



December 22, 2008

Phase 1 Executive Summary: Pre-Project Review of AECL's Advanced CANDU Reactor — ACR-1000

Background

The Canadian Nuclear Safety Commission (CNSC) is Canada's sole nuclear regulatory agency operating under the Nuclear Safety and Control Act (NSCA). The CNSC regulates the use of nuclear energy and materials to protect the health, safety and security of Canadians and the environment, and to respect Canada's international commitments on the peaceful use of nuclear energy.

It should be noted that a pre-project review is an optional service provided by the CNSC when requested by a vendor. This service does not involve the issuance of a licence under the NSCA and it is not part of the licensing process. The conclusions of such reviews will not bind or otherwise influence decisions made by the Commission.

The review is solely intended to provide early feedback on the acceptability of a nuclear power plant design based on Canadian regulatory requirements and expectations. The CNSC will require a far more detailed review of the design and safety case for a specific application and a specific site.

Atomic Energy of Canada Limited (AECL), a vendor of nuclear power plants, is designing a two-unit Advanced CANDU Reactor (ACR-1000) nuclear power plant, each unit with a gross electrical output of 1165 Mega Watts electrical. The ACR-1000 design is largely based on the design concepts and the reactor and process system designs of current CANDU plants. Despite these similarities, there are some important differences between the ACR-1000 design and existing CANDU technologies.

In April 2008, AECL requested the CNSC to perform a pre-project design review of the ACR-1000 design. Subsequently a Memorandum of Understanding (MOU) was signed between the two organizations. The MOU outlines the agreement on the pre-project design review including the objectives, the technical scope of review, the timetable, deliverables, the costs, working arrangements and general conditions.

Objectives and Review Phases

The objectives of the pre-project review are to:

- assess whether the ACR-1000 design is, at an overall level, compliant with the CNSC regulatory requirements;
- assess whether the design meets the CNSC's expectations for new nuclear power plants in Canada; and
- identify whether there are any potential fundamental barriers to licensing the ACR-1000 design in Canada.

To achieve the above stated objectives, CNSC staff assesses the safety and security aspects of the design to identify any potential licensing and technical issues that could constitute a potential fundamental barrier. This review provides an opportunity for the CNSC staff to assess the design prior to any licensing activities, and to identify potential issues for resolution relating to the ACR-1000 compliance with regulatory requirements and expectations. Such a review will help increase regulatory certainty and ultimately contribute to public safety.

The pre-project review process is divided into two phases:

- **Phase 1:** This phase is an overall assessment of the information submitted in support of the ACR-1000 design against CNSC regulatory requirements and regulatory documents. Its purpose is to determine whether the design intent is compliant with the CNSC requirements and meets the CNSC's expectations for the design of new nuclear power plants in Canada. The Phase 1 review of the ACR-1000 design is now complete and the findings are provided in the following pages.
- **Phase 2:** Subsequent to Phase 1, this phase will go into further detail with a focus on identifying whether there are any potential fundamental barriers to licensing the design in Canada. It should be noted that the findings from the Phase 1 review do not in any way prejudice the conclusions of the Phase 2 review.

Phase 1 Review Process and Focus Areas

To facilitate the Phase 1 review, AECL submitted the documentation in support of the ACR-1000 design including documents demonstrating how the nuclear power plant design meets the regulatory requirements and expectations of the CNSC. Supporting documents included the ACR-1000 Technical Description, ACR-1000 Generic Safety Case Report, and the Safety Design Guides used by the designer. In performing the Phase 1 review, CNSC staff aimed to identify items requiring further information, issues requiring further follow-up, issues of clear non-conformance with regulatory expectations, or issues that may lead to potentially significant design changes.

For the Phase 1 review, CNSC staff selected 16 review focus areas to assess how AECL has taken into account regulatory requirements and expectations of the CNSC in the design. The review included the safety principles, specific design expectations of systems, structures and components important to safety, robustness of the design against malevolent acts, and a safety analysis that demonstrates the adequacy of the design. The review of these areas sought to ensure that the fundamental safety functions such as reactor control, reactor shutdown, cooling of the reactor core and containment of radioactive material are designed to meet the expectations of the CNSC for new nuclear power plants in Canada.

The Phase 1 review also included an assessment of other aspects, including human factors engineering, radiation protection, protection from fire, protection against out-of-core criticality, quality assurance, safeguards, and security. In addition, initial consideration was given to the extent to which generic or outstanding safety issues (for example Generic Action Items) have been resolved, and the bases of knowledge for new or innovative design features in the ACR-1000 design.

Phase 1 Review Criteria

For each of the review focus areas, CNSC staff assessed the submitted documentation using the requirements and expectations relevant to the individual review area:

- CNSC Regulations such as the Radiation Protection Regulations and Nuclear Security Regulations;
- CNSC Regulatory documents, in particular RD-337 “Design of New Nuclear Power Plants” that provides technology-neutral design expectations; and
- CSA Standards such as those for Design Quality Assurance.

Phase 1 Review Findings

Based on the Phase 1 pre-project review of the documentation submitted, CNSC staff concludes that:

- AECL has provided sufficient design and analysis information for the purpose of this review;
- At an overall level the design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plants in Canada. This conclusion will be further confirmed during the Phase 2 review when open specific technical items identified for each review area requiring further information are fully addressed. CNSC staff anticipates that these items can be brought to closure during Phase 2; and
- CNSC staff did not find any issues that would lead to significant design changes.

For the specific topical areas identified below, in order for the CNSC to reach a positive conclusion during the Phase 2 review, CNSC staff will do further assessment with respect to:

- AECL's qualification programs that demonstrate the adequacy of new or innovative features such as the reactor core design including the fuel. It is expected that the design of new or innovative features be proven fully by testing or analysis;
- The ALARA (As Low As Reasonably Achievable) principle for radiation protection, to ensure that it is incorporated adequately into the design; and
- The adequacy of AECL's Quality Assurance programs and how these are being complied with during the design process.

Notwithstanding the observations above, CNSC staff is of the opinion that these areas are likely resolvable during the Phase 2 review.