

## New Risk-Informed Inspection Standards Increase Plant Safety at CANDU Reactors

*To focus critical resources on those systems and components that can initiate or mitigate plant events, EPRI's risk-informed in-service inspection (RI-ISI) methodology has been revised and adapted to address CANDU technology.*

The CANDU Owners Group (COG) is a not-for-profit organization dedicated to providing programs for cooperation, mutual assistance, and exchange of information for the successful support, development, operation, maintenance and economics of CANDU technology. All CANDU operators are members of COG.

In response to a Canadian Nuclear Safety Commission (CNSC) request, COG utilities established a working group in 2009 to promote the implementation of common RHSI methodologies for application to CANDU systems piping. The development and application of new standards could increase plant safety and lower inspection costs by focusing inspection resources on those systems with greatest safety significance.

"We had three main objectives," explained Mehdi Rezaie-Manesh, senior technical engineer, Ontario Power Generation (OPG), speaking on behalf of COG and the joint project members "The first one was to establish a common Canadian utility position on application of RHSI to CANDU stations. Secondly, we wanted to develop a common approach for CANDU plant owners to meet ongoing challenges—degradation mechanisms, secondary side issues, and so forth. Finally, we wanted to provide a forum for discussion of common RHSI issues, sharing knowledge, experience and lessons learned among members."

The working group, which includes members from COG, EPRI, and the vendor community, advises CANDU utilities on the applicability of RHSI tools to better meet the challenges of ongoing operations while recognizing the need for consistency among licensees. These initiatives also provide the means to take advantage of available safety gains associated with the ranking and prioritization of significant inspection activities.

### Pilot Study Leads to Updated Methodology

To achieve their objectives, COG conducted a pilot study applying the traditional EPRI RHSI methodology (EPRI Report [112657](#)) to a CANDU unit. "The methodology was originally developed for primary systems in the light water reactor fleet, so we had to make some adjustments for CANDU technology," Rezaie-Manesh said. After reviewing the CANDU design and supporting probabilistic risk assessment analyses, EPRI updated the methodology to be CANDU-specific, providing a "best fit" RHSI methodology for piping weld evaluation.



Ontario Power Generation's Darlington Station

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**~ Mehdi Rezaie-Manesh,  
Ontario Power Generation**

Meanwhile, in response to industry concerns about the impact of balance-of-plant (BOP) systems failure on nuclear safety, the scope of the COG RHSI study was extended beyond primary systems to cover all CANDU systems. The scope was further expanded beyond piping welds to include all pressure retaining components and elements, such as tanks, vessels, pumps, valves, mechanical couplings, and rotating machineries, as well as their supports. "This initiative was the first large-scale extension of RHSI methodology to such a wide range of systems and components," said Rezaie-Manesh. "The methodology addresses unique aspects of the CANDU design, including potential types of degradation, susceptibility criteria, and multi-unit impacts."

Proof of concept was achieved by conducting a pilot plant application at OPG's Darlington station, Unit 2. EPRI and COG demonstrated the CANDU "best fit" RHSI methodology to be applicable to CANDU nuclear and BOP systems and components. COG directed a diverse team of stakeholders on the project, working with RHSI subject matter experts and plant personnel.

### Pre-Screening Process

"Given the nature of a nuclear power plant, a large number of systems could potentially be subject to an RHSI evaluation," Rezaie-Manesh explained. Because a system-by-system evaluation could become unreasonably resource-intensive, a pre-screening process was developed. "This process efficiently identifies those systems, or portions of systems, that need to be subject to the full extent of RHSI methodology. It also provides technical justification for excluding other, less critical

systems." Each element that requires the full RHSI evaluation is also subject to a "consequence of failure" assessment and "potential of failure" assessment.

### A New Standard for Inspection

Results of the project demonstrated that the EPRI RHSI methodology can be adapted to CANDU technology, and can be efficiently applied to identify important systems and components requiring plant resources and attention. The CANDU RHSI methodology and the results of the pilot plant application have been used to develop a new Canadian Standard Association (CSA) standard. CSA N285.7, "Periodic Inspection of CANDU Nuclear Power Plant Balance of Plant Systems and Components," was developed after endorsements were obtained from a variety of stakeholders (utilities, regulatory agencies, vendors, and industry consultants). The long-term plan is to incorporate CSA N285.7 in plant licensing, and to implement RHSI methodology in periodic inspection of primary systems, enhancing CSA N285.4, "Periodic Inspection of CANDU Nuclear Power Plant Components."

"We will see the benefits of this initiative and plan," Rezaie-Manesh said. "We will improve plant safety by reallocating inspections on primary-side systems to BOP systems. That helps us to identify critical components and focus our resources more efficiently. In addition, identifying and eliminating low value-add inspection activities reduces worker exposure and, potentially, inspection costs."

**For more information**, contact the EPRI Customer Assistance Center at 800.313.3774 ([askepri@epri.com](mailto:askepri@epri.com))

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