

June 11, 2003

ORGANIZATION: ATOMIC ENERGY OF CANADA LIMITED (AECL)

SUBJECT: SUMMARY OF MEETING HELD ON MAY 6-8, 2003, TO DISCUSS ACR-700 LIMITED AND SEVERE CORE DAMAGE ACCIDENTS AND PRA

The Nuclear Regulatory Commission (NRC) hosted a public meeting with Atomic Energy of Canada Limited (AECL) on May 6-8, 2003, at the NRC Headquarters to discuss the Advanced CANDU Reactor (ACR-700) limited and severe core damage accidents and probabilistic risk assessment (PRA). 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 sequences of limited and severe core damage accidents and the application of previous CANDU PRA insights into the ACR design.

An overview of the sequences of limited and severe core damage accidents due to the severe flow blockage, loss-of-coolant accident (LOCA) with a loss of emergency core cooling (LOECC), LOECC and loss of moderator cooling, and station blackout was provided. AECL defined the limited core damage accidents as improbable events for which the channel core geometry is maintained and the following examples of events were provided:

- Small and Large LOCA with LOECC
- End Fitting Failure with LOECC
- Pressure Tube/Calandria Tube Failure with LOECC
- Steam Generator Tube Rupture with LOECC
- Stagnation Feeder Break
- Severe Channel Flow Blockage

The severe core damage accidents were defined as highly improbable events for which there is the possibility of core disassembly. LOCA with LOECC and loss of moderator cooling, and station blackout (Loss of all AC Power) were presented as the examples of severe core damage accidents. AECL stated that these accidents are highly improbable events due to the inherent CANDU reactor safety features such as moderator, shield tank and passive reserve water system reservoirs to limit the core damage consequences by providing sufficient thermal capacity and time for operator intervention. The staff raised a question concerning the status on the proposed approach to the definitions of limited core damage accidents as beyond design accidents with the Canadian Nuclear Safety Commission (CNSC) since these units have historically been treated as design basis accidents in Canada. AECL stated that it is in discussions with the CNSC, but the analyses of limited core damage accidents are not far from the previous CANDU design approach.

The overview was followed by the detailed technical presentations on the fuel and fuel channel behavior, fission product release in reactor cooling system (RCS), iodine and hydrogen behavior in containment during the limited and severe core damage accidents. AECL also

discussed on-going R&D programs on the ACR fuel channel behavior and the extensive experiment data bases on fission product chemistry, fuel channel thermal mechanical properties, hydrogen combustion, pressure tube behavior, etc. The extensive experimental data bases and R&D programs were necessary in understanding the phenomenology of severe core damage accidents and providing inputs to the MAAP4 CANDU Computer Code for modeling severe accident behavior in ACR.

The staff suggested that a future technical presentation by AECL address the correlation of the source term codes used in experimental data analyses with the specific accidents scenarios. This will help the staff to identify the computer models for each accident scenario during the pre-application phase of the ACR design review. AECL took this request under advisement.

During a background discussion, the staff expressed an interest in reviewing the MAAP4 CANDU computer codes to understand the calculations of severe core damage accidents progression in ACR. Although MAAP4 CANDU computer codes are not currently available for the ACR design, AECL did not foresee any obstacles in providing a copy of existing MAAP4 CANDU computer codes to NRC staff.

The meeting continued with a presentation on the ACR PRA. AECL presented the following PRA targets for ACR:

- ACR summed severe core damage frequency: Less than 1E-05/yr
- ACR summed large release frequency: Less than 1E-06/yr
- Seismic margin: 0.5g based on a 0.3g Design Basis Earthquake

The overview of common cause failure (CCF), human reliability, recovery, uncertainty, and sensitivity analyses was provided in achieving the PRA targets. In addition, the engineering insights from previous CANDUs and the severe core damage consequences analyses will be factored into the ACR PRA to identify the high risk contributors.

AECL provided 35 open literature publications on the following topics discussed during the meeting:

- Severe Core Damage Accident Scenarios
- Fuel Channel Behavior
- Fission Products and Fuel Behavior
- Hydrogen Behavior
- Iodine Behavior
- PRA

For additional details on the material covered in these presentations please refer to the Agency wide 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. ML031340707. 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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Enclosures: As stated

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AECL Presentation on ACR-700
Limited and Severe Core Damage Accidents and PRA
May 6-8, 2003 Auditorium 8:30am - 5:00pm

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