May 30, 2003

ORGANIZATION: ATOMIC ENERGY OF CANADA LIMITED (AECL)

SUBJECT: SUMMARY OF MEETING HELD ON MARCH 27, 2003, TO DISCUSS ACR-700 SAFETY DESIGN PHILOSOPHY

The Nuclear Regulatory Commission (NRC) hosted a public meeting with Atomic Energy of Canada Limited (AECL) on March 27, 2003, at the U. S. Nuclear Regulatory Commission (NRC) Headquarters to discuss the Advanced CANDU Reactor (ACR-700) safety design philosophy. For a list of meeting attendees refer to Enclosure 1.

This meeting was part of a series of technical workshops planned during the ACR pre-application phase with the purpose of familiarizing the staff with the CANDU design. The main objective of the meeting was to present the safety design and analysis bases, and to discuss the ACR safety design approach including design basis accidents (DBA), limited core damage accidents, severe core damage accidents and acceptance criteria (AC).

An overview of the safety approach of the CANDU reactor design was provided and the foundations of the safety philosophy were discussed. The ACR safety design approach follows the defense-in-depth approach as applied to water-cooled reactors. To achieve a low probability of a serious event, the design principles of safety functions are driven by independence, redundancy, separation, reliability, testability, diversity, simplicity, and safe failure. AECL highlighted additional inherent safety characteristics in the ACR design compared to existing CANDU plants. Examples include the negative power reactivity coefficient and the larger safety and operating margins due to the use of CANFLEX fuel with lower element rating and higher critical heat flux.

The ACR design has two independent shutdown systems. The shutdown system 1 (SDS 1) consists of 20 mechanical shutoff rods that drop into the core by gravity and insert -50 milik (mk) of reactivity to shut down the reactor after an accident. The SDS 2 is designed to inject concentrated gadolinium nitrate solution into the moderator, providing -50 mk of reactivity to shut down the reactor after an accident and contains enough gadolinium to keep the reactor shut down. There are six pressurized tanks and only five tanks are needed to shut down the reactor. SDS 1 is set to operate first and, only if required, SDS 2 is actuated, depending on the settings. In response to a question from the staff, AECL will address at a future meeting if design inspectability is considered as a design criteria.

At the staff's request, AECL agreed to address, at a future meeting, if a complete stress analysis for piping design would be available during the design certification review.

AECL has proposed a licensing approach for the ACR, both in the U.S. and Canada, which starts from the approach used for previous CANDU reactors, but treats severe accidents in a more risk-informed fashion. AECL noted the following definitions as they apply to the ACR design:

1. Design Basis Events (DBEs): Events which must be accommodated by the plant design within specified limits of the radiological dose to the public and of the key barriers to the release of radioactivity to the environment.

2. Limited Core Damage Accidents: Improbable events beyond the design basis, which must be accommodated within specified radiological dose limits to the public.

3. Severe Core Damage Accidents: Extremely improbable events beyond the design basis, which lead to loss of core geometry.

An example of a design basis event includes pressure tube (PT) failure with the calandria tube intact. Testing has been conducted for CANDU reactors to validate that the failure of a single PT and calandria tube do not result in failure of adjacent pressure or calandria tubes. As a result, AECL does not consider failure of a fuel channel leading to failure of adjacent fuel channels as an event. AECL clarified that limited core damage accidents generally include a combination of events. Examples of limited core damage accidents include a small or large loss-of-coolant accident (LOCA), plus a loss of emergency core cooling (LOECC). An example of a severe core damage accident was identified as a LOCA, plus LOECC, plus unavailability of moderator heat sink and unavailability of moderator makeup by the Reserve Water System (RWS).

The staff discussed the containment differences and suggested that AECL consider addressing these differences during the pre-application phase of the ACR design review.

During a background discussion, the staff noted a difference in the regulatory philosophy and stated that the NRC would benefit during the pre-application phase of knowing where the ACR design differs from NRC requirements.

The meeting continued with a presentation on the ACR safety analysis approach. The ACR analysis approach is founded on the risk-informed objective. The most probable occurrences should yield the least radiological consequences, and situations having the potential for the greatest consequences should be least likely to occur.

The staff expressed an interest in reviewing the emergency guidance for severe accidents, and AECL stated that since emergency guidance is determined in conjunction with utilities; it would not be available during the pre-application review phase, but would be provided during the ACR design certification review.

A followup ACR familiarization meeting is scheduled to be held on May 6-8, 2003, to discuss ACR Limited and Severe Core Damage Accidents and supporting technology base and Probabilistic Risk Assessment (PRA).

For additional details on the material covered in these presentations please refer to the Agencywide Documents Access and Management System (ADAMS). This system provides text and image files of NRC's public documents. The presentations mentioned above may be accessed through the ADAMS system under Accession No. ML030870716. If access to

ADAMS is not available or if there are problems in accessing the handouts located in ADAMS, contact the NRC Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr@nrc.gov.

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Project No. 722

Enclosures: As stated

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ACR-700 Safety Design Philosophy
March 27, 2003 Auditorium 9:00am - 4:00pm

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