the full impact of the earthquake at Kashiwazaki-Kariwa, as well as the broader implications across the Japanese fleet.

The earthquake provides an important opportunity to learn how nuclear power plants behave under extreme conditions. EPRI has requested permission from TEPCO to examine the plants and to review safety and performance-related data from the earthquake in order to identify and disseminate lessons learned with the global nuclear power industry. Such analyses could also lead to improvements in the analytical models used to predict the consequences of earthquakes on nuclear power plants. EPRI is closely coordinating its efforts with those of other organizations extending support in response to the Kashiwazaki-Kariwa earthquake, including the Nuclear Energy Institute and the Institute of Nuclear Power Operations.

EPRI supports TEPCO and other Japanese nuclear utilities in many other areas as well, building on relationships formed through more than five years of EPRI engagement in Japan. As of summer 2006, both TEPCO and Chubu Electric are full members of the EPRI nuclear program, and all the Japanese utilities are members of the Nuclear Maintenance Applications Center (NMAC). As a result of industry benchmarking efforts, and in light of significant pending changes in Japanese regulatory requirements, some Japanese utilities have decided to modify their maintenance and equipment reliability strategies. Through structured implementation of condition-based maintenance (CBM) and maintenance basis optimization programs, these utilities have set a course toward world-class performance.

Until very recently, Japanese utilities have remained predominantly dependent on time-based preventive maintenance. U.S. utilities, on the other hand, have embraced CBM techniques over the past two decades, and only perform time-based maintenance for a small percentage of equipment. This fundamental difference has prevented Japanese nuclear plants from achieving performance levels comparable to those in the United States. The performance gap manifests itself in higher maintenance costs and lower capacity factors.

Transitioning from time-based to condition-based maintenance represents a significant challenge that needs to be managed as a process incorporating a common, multi-disciplined vision. Over the past few years, EPRI has provided – and continues to provide – guidance to a number of Japanese nuclear utilities through a change management process that includes the following key steps:

- Establishing a company-wide CBM change management vision, corresponding CBM mission, and CBM project plan.
- Interviewing all levels of management to clarify the vision and identify inconsistencies regarding vision, mission, and overall strategy for operations, engineering, and maintenance.
- Coordinating numerous brainstorming exercises, training sessions, and field oversight activities.
- Providing oversight on the application of predictive maintenance technologies such as vibration, oil and infrared analysis as well as troubleshooting and root cause analysis techniques.
- Providing guidance for prioritizing all action items based on U.S. experience and the utility’s vision.
- Proposing and developing new organizational structures that support CBM and component and system engineering implementation.
- Training personnel on the use of change management tools, meeting facilitation, brainstorming, machinery diagnostics, and systems and component engineering health reporting.
Because the full scope of the CBM programs can take several years to complete, improvements in lagging indicators such as capacity factor are not yet expected. Supporting indicators, however, are demonstrating that successful changes are occurring:

- Significant numbers of equipment have been scoped into technology programs.
- Documented anomalies are being tracked through equipment health assessments.
- New procedures are being written, and have been written, that provide detailed guidance in achieving standardization.
- Maintenance feedback processes have been developed that encompass growing numbers of equipment.
- Process flow maps have been developed that define the overall CBM process and all sub-processes.

Based on these initial results, the Japanese utilities are driving for regulatory changes that will enable extended refuel outage cycles (from 13 months to 15 to 24 months), reduction in time-based maintenance tasks, implementation of at least three predictive maintenance technologies (vibration, lube oil and infrared analysis), and development of system and component engineering functions, which have been primarily a U.S. standard. Interestingly, while CBM and the use of predictive technologies are not regulated in the United States, the current push by authorities in Japan will be to regulate them to ensure quality and robustness.

Due to actions by some of the Japanese utilities and EPRI’s technical participation, the Japanese Federation of Electric Power Companies (FEPC) formed a team to address these proposed regulatory changes from the end of 2008 through 2010. EPRI has provided the FEPC team with insight into equipment scoping, the maintenance rule, the development of a maintenance basis, and understanding the equipment reliability and CBM processes used in the United States.

For more information on change management and condition-based maintenance, contact Anthony Dippolito, Senior Project Manager, at 610.429.9834 x13 or Adippolito@epri.com, or Bill Closser, Manager of Nuclear Plant Technology Applications and Services, at 865.218.8078 or Wclosser@epri.com.

Procured Item Quality Initiative Targets Supplier and Utility Behaviors

Ongoing initiative identifies collaborative efforts that can improve product quality throughout the product life cycle.

The nuclear industry has encountered numerous quality issues where both safety and non-safety products have not met the requirements for in-plant use. Areas impacted include new parts and components, replacement parts and components, and repair and refurbishment services. EPRI launched an initiative in the first half of 2007 to gather industry examples of procured item failure. Subsequent data analysis enabled identification of key contributors to quality problems as well as actions that could be taken to improve quality. From this foundation, spin-off collaborative research efforts are being identified and implemented to enhance quality.

Research efforts to date indicate that both utilities and suppliers can contribute negatively to product quality. Supplier contributions include lack of worker skills, inadequate manufacturing controls, aging workforce, and unavailability of original design and manufacturing information. Utility contributions – much less discussed but just as important – include fast-tracked design efforts, mid-production design changes, expedited production schedules, ill-defined specification structure and content, and insufficient or inaccurate communication of technical and quality requirements. Additionally, vendors frequently cite unique or non-standard technical requirements as causing considerable confusion and disruption in design and production efforts.

Many different organizations are involved in the procurement life cycle, from identification of need to delivery, installation, and testing. In the past, the nuclear industry has primarily focused on detecting quality problems with procured items after they arrive on-site, and correcting them before the items are installed. Problem identification at receipt inspection or installation is an important line of defense. However, when problems are identified this late in the game in an outage situation, the battle is almost certainly lost. By applying the “Prevent, Detect, Correct” model (see figure) to procured item quality, it becomes clear that concentrated efforts in the early stages of the procurement cycle can prevent quality issues before significant impacts occur.
EPRI has identified several collaborative projects that are preventive in nature. These promising efforts involve developing standard design checklists and specifications for commonly procured items and developing standard procurement clauses for complex orders. Common specifications would aid utilities in improving technical requirements and aid suppliers in resolving non-standard or conflicting technical requirements. Standard procurement quality clauses for complex procurement orders would further facilitate communication of requirements between utilities and suppliers. Projects that are detective in nature include standard source and receipt inspection templates. EPRI is also working on a guidance document that will include industry best practices in the area of procured item quality.

EPRI’s Procured Item Quality initiative is an ongoing effort, with work extending into 2008. The next meeting of the Technical Advisory Group – where project status and next steps will be discussed – is scheduled for September 24-25 in Charlotte, NC, and is open to utility participation.

For more information, contact Marc Tannenbaum at 704.595.2110 or mtannenbaum@epri.com.

**EPRI Study Finds More Room at Yucca Mountain**

*Analysis concludes physical capacity of Yucca Mountain geological repository could be increased four to nine times current limit at minimal incremental cost.*

An EPRI report analyzing expanded capacity options at the proposed Yucca Mountain geological repository for commercial spent nuclear fuel indicates that the technical capacity is four to nine times the current legal limit. Such a geological repository is one element of an integrated spent fuel management approach—encompassing on-site storage, interim storage, long-term central storage and possible reprocessing—designed to sustain long-term operation of existing U.S. nuclear power plants and facilitate projected expansion of nuclear power.

The report, *Room at the Mountain*, also provides preliminary cost estimates for expanding Yucca Mountain. Increasing the capacity from its current legal limit of 70,000 metric tons of heavy metals (MTHM) to 260,000 MTHM would result in costs only 28% higher than those for the existing repository design, on a net present value dollar basis.

In a 2006 preliminary report on Yucca Mountain expansion opportunities, EPRI determined that the increased capacity could be achieved by expanding the repository area into adjacent, competent rock formations, and by increasing the loading density of spent fuel casks in a given area. For the 2007 report, EPRI conducted more detailed analysis of the thermal, hydrologic, and rock stability aspects of the higher loading density design than was available for the 2006 report. The additional EPRI work demonstrates that the higher loading density design can satisfy all temperature criteria and accommodate the construction and ventilation of additional disposal drifts.
The EPRI report indicates that Yucca Mountain could not only store all of the waste from existing U.S. nuclear power plants, but also waste produced from a significantly expanded U.S. nuclear power plant fleet for at least several decades. If all U.S. operating commercial nuclear reactors operated for 60 years, approximately 140,000 MTHM of commercial spent nuclear fuel would require disposal, including the existing spent fuel from reactors previously shut down. Further, even if the United States decides to close the nuclear fuel cycle through reprocessing and advanced reactors, the expanded Yucca Mountain capacity would allow time for the necessary R&D to accomplish a full-scale and economically competitive closed fuel cycle without the need for a second repository.

For more information, contact John Kessler at 704.595.2249 or jkessler@epri.com.

**Degradation Database Provides Information to Guide Steam Generator Maintenance Programs**

*EPRI's Steam Generator Degradation Database enables engineers to tap into worldwide steam generator experience to assess tube degradation trends and guide strategic planning.*

Steam generator degradation experience represents a valuable resource to nuclear plant owners, providing utility engineers with early warning of potential problems and facilitating early action to eliminate or minimize future steam generator degradation. The EPRI Steam Generator Degradation Database (SGDD) is a user-friendly, interactive database that allows utility engineers to access steam generator observations and experiences from other plants and use that information as the basis for developing effective steam generator operation and maintenance practices. SGDD is particularly useful to utilities in addressing NEI 97-06, a self-imposed industry requirements document that describes fundamental elements that must be included in a utility's steam generator program. The SGDD database is available to members of EPRI’s Steam Generator Management Program at [http://sgdd.epri.com](http://sgdd.epri.com).

SGDD is populated with available data by utility engineers, ensuring up-to-date steam generator information is available to all EPRI member utilities. The ability to add and modify data in SGDD allows steam generator engineers to control the quality of data input into SGDD.

More than 20 tables have been developed and populated within SGDD, using data from all U.S. pressurized water reactor (PWR) nuclear plants and many other non-U.S. PWR plants. Data within SGDD includes information on steam generator design, tube repairs, damage mechanisms, inspection scopes, nondestructive evaluation (NDE) results, in-situ pressure testing, pulled tubes, steam generator replacement, primary-to-secondary leakage, loose parts and chemistry. Functions available in SGDD allow users to input data, run reports on selected data, download reports for additional processing, and view the latest version of the *SG Progress Report*, which alerts users to new data that has been posted in SGDD in the previous 24 hours.

SGDD assists utility steam generator engineers in 1) quickly obtaining steam generator information, 2) preparing steam generator degradation assessments, 3) performing inspection planning activities, 4) preparing operational steam generator assessments, and 5) performing steam generator strategic planning. For example, the accompanying figure shows tube degradation trends from 1973 to 2007, highlighting the preponderance of stress corrosion cracking (SCC), but also revealing periodic concerns with pitting, fatigue and wear that may warrant attention. With such knowledge of steam generator operating experiences at other nuclear plants, utility management and engineering personnel can tailor steam generator programs to achieve optimum, cost-effective performance over the life of the plants.
Modeen Visit to South Korea Stresses Importance of Global R&D Engagement

**EPRI Chief Nuclear Officer Dave Modeen meets with key industry officials to discuss nuclear research priorities and potential collaborative opportunities.**

Dave Modeen, EPRI’s Chief Nuclear Officer, visited the Republic of Korea in mid-August to discuss nuclear research priorities with key industry officials and to deliver a keynote presentation at the World Nuclear University Summer Institute. Mr. Modeen met with executives from the state-owned Korea Hydro & Nuclear Power Company (KHNP), which operates the country’s nuclear and hydroelectric power stations, and from the Korea Electric Power Research Institute (KEPRI), which manages a diverse set of electricity-sector research organizations including the Nuclear Power Laboratory.

South Korea has embraced nuclear power as a centerpiece of its national energy strategy. With 20 operational reactors, and several more under construction or in development, nuclear power accounts for nearly 40% of domestic electricity generation. With an installed capacity of more than 17,000 MW, South Korea is the world’s sixth-largest nuclear generator.

With its lengthy nuclear history, South Korea is beginning to confront many of the same issues faced by nuclear operators around the world. Mr. Jong Shin Kim, KHNP president, noted that KHNP’s foremost concern is gaining public acceptance for extending the operation of its first nuclear unit, Kori-1, which entered service in 1977 but is currently shut down awaiting approval for continued operation. Further, to address emerging concerns with steam generators and materials, KHNP actively participates in EPRI’s Steam Generator Management Program (SGMP) and Materials Reliability Program (MRP).

Dr. Myung Jae Song, KHNP senior vice president, noted that KHNP nuclear plants are among the world leaders in terms of capacity factor, due in large part to internal research activities and technological improvements. KHNP also leverages external research. For example, the company has furthered a low-level waste vitrification technology originally developed by EPRI, maturing it to a point where near-term commercialization is likely.

At KEPRI, Dave Modeen and KEPRI President Dr. Sang-doug Park reaffirmed the increasing importance and necessity of collaboration between the two organizations, recognizing their unique complementary technical capabilities. KEPRI is an active participant in EPRI nuclear programs: as a member of the Non-Destructive Evaluation program, as a co-funder of SGMP (jointly with KHNP), as the managing entity for KHNP’s participation in the Materials Reliability Program, and as a partner with EPRI in the area of dissimilar metal welds PDI (Performance Demonstration Initiative).
The World Nuclear University is a global partnership of leading institutions committed to enhancing education and leadership in the nuclear power sector. The annual Summer Institute provides a unique six-week educational experience for more than 100 future global leaders in the field of nuclear science and technology, from more than 30 countries. During his presentation, Modeen outlined the role of enabling R&D programs in satisfying increased electricity needs using non- or zero-emitting technologies in the decades ahead. Modeen presented insights from recent EPRI analyses of the potential carbon dioxide emission reduction contributions from renewable energy sources, energy efficiency, carbon capture and storage from coal generation, and nuclear energy. Given that the Summer Institute topics are almost exclusively focused on nuclear energy, EPRI believes it is particularly important to provide information on other generation and use technologies. Modeen completed his remarks with a detailed review of specific nuclear-related R&D priorities to enable a strong, vibrant global commercial nuclear industry.

Photo caption: On August 21 in Washington, D.C., officials from KEPRI and EPRI signed a three-year agreement in which EPRI will provide technical support to Korean efforts to establish a performance demonstration system for dissimilar metal welds. EPRI first assisted its Korean counterparts in establishing a performance demonstration system at the KEPRI NDE Center in Daejeon in 2002-2004.