PRA Applications in Canada

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PRA Applications in Canada

- Introduction
- History
- Scope and Targets
- Canadian PRA Regulatory Requirements

Introduction

- PRA has been used as a design audit tool since 1978
- AECL will use PRA as an input to design decisions and later confirm these decisions in the PRA
- Scope and targets of the ACR PRA is presented

History of PRA Applications

- NRX Accident - December 12, 1952
- WASH 1400- Reactor Safety Study 1975 (PWR and BWR)
- Safety Design Matrices (SDMs) 1978-1983 by AECL
- Reactor Safety Study Methodology Application Program (RSSMAP)
- Interim Reliability Evaluation Program (IREP)
- USNRC NUREG 1150 - Update of WASH 1400 with additional 2 PWRs and 1 BWR - late 1980s
- Individual Plant Evaluation (IPE) - Level 1 internal event PRAs required for all US operating NPPs - early 1990s
- Individual Plant Evaluation for External Events (IPEEE) - external event PRAs required for all US operating NPPs - late 1990s

CANDU PRA Status

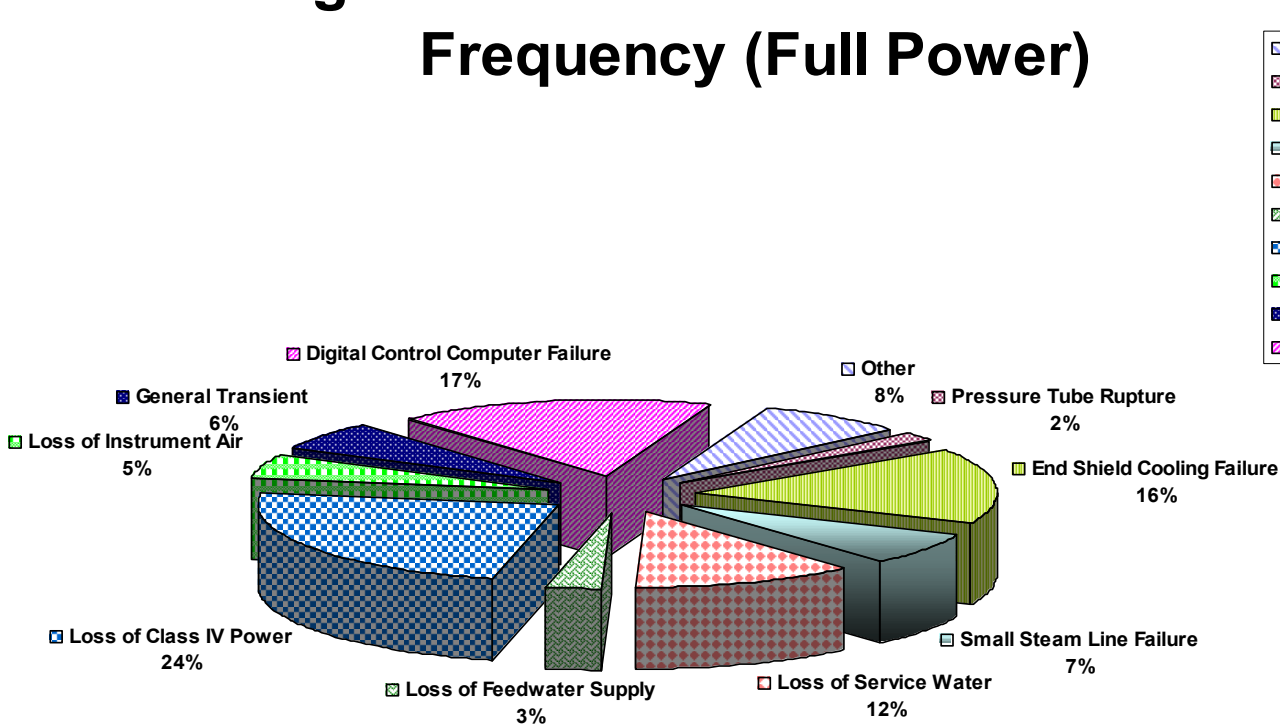
Work Done in Canada

- SDMs 1978-1983: Gentilly 2, Pt. Lepreau, Wolsong 1, Pickering B, Bruce B
- CANDU 600 Probabilistic Safety Study - March 1988
- Darlington Probabilistic Safety Evaluation - December 1987
- Wolsong 2/3/4 PRA - March 1995
- Pickering A Risk Assessment (PARA) - December 1995
- Darlington A Risk Assessment
- Pickering B Risk Assessment
- Bruce B Risk Assessment - 1999
- KEPRI- Wolsong 2/3/4 Level 2 PRA - August 1997
- Qinshan CANDU Unit 1 and 2 PRA - May 2001
- Generic PSA
- Pickering A Return to Service - Use insights from PARA
- PRA for Pt. Lepreau and Gentilly-2 Refurbishment is ongoing

PRA Scope Performed By AECL

Plant	Level of PRA	Commentary
SDMs-Gentilly-2, Pt.Lepreau Wolsung 1,Bruce B, & Pickering B	Partial Level 1	Internal Events, "No heat sink " frequencies not summed.
CANDU 6 Probabilistic Safety Study	Full Level 1 PRA and Level 2 PRA	Internal Events. Using SDM input "no heat sink" sequences summed. Level 2 PRA used WASH-1400 methodology.
Wolsong 2/3/4	Full Level 1 PRA	Internal Events (Full Power and Shutdown). Detailed Accident Sequence Quantification (ASQ) using CAFTA code.
Qinshan CANDU 1/2	Full Level 1 PRA	Internal Events (Full Power and Shutdown). Detailed Accident Sequence Quantification using CAFTA code.
Generic CANDU 6 and CANDU 9 PRA	Level 1 & Level 2 PRA Methodology and Reference Analysis	Internal, External and Shutdown Events to demonstrate methods and tools
ACR	Full Level 1 and Level 2 PRA	Internal (full power and shutdown state) and External Events

Wolsong 2/3/4 Summed Severe Core Damage Frequency (Full Power)



Summation = 6.1E-06/Year

PRA Targets

- ACR summed severe core damage frequency will be less than 1E-05/yr
- ACR summed large release frequency target will be less than 1E-06/yr
- Seismic margin target of the plant HCLPF is 0.5g based on a 0.3g Design Basis Earthquake

Canadian PRA Regulatory Requirements

- CNSC – R7, R8, and R9 - Special Safety Systems Reliability Requirements
- CNSC – S98 - Requirements for Reliability Analysis of Safety Related Systems in Nuclear Reactor
- CNSC – R99 - Reporting Requirements for Operating Nuclear Power Facilities
- CNSC – P-151 Draft 1 Regulatory Policy on the Use of a Balanced Approach for Regulatory Decision Making
- CNSC – G-152 Regulatory Guide on Guidance on the Balanced Use of Deterministic and Probabilistic Criteria in the Decision - Making

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