

Ontario Power Generation and Conexus Nuclear Advance EPRI's Multi-Unit Nuclear Risk Framework for CANDU Reactors



Ontario Power Generation (OPG) and Conexus Nuclear collaborated with EPRI to refine nuclear safety multi-unit risk assessment methodologies for Canada Deuterium Uranium (CANDU) reactors. Prior frameworks—developed primarily for pressurized water reactors (PWRs) and dual-unit sites—did not fully represent tightly coupled configurations of CANDU stations, creating complex inter-unit dependencies. These gaps made traditional phased approaches—starting with single-unit risk before extending to multi-unit—impractical, limiting both risk-informed decision-making and regulatory support. OPG and Conexus enhanced EPRI's multi-unit risk assessment framework to more accurately model CANDU reactor interactions, providing a stronger basis for safety evaluations and clearer guidance for future applications.

Benefits

More than 90% of the world's nuclear reactors operate at multi-unit sites. The OPG and Conexus collaboration delivered a robust risk assessment framework tailored to these environments, enhancing safety and operational planning. Improved modeling of multi-unit interactions reduces uncertainty in risk assessments and supports stronger regulatory alignment by providing a structured, defensible approach for meeting regulatory requirements for multi-unit risk evaluations. The updated methodology also removes the need for phased single-unit assessments, reducing resource requirements and shortening project timelines. Beyond this implementation, the work helps establish best practices for multi-unit risk modeling applicable to future reactor designs, including small modular reactors (SMRs).

Application

OPG and Conexus applied and refined EPRI's multi-unit risk framework for CANDU reactors, demonstrating its flexibility across reactor types and configurations. The collaboration involved detailed case studies, technical workshops, and methodology reviews. OPG provided operational data, probabilistic safety assessment (PSA) models and expert insights, while Conexus facilitated engagement with industry stakeholders.

Over a two-year effort—culminating in a final review hosted by Conexus in Toronto—the team completed the first-of-its-kind framework application. Enhancements include improved modeling of inter-unit common cause failures, expanded human reliability considerations, and integration of multi-unit risk into base PSA models.

The results of this effort are captured in the following EPRI report:

- Application of Multi-Unit Probabilistic Safety Assessment Strategies in Canada: Multi-Unit Risk for CANDU Nuclear Generating Stations Operating in Canada, 3002029304

Additional EPRI resources involved in this project include:

- Collaboration Between KHNP and EPRI on Aspects of Risk-Informed Decision-Making for Multi-Unit Sites, 3002020756
- Framework for Assessing Multi-Unit Risk to Support Risk-Informed Decision-Making: General Framework and Application-Specific Refinements, 3002020765

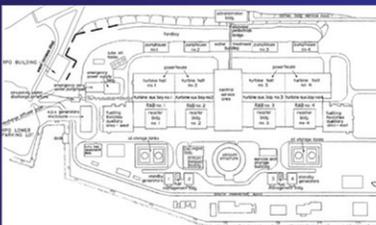


Figure 1
Depicts the layout of the four-unit Darlington Nuclear Generating Station site.



Figure 2
Shows the Darlington Nuclear Generating Station turbine hall open to all four units.



Figure 3
Shows a Canadian CANDU four-unit main control room.

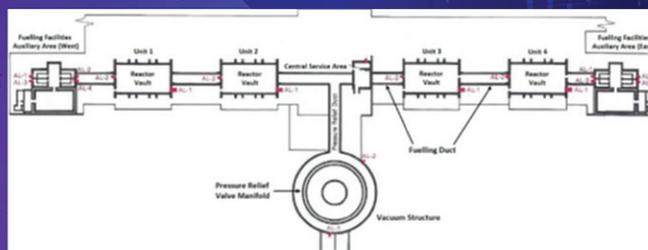


Figure 4
Highlights the Canadian CANDU multi-unit containment envelope and the interconnection among the four units.