Canada's Nuclear Regulator

January 29, 2010

Phase 1 Executive Summary:
Pre-Project Design Review of Westinghouse Electric Company's Advanced Passive Plant Design — AP1000

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

Executive Summary

Background

The Canadian Nuclear Safety Commission (CNSC) is Canada's sole nuclear regulatory agency and operates 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 design 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.

Westinghouse Electric Company (WEC), a vendor of nuclear power plants, has designed the AP1000 pressurized water reactor (PWR), which has a net electrical output of 1117 megawatts. The AP1000 design builds on traditional PWR technology featuring passive safety systems and a number of plant simplifications. WEC has stated that these features enhance the safety of the plant. The AP1000 design contains a number of unique features and relies on passive safety systems and features — it is regarded as an "advanced passive plant design".

In November 2008, Westinghouse Electric Company requested the CNSC to perform a Phase 1 pre-project design review of the AP1000, and a Service Agreement was then signed between the two organizations. The Service Agreement outlines the objectives, the technical scope of the review, the schedule guideline, the organizations' deliverables, costs, working arrangements and general conditions.

Objectives and Review Phases

The objectives of a pre-project design review are to:

- assess whether a reactor 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
- identify potential fundamental barriers to licensing a reactor design in Canada

Published with the consent of Westinghouse Electric Company

To achieve the above stated objectives, the CNSC staff assesses the safety and security aspects of the design to identify 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 compliance of the design with regulatory requirements and expectations. Such a review will help increase regulatory certainty and ultimately contribute to public safety.

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

- **Phase 1:** This phase is an overall assessment of the information submitted in support of a reactor design against the 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.
- **Phase 2:** Subsequent to Phase 1, this phase goes into further detail with a focus on identifying whether there are any potential fundamental barriers to licensing the reactor design in Canada. It should be noted that the findings from the Phase 1 review do not in any way prejudge the conclusions of the Phase 2 review.

The Phase 1 pre-project design review for AP1000 is now complete and the principal findings are provided in the following pages.

Phase 1 Review Process and Selected Review Topics

To facilitate the Phase 1 review, WEC submitted a Design Control Document, similar to a Safety Analysis Report, providing a technical description of the design and information on the safety analysis. A number of supporting documents for the AP1000 design were also provided, including a compliance report to demonstrate how the design meets the CNSC's requirements and expectations, including those set out in the regulatory document *Design of New Nuclear Power Plants* (RD-337).

For the Phase 1 review, CNSC staff selected 17 review topics to assess the AP1000 design, including 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 topics is performed to ensure that fundamental safety functions — such as reactor control, reactor shutdown, reactor core cooling, and confinement of radioactive material — are designed to meet CNSC regulatory requirements and expectations for new nuclear power plants in Canada.

Other review topics included an assessment of radiation protection, protection from fire, protection against out-of-core criticality, quality assurance, safeguards, security, and human factors engineering. In addition, initial consideration was given to the extent to which generic or outstanding safety issues have been resolved, and the knowledge for new or innovative design features in the AP1000 design has been established.

International Collaboration of Regulatory Authorities

The Multi-National Design Evaluation Program (MDEP) is a joint effort of several national regulatory authorities to enhance the safety of new reactor designs through various joint activities. The CNSC is a participant for Canada in the MDEP and the MDEP AP1000 Working Group.

It should be noted that the MDEP AP1000 Working Group is evaluating a number of the AP1000 design aspects important to safety. In particular, the issues of shield building design methodology and the squib valve technology are under review. These two issues were therefore beyond the scope of the Phase 1 review, but would be considered in a Phase 2 design review if one is conducted.

Phase 1 Review Criteria

To assess the review topics, the CNSC staff primarily used a set of criteria stated in the RD-337 — a document providing technology-neutral design expectations. A limited number of the review topics were assessed against some specific Canadian regulatory documents and standards such as the *Radiation Protection Regulations*, the regulatory document *Safety Analysis for Nuclear Power Plants* (RD-310), and the Canadian national standard *Design Quality Assurance for Nuclear Power Plants* (CSA N286.2).

Phase 1 Review Findings

Based on the documentation submitted for the Phase 1 pre-project design review of the AP1000, the CNSC staff concludes that in general:

- WEC has provided sufficient design and analysis information for the purpose of the review.
- WEC has understood the CNSC regulatory requirements and expectations for the design of new nuclear power plants in Canada.
- At an overall level, the AP1000 design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plants in Canada. However, for each of the review topics some specific issues were identified that would require further information or more detailed review to reach a firm conclusion. Such issues would be considered either during a Phase 2 pre-project design review or during a licensing review.
- It found no issues that would require significant design changes.

For some of the review topics, CNSC staff could not find sufficient evidence in the submitted documentation showing that the AP1000 design intent fully complies with the CNSC requirements and expectations. Specific observations were made for the following topics:

- Fire protection, where design provisions and analysis methodologies should follow and be consistent with Canadian practices.
- Radiation protection, where analysis methodologies should follow and be consistent with Canadian practices and regulatory requirements. In particular, it should be demonstrated

that Canadian dose limits and safety goals are met and doses are As Low As Reasonably Achievable (ALARA).

- Out-of-core criticality, where WEC should demonstrate that the design complies with all requirements of the ANSI/ANS-8.3-1997 standard.

A further review would be needed in order to reach definitive conclusions on the compliance of the design for the above identified topics.

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

Should a Phase 2 pre-project design review or licensing review occur, the CNSC staff would expect WEC to submit detailed information on how the design meets Canadian requirements.