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January 24, 2002

Our File: 108US-01321-021-001
Your File: Project No. 722

Ms. Belkys Sosa,
ACR Project Manager,
US NRC – M/S 0-4D9A
11555 Rockville Pike
Rockville, MD 20852-2738
U.S.A.

References:

1. Letter from V.J. Langman, "Proprietary Documentation in Support of the ACR Pre-Application Review - Generic CANDU Probabilistic Safety Assessment (PSA)", AECL file 115-01321-021-002, December 10, 2002.
2. Letter from V.J. Langman, "Further to the ACR Pre-Application Plan - Detailed Deliverables and Schedule for Focus Topics", AECL file 108US-01321-021-001, December 18, 2002.

Re: **Documentation in Support of the ACR Pre-Application Review - Generic CANDU Probabilistic Safety Assessment (PSA)**

The following information supercedes that provided in Reference 1.

In support of the successful resolution of ACR pre-application focus topic 11, "ACR PRA methodology" (Reference 2), you will find on the enclosed CD two reports, which describe the methodology used for the PSA of CANDU reactors, and the results of the reference analysis for the CANDU 6 and CANDU 9 reactors.

As described in Attachment 1, the two PSA reports listed in Attachment 2 are being provided in order for the NRC staff to review the PSA methodology, which is being applied to the ACR. These PSA reports also provide the NRC staff with background information on the key generic features of a CANDU PSA.

If you have any questions on this letter and/or the enclosed information please contact the undersigned at (905) 823-9060 extension 6543.

Yours sincerely,

Vince Lang

Vince J. Langman
ACR Licensing Manager

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/Attachments

1. Background on the Generic CANDU Probabilistic Safety Assessment
2. List of PSA Reports in Support of ACR Pre-Application Review

/Enclosure

1. One CD containing copies of the two Generic CANDU PSA reports

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Attachment 1

Background on the Generic CANDU Probabilistic Safety Assessment

(Letter from V. Langman, "Documentation in Support of the ACR Pre-Application Review – Generic CANDU Probabilistic Safety Assessment (PSA)", January 24, 2003)

AECL produced the Generic CANDU Probabilistic Safety Assessment (GPSA) with the purpose of defining the scope and the methodology to be applied to the PSAs of future projects. As part of the GPSA a reference analysis was also developed for critical sequences of CANDU 6 and CANDU 9 systems based on insights gained from AECL's experience with previous PSAs, in particular the Wolsong 2/3/4 PSA.

The methodology is covered in the first report, 91-03660-AR-001, and the reference analysis for CANDU 6 and CANDU 9 is provided in the second report, 91-03660-AR-002.

The scope of the GPSA includes Level 1 with both internal and external events, and Level 2 with the analysis of severe core damage progression and containment response. The methodology for both Level 1 and Level 2 PSAs uses approaches consistent with international standards and practices. For Level 1 PSA, major enhancements areas in the GPSA relative to previous CANDU PSAs are human reliability analysis, common cause failure analysis and external event analysis. The Level 2 PSA uses the MAAP4 CANDU code, which is an adaptation of the original MAAP code developed by EPRI to the CANDU pressure tube reactor.

The reference analysis of CANDU 6 and CANDU 9 provides the framework of the detailed analysis to be implemented in PSAs of future AECL projects. The reference analysis was developed with a two-pronged approach: to cover accident sequences that past experience had shown to be the major contributors to severe core damage, and to concentrate on analysis areas, such as external events and severe core damage progression, which had received limited treatment in previous AECL PSAs.

The following are examples of the important findings from the reference analysis.

- For internal events at power it is shown that the dominant sequences are loss of end shield and loss of Class IV electrical power.
- For seismic events, the contribution of failure modes is greatly affected by the hazard curve. Because of the large uncertainties in seismic hazard input, a PSA-based seismic margin assessment may be considered instead of a seismic PSA.
- For shutdown events, the results indicate that the loss of service water event with the reactor coolant system drained to the reactor headers is the dominant contributor to the severe core damage frequency.
- Preliminary results of the MAAP4 CANDU analysis of CANDU 6 showed long failure times for calandria vessel and containment for severe core damage sequences stemming from station blackout and large LOCA. These results, which are due to the presence of large, passive heat sinks (i.e., the moderator and shield tank water), confirm that there is sufficient time for the operator to arrest the accident progression by administering accident management measures.

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The GPSA methodology is currently being applied to the probabilistic safety assessment of the Advanced CANDU Reactor (ACR) design. The current stage of the application of the GPSA to the ACR focuses on design assist PSA analyses. The objectives of these analyses are to establish design targets for the reliability of the mitigating systems, to set requirements for prevention and mitigation of severe accidents, and to assess the design adequacy of the ACR safety features.

The ACR PSA will be a Level 1 and 2 PSA, inclusive of internal and external events, at-power and shutdown states, and severe core damage. PSA-based seismic margin analysis will be performed for seismic events.

The two GPSA reports are being provided in order for the NRC staff to review the PSA methodology, which is being applied to the ACR. The GPSA reports also provide the NRC staff with background information on the key generic features of a CANDU PSA.

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Attachment 2

List of PSA Reports in Support of ACR Pre-Application Review

(Letter from V. Langman, "Documentation in Support of the ACR Pre-Application Review - Generic CANDU Probabilistic Safety Assessment (PSA)", January 24, 2003)

1. "Generic CANDU Probabilistic Safety Assessment – Methodology", Report 91-03660-AR-001, Revision 0, Controlled, July 2002.
2. "Generic CANDU Probabilistic Safety Assessment – Reference Analysis", Report 91-03660-AR-002, Revision 0, Controlled, July 2002.