September 16, 2003

ORGANIZATION: ATOMIC ENERGY OF CANADA LIMITED (AECL)

SUBJECT: SUMMARY OF MEETING HELD ON SEPTEMBER 3-4, 2003, TO DISCUSS ACR FUEL DESIGN AND ON-POWER FUELING TECHNOLOGY

The Nuclear Regulatory Commission (NRC) hosted a public meeting with Atomic Energy of Canada Limited (AECL) on September 3-4, 2003, at the U. S. Nuclear Regulatory Commission (NRC) Headquarters to discuss the Advanced CANDU Reactor (ACR-700) fuel design and on- power fueling technology. For a list of meeting attendees refer to Enclosure 1.

This was the first meeting for the phase 2 of ACR pre-application review which involved a more detailed and specific technical presentation of the ACR fuel design and on-power fueling technology. During phase 1, the staff participated in a series of meetings and tours of Atomic Energy of Canada Limited (AECL) test facilities to gain an understanding of the ACR design and the technology base associated with the ACR.

The main objectives of the meeting were to present the ACR on-power fueling technology and ACR fuel design & qualification and CANFLEX fuel experience base and to promote in-depth technical discussions between AECL and NRC staff.

An overview of the on-power fueling technology covering 1) fueling scheme; 2) fueling equipment and interfaces; 3) design features to enhance safety; 4) ACR fuel handling system; and 5) CANDU design and experience were presented.

AECL stated that the CANDU fueling machine (FM) is considered as a part of the reactor cooling system (RCS) whenever the FM is on a reactor by becoming an extension of the RCS pressure boundary. The staff raised a concern that the fueling machine snout attachment lock and channel closure may be outside of normal American Society of Mechanical Engineers (ASME) pressure vessel code practice. AECL responded that the ASME code design and material requirements were used for CANDU pressure boundary components whenever it was practical. Most CANDU pressure boundary components comply with the ASME fabrication specifications, allowable properties, and design/analysis rules, the ASME code does not adequately address some unique pressure boundary components such as the use of Zr-2.5wt% Nb for pressure tubes and closure plugs and 403 SS end fittings. AECL stated that these specialized materials and design features were governed by the Canadian Standards Association (CSA) codes endorsed by the Canadian regulator.

The meeting continued with an overview of the CANDU fuel design and ACR fuel design and qualification. AECL presented the CANDU fuel features, evolution of CANDU fuel and design requirements. The CANDU fuel is small, lightweight, simple in design and easy to manufacture. It has evolved from a 7-element fuel bundle to the current 43-element CANFLEX fuel bundle. The ACR fuel design is based on the proven 43-element CANFLEX design and Low Void Reactivity Fuel (LVRF) concept utilizing the enriched uranium (2.1% U-325) in 42 outer-

elements and dysprosium mixed with natural uranium in center element. The staff noted that the ACR fuel design was modified since the last familiarization meeting. The ACR fuel qualification plan intends to confirm that limiting operating conditions are within criteria by conducting the following assessments:

- Thermal integrity - confirm temperatures in critical parts remain within design allowances during critical heat flux (CHF), end temperature peaking, etc.
- Structural integrity of fuel element - confirm fuel element parts retain structural integrity during stress corrosion cracking, internal gas pressure, longitudinal ridging, etc.
- Structural integrity of fuel bundle - confirm fuel bundle parts operate with sufficient margin against cracking or breakage during refueling loads, fatigue, etc.
- Dimensional compatibility - confirm the fuel bundle parts stay within dimensional compatibility with fuel channel and fuel handling systems

The staff requested to see the transient accident analyses of fuel design. AECL stated that the in-reactor tests such as high power envelope, power-ramp test and separate-effects tests will be conducted for normal operating conditions. However, the design basis analyses describing various accident scenarios will be submitted at a later date. ACR fuel qualification tests are expected to be completed by March 2007.

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. ML032530124-pkg. If you do not have access to ADAMS 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

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The next ACR technical meeting is scheduled for October 20-24, 2003 at AECL in Toronto, Canada. This will be a closed meeting and the NRC staff plans on attending the review of the ACR-700 CATHENA input model development.

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ACR-700 On-Power Fueling and Fuel Design
September 3-4, 2003, Room O-13B4, 8:30am - 4:30pm

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ACR-700 On-Power Fueling and Fuel Design
September 3-4, 2003, Room O-13B4, 8:30am - 4:30pm

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