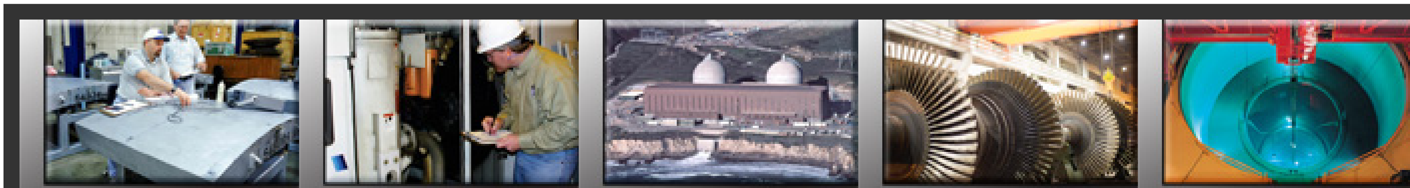
Nuclear Executive Update



An EPRI Progress Report **March 2008**

The Nuclear Executive Update is published bi-monthly. If you have comments about the newsletter, please contact Brian Schimmoller, bschimmoller@epri.com, 704-595-2076.

EPRI regularly engages a wide range of nuclear-related research organizations, industry groups, government agencies, and other affiliated entities. We are committed to maintaining an ongoing, active dialogue with these organizations to clearly delineate areas of responsibility, avoid duplication of effort, and identify opportunities for collaboration – all with an eye toward maximizing the value EPRI delivers to members and stakeholders. In this issue of the newsletter, I'm going to touch on our engagement with several nuclear-related *business and operational entities.*

Guiding all of our external interactions is the recognition that common membership affords an opportunity to more effectively address common interests and challenges. For example, EPRI's active participation in Nuclear Energy Institute working groups and task forces broadens awareness of technical and business stress points, enabling EPRI to craft research plans that pursue practical and applicable solutions within financial and regulatory constraints. Over the past two decades, for instance, EPRI engagement in various NEI working groups has led to regulatory agency acceptance of probabilistic risk assessment techniques for seismic design, fire protection and accident management.

EPRI's engagement with the Institute of Nuclear Power Operations focuses on translating performance challenges and improvement opportunities into concrete technical and operational solutions. Dialogue between INPO and EPRI helps ensure that performance goals stretch – but do not surpass – available technical responses. Most recently, this collaboration manifested itself in the industry's Zero by 2010 fuel failure initiative, in which INPO developed a significant performance goal, but vetted with EPRI and others to ensure that the goal had a technical basis.

On the international front, we are working with the Federation of Electric Power Companies of Japan to develop revised and regulator-accepted maintenance requirements that will drive reliability and safety improvements at Japan's ten nuclear utilities. We are also supporting International Atomic Energy Agency efforts to develop guidance that will essentially serve as international standards on the procurement, construction and operation of nuclear plants in many parts of the world.

External outreach extends to many other industry groups, including Nuclear Electric Insurance Ltd., the Utilities Service Alliance (USA), STARS (Strategic Teaming and Resource Sharing), the Nuclear Non-Operating Owners' Group, and the World Association of Nuclear Operators (WANO). We will continue stress-testing these relationships to ensure alignment with industry priorities and EPRI's mission. For more information on any of these external engagement efforts, please contact me or Dave Modeen, who is responsible for our external affairs activities.

Sincerely,

Chris Larsen

Vice President and Chief Nuclear Officer
EPRI Nuclear Sector

Next Issue:

- *EPRI's engagement with nuclear-related research organizations around the world*
- *EPRI's evolving "Long-Term Operation" activities, focused on plant operation through and beyond 60 years.*

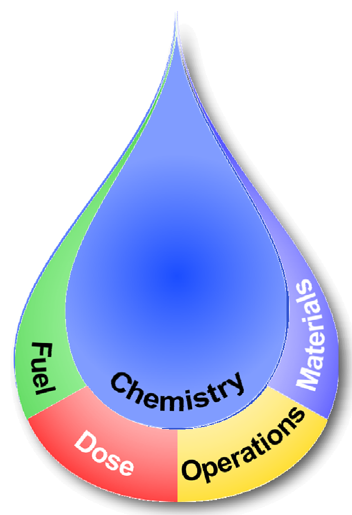
TECHNICAL HIGHLIGHTS

BWR and PWR Water Chemistry Guidelines Fully Revised by End of 2008

PWR Primary Water Chemistry Guidelines published in December 2007; PWR Secondary Water Chemistry Guidelines and BWR Water Chemistry Guidelines to be published by December 2008.

Consistent with its industry commitment to provide clear, up-to-date and technically based requirements for water chemistry at nuclear power plants, EPRI is releasing three guideline revision documents between December 2007 and December 2008: Boiling Water Reactor Water Chemistry Guidelines, Pressurized Water Reactor Primary Water Chemistry Guidelines, and Pressurized Water Reactor Secondary Water Chemistry Guidelines. These three guidelines documents contain Mandatory, Needed, and Good Practice elements, consistent with industry guidance developed for materials issues (e.g., NEI 03-08).

As illustrated in the accompanying tear-drop figure, the effects of water chemistry on materials degradation, fuel performance, radiation fields, and overall plant performance must be considered and weighed appropriately. Given the complexity in managing these issues, close collaboration with other EPRI programs is required. For example, the Fuel Reliability Program (FRP) provides expertise to consider potential impacts on fuel performance; the BWR Vessels and Internals Program (BWRVIP), Materials Reliability Program (MRP) and Steam Generator Management Program (SGMP) provide expertise on materials-related degradation impacts for BWR, PWR primary chemistry and PWR secondary chemistry, respectively; and the Radiation Management Program provides expertise regarding the effects of chemistry on plant radiation fields.



The three water chemistry guidelines are individually reviewed by an industry committee on a two-year basis and revised on a four-year basis. EPRI published the PWR Primary Water Chemistry Guidelines, Revision 6, in December 2007 (EPRI Technical Report No. 1014986). Full implementation is required by June 17, 2008 (by Sept. 17, 2008 if a plant's refueling outage occurs between Dec 17, 2007 and June 17, 2008). Significant changes include:

- More emphasis on elevated pH operation
- More guidance on pH control during chemistry transients
- Changes to some of the required and diagnostic parameters
- Updated methodology for plant-specific optimization to reflect lessons learned

The PWR Secondary Water Chemistry Guidelines, Revision 7, will be completed by December 2008. The industry committee is scheduled to submit a draft version for multi-layer review by various SGMP committees and the U.S. Nuclear Regulatory Commission by July. Significant issues include:

- Guidance specifically tied to steam generator tubing material in recognition of the improved corrosion resistance of newer materials such as Alloy 600TT and 690TT
- Dispersant application for mitigating steam generator fouling
- Steam generator wet layup requirements and hydrazine requirements during operation
- Increased flexibility for plants during startup

The BWR Water Chemistry Guidelines, 2008 Revision, is also scheduled for completion by December 2008, with draft submittal to several BWRVIP and FRP committees by July. Significant issues include:

- Requirements to support fuel performance and reliability, consistent with the industry's Zero by 2010 fuel failure initiative
- Mitigation of materials cracking issues via on-line noble metal chemical addition and improved hydrogen availability
- Review of feedwater iron and zinc limits
- Enhanced monitoring recommendations

Implementation of the second two guidelines will follow a six-month schedule similar to that of the PWR Primary Water Chemistry Guidelines.

For more information, contact Keith Fruzzetti at 650-855-2211 or kfruzzet@epri.com.

New Nuclear Build Presents Opportunities for NDE Integration

NDE technology transfer from existing plants could minimize repair requirements and reduce the number of required inspections for new plants.

Evolution in nondestructive evaluation (NDE) technology and regulatory philosophy provides significant technology transfer opportunities from existing plants to new plants. Through the Advanced Nuclear Technology Program, EPRI has initiated a project titled "NDE and Repair Reduction for New Nuclear Build" to exploit two of these opportunities, one aimed at minimizing repairs and one aimed at combining inspections.

New nuclear power plants must comply with federal regulations requiring construction inspections, pre-service inspections, and in-service inspections, all governed by ASME Code. The construction and pre-service inspections are performed before the plant goes online. The ASME Section III construction inspection is optimized for fabrication defects, and the ASME Section XI pre-service inspection is optimized for service-induced defects (i.e., it provides a baseline for the in-service inspections that will be performed throughout the plant lifetime).

During construction of the existing fleet, many piping welds required multiple repairs as welding defects were detected. The repairs left the welds in a state of high residual tensile stress, which is one of the conditions necessary for stress corrosion cracking. Operating experience has clearly shown that stress corrosion cracking occurs preferentially at the location of weld repairs. Minimizing repairs would not only save the cost and delay of the repairs themselves, but also the cost of mitigating the welds or repairing subsequent degradation during plant operation.

ASME Section III's defect allowability criteria are a "workmanship" standard. Many small, embedded defects that are unallowable according to Section III are actually of no structural significance. EPRI is preparing a fracture mechanics-based technical justification to support the acceptance of such benign defects without repair, and is driving a Code action to enable implementation. Also, because the approach requires qualified NDE techniques and technicians that can detect and measure defects with sufficient accuracy to support their acceptance, the EPRI project will begin developing the infrastructure to support qualification and training.

The project's second objective is to use only one inspection to obtain compliance credit for both the Section III construction inspection and the Section XI pre-service inspection. This will provide a cost benefit for every weld. During construction of the existing fleet, the two inspections were separate because each was technically optimized for its specific purpose: one for detecting fabrication defects throughout the weld, and the other for detecting in-service degradations near the inside surface. EPRI will develop and qualify techniques using modern NDE technologies to integrate both capabilities into a single inspection.

While the project is primarily designed to support new build activities in the United States, it will also be applicable to new build in other nations. The technical justification for acceptance of small fabrication defects, for example, can be adapted to other nations' requirements. Moreover, the supporting NDE qualification program may be directly applicable in nations that apply ASME Code or, if necessary, technical justifications can be developed to enable application.

For more information, contact Greg Selby at 704-595-2095 or gselby@epri.com.

EPRI Guidance Ensures Effective Use of Alloy 52M Weld Overlays to Mitigate Stress Corrosion Cracking

The Overlay Handbook guides successful pressure boundary weld application from both a welding and inspection perspective.

Recent cracking incidents in pressurized water reactor (PWR) Alloy 600 nozzles and penetration locations have increased concern about primary water stress corrosion cracking (PWSCC) in Alloy 82/182 welds. These weld filler materials are used extensively for PWR primary water pressure boundary welds, increasing plant exposure to service-induced cracking. Weld overlays with Alloy 52M, a PWSCC-resistant weld metal, represent a proven method to mitigate or repair PWSCC in Alloy 82/182 materials. EPRI's Repair & Replacement Applications Center has prepared specific guidance and lessons learned for overlay repair using the new Alloy 52M weld material.

Many plant locations susceptible to PWSCC have access limitations that make examination difficult and limit mitigation processes. As a result, many utilities have performed weld overlays. Full structural weld overlays subject the inner portion of the pipe to compressive stress, constraining the propagation of stress corrosion cracking. PWSCC is further inhibited by using the crack-resistant Alloy 52M as filler metal. Although the Alloy 82/182 material remains exposed to the primary coolant (since the weld overlay is applied to the outside surface of the weld), the thickness of the overlay is sufficient to meet ASME Code safety factors without taking credit for the original pipe wall.

RRAC received numerous requests from utilities and vendors asking for guidance in applying Alloy 52M weld overlays due to problems with early applications. For example, Alloy 52M material is difficult to weld, frequently exhibiting unacceptable welding defects that could complicate ultrasonic examination. RRAC worked with the weld filler material supplier and welding vendors to evaluate key factors that influence weld quality, including the filler metal chemistry, welding parameters, and base material chemistry interactions. In coordination with the EPRI Nondestructive Evaluation Center, RRAC also examined lessons learned from successful and unsuccessful Alloy 52M applications from both a welding and inspection perspective.

Alloy 52M weld overlay

EPRI published a guidance document, the *Overlay Handbook* (EPRI Technical Report No. 1014554), which has been utilized by several utilities to guide recent weld overlay applications. To date, weld overlays have been installed at 30 PWR plants to mitigate or repair PWSCC on pressurizer nozzle dissimilar metal welds. Eight additional PWR plants are scheduled to apply weld overlays in 2008.

The continued use of overlays for both repair and mitigation of stress corrosion cracking has promoted the development of other advanced welding alloys that could enhance weld quality and provide superior resistance to stress corrosion cracking for both PWR and BWR units. These welding alloys would maintain the high cracking resistance of the current Alloy 52 materials, while reducing the potential for a variety of welding-related defects.

For more information, contact Greg Frederick at 704-595-2071, gfrederi@epri.com.

EPRI Revives Standard Radiation Monitoring Program for PWRs

EPRI has reinstated a radiation monitoring program for pressurized water reactors to benchmark industry dose rates and identify source term reduction opportunities.

In 2003, in response to a negative trend in cumulative exposure at nuclear power plants, EPRI, the Nuclear Energy Institute, and the Institute of Nuclear Power Operations collaboratively developed the RP2020 Initiative. The Initiative's main goal is to promote radiation protection fundamentals, leading to reduced dose and essentially "taking radiation off the table" as an industry metric. EPRI has the technical lead in investigating and developing technologies and strategies for radiation source term reduction. Central to this effort is reliable radiation field data.

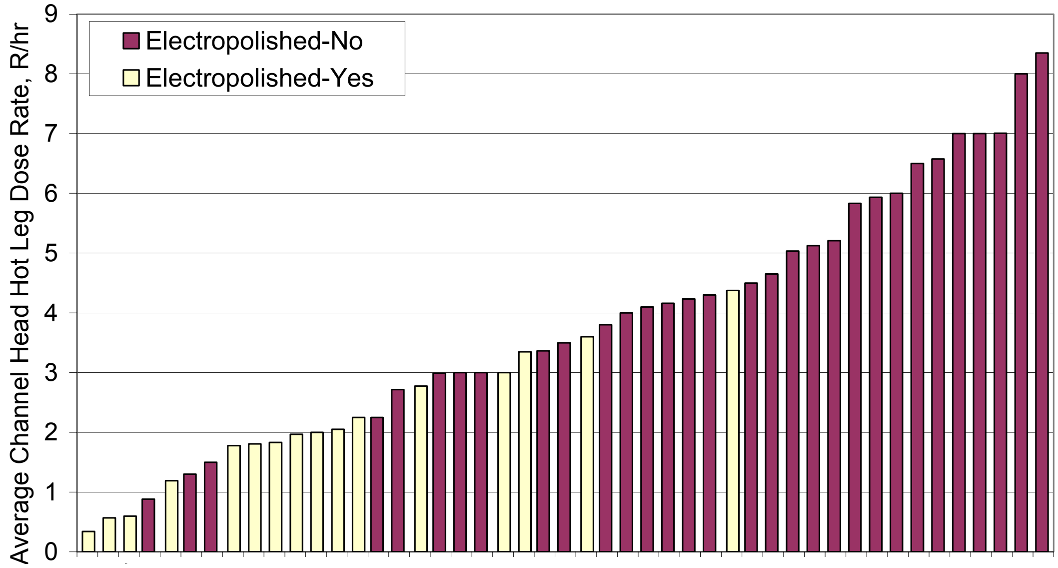
While boiling water reactors already have a well-established data collection mechanism through the EPRI-managed BWR Radiation Assessment and Control program, the corresponding mechanism for pressurized water reactors, the PWR Standard Radiation Monitoring Program (SRMP), was discontinued in 1996 due to a lack of funding and industry interest. Through the impetus provided by the RP2020 Initiative, EPRI reinstated the SRMP in 2007.

Initial industry participation has been excellent, with 80% of U.S. power plants submitting data in 2007; 100% participation is desired, however, to maximize program value. EPRI is also pursuing international participation, and EDF has recently agreed to contribute data to SRMP from many of its 58 nuclear plants.

By collecting data and evaluating radiation fields at similar locations in the plant, differences can be readily identified and corresponding research directed at contributing factors related to plant design, materials, work practices, etc. The vast majority of requested sampling points are typically already included in existing plant radiation monitoring programs. Further, EPRI has assigned the sampling points to one of three categories: required, recommended, and optional. If a sampling point is inaccessible or would entail significant time and resources, that point can be omitted.

Preliminary data analysis indicates that the plant changes with the largest impact on radiation field reduction are steam generator replacement, zinc injection, and electropolishing steam generator channel bowls (see figure). Next steps include developing recommendations for source term reduction technologies specifically related to plant design and operating conditions, and applying gamma spectroscopy to develop a more detailed understanding of source term generation and reduction.

For more information, or to participate, contact Dennis Hussey at 650-855-8529 or dhussey@epri.com. Additional information: EPRI Report No. 1015119, *Application of the Standard Radiation Monitoring Program for PWR Radiation Field Reduction.*



Dose rate comparison of PWR hot leg channel head bowls with and without electropolishing

Preventive Maintenance Basis Database Balances Plant Reliability against Available Resources

The upgraded database, portions of which are being used by 80% of North American nuclear operating companies, offers expanded capabilities to inform plant decision making.

Version 2 of the Preventive Maintenance Basis Database, released in December 2007 (EPRI Product No. 1014971), contains more than 60,000 pieces of expert panel information on 136 power plant components. While the preventive maintenance templates, task descriptions, and technical bases for the 136 components are the primary capabilities used by most plants, the PMBD contains other component-level information valuable to plant operation and maintenance:

- Failure locations
- Degradation mechanisms for each failure location
- Degradation influences for each degradation mechanism
- Discovery methods
- Failure timing
- PM task effectiveness

As an example, for a vertical pump, the PMBD can identify the failure location as the bearing retainers and spiders, the degradation mechanism as cracking, the degradation influence as fatigue, discovery methods as vibration and inspection, and failure timing as five years on average, with an earliest known occurrence at three years.

In addition to the primary uses above, plant engineering groups can use PMBD to:

- Justify and document the basis for adding or deleting PM tasks
- Justify and document the basis for changing the frequency of PM tasks
- Establish system and component monitoring requirements
- Troubleshoot component failures
- Simplify root cause evaluations

- Determine reliability risks associated with maintenance decisions
- Inform parts procurement and inventory needs
- Establish component maintenance strategies

The PMBD Vulnerability Analysis, for example, allows a plant engineer to input current plant PM tasks for a component and quickly examine the known failure events for that component. The engineer can then modify aspects of the plant PM tasks and gauge the effect on component reliability.

For more information on the PMBD and its uses, contact Leonard Loflin at 704-595-2010 or leloflin@epri.com.

Technology Transfer Awards Recognize Successful Application of EPRI Results

Nuclear Sector presents 14 technology transfer awards to 36 individuals representing 14 nuclear owners/operators.

To recognize the individual and corporate commitment associated with implementing EPRI products and research results, the Nuclear Sector presented 14 technology transfer awards at its advisory meetings in January. EPRI Chief Nuclear Officer Chris Larsen and External Affairs Director Dave Modeen conferred the awards to representatives from 14 nuclear utilities, including three international nuclear plant operators.

The awards recognized a wide array of technology transfer activities, from software tool application to international training sessions. Award details and recipients are listed below. For more information, contact Terry Talbert at 202-293-6183 or ttalbert@epri.com, or visit the "Applying Results" page on www.epri.com.

Award title	Company	Recipients
Modifications to the 48-hour hold requirement for Code Case N-638-1	AmerenUE	Tom Elwood, Michael Hoehn II, Dan Stepanovic
Implementation of EPRI guidelines to detect cable insulation deterioration	American Electric Power	Colby Baker, Hamid Heidarisafa
Pilot testing of EPRI's streamlined risk-informed in-service inspection methodology	American Electric Power, Entergy	Steve Cherba, Paul Donavin, James Hawley, Carl Lane; Kevin Hall, Steve Lewis, Steve Scott, Gary Smith
Information exchange of EPRI's flow-accelerated corrosion programs in Asia	Dominion Resources Inc., Duke Energy Corp., Exelon Corp., Tokyo Electric Power Co.	Christopher Hooper; David A. Smith; Aaron Kelley; Naoki Hiranuma, Masao Honjin
Implementation of EPRI technology and research results across EDF	EDF	Jean-Pierre Faulot
Development of CIRCE tool for water chemistry optimization	EDF	Ellen-Mary Pavageau
Implementation of EPRI instrumentation and control technology and research results throughout the Exelon fleet	Exelon Corp.	Christopher Wiegand
Code Case N-740 implementation to utilize structural weld overlay for pressurized water stress corrosion cracking	FirstEnergy Nuclear Operating Company	Dan Patten
Application of the Principles of the EPRI GE ESBWR Radwaste System Design Review	NRG Energy, Inc.	Milt Rejcek

Award title	Company	Recipients
Demonstration of remote ultrasonic tool for bottom head drain inspections	PPL Corporation	Mark Hanover, Randy Linden
Development of methodology for containment coatings adhesion testing	Southern California Edison	Daniel L. Cox
Implementation of low-level zinc injection to improve fuel reliability	Tennessee Valley Authority	Don Adams, Betsy Eiford-Lee, Craig Faulkner, Jim Lemons
Falcon technology implementation to protect fuel rods with damaged fuel pellets	Tennessee Valley Authority	Kevin Elam, Craig Faulkner, Greg Kniedler, Jim Lemons
Information exchange through the first European ChemWorks training session	Vandellos Nuclear Power Station	Emma Capafons Domench, Enrique Fernandez Lillo

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