Canada's Nuclear Regulator

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Phase 1 Executive Summary
Pre-Project Design Review of ATMEA's ATMEA1 Reactor

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

Executive Summary

A vendor pre-project design review of a new nuclear power plant provides an opportunity for CNSC staff to assess a design prior to any licensing activities and to identify potential issues that would require resolution. The CNSC recently completed a Phase 1 review of the ATMEA1 design requested by ATMEA. Phase 1 of a pre-project review determines if the vendor understands Canadian regulatory requirements and CNSC expectations, and if the design intent is compliant with CNSC requirements and expectations. As a result of the Phase 1 review CNSC staff have determined that the design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plant designs in Canada. It should be noted that this is subject to the successful completion of the committed activities of ATMEA for the design, in particular, those related to Canadian codes and standards.

1.0 Background

1.1 Introduction

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.

A vendor pre-project design review is a high-level assessment of a vendor's proposed reactor technology. It is an optional service provided by the CNSC when requested by a vendor. This service does not involve the issuance of a license 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 new nuclear power plant design based on Canadian regulatory requirements and expectations. The CNSC will require a much more detailed review of the design and safety case for a specific application at a specific site.

ATMEA, a vendor of nuclear power plants, is designing the ATMEA1 pressurized water reactor (PWR), which has a conventional three-loop configuration with a net electrical output of 1,100

megawatts. The primary system design, loop configuration and main components of the ATMEA1 are similar to those of currently operating PWRs. ATMEA has stated that the ATMEA1 is an evolutionary PWR based on the optimum integration of the most modern and proven technologies developed by AREVA and MHI. The ATMEA1 design contains improved features on both passive and active safety systems.

In July 2011, ATMEA requested that the CNSC perform a Phase 1 pre-project design review of the ATMEA1 design, 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.

1.2 Design Review Objectives

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

- assess whether the vendor understands Canadian regulatory requirements and CNSC expectations
- assess whether the design intent complies with CNSC design requirements for new nuclear power plants in Canada
- identify based on the review of the review topics, any potential fundamental barriers to licensing a reactor design in Canada

To achieve the above stated objectives, CNSC staff assess the safety, security and safeguard aspects of the design. A vendor pre-project design review provides an opportunity for CNSC staff to assess the design prior to any licensing activities, and to identify for resolution any potential issues related 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.

1.3 Design Review Phases

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

- **Phase 1: Assessment of Compliance with Regulatory Requirements.** 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 CNSC requirements and meets the CNSC's expectations for the design of new nuclear power plants in Canada.
- **Phase 2: Identification of Fundamental Barriers to Licensing.** 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 Phase 1 review do not in any way prejudge the conclusions of Phase 2 review.

- **Phase 3:** A follow up to Phase 2, this phase focuses on a more detailed review of selected topics identified by the vendor.

The Phase 1 pre-project design review for the ATMEA1 is now complete and key information is provided in the following pages.

2.0 Phase 1 Review

2.1 Phase 1 Review Process and Selected Review Topics

To facilitate the Phase 1 review, ATMEA submitted the Standard Design Description, providing a technical description of the design. A number of supporting documents for the ATMEA1 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 RD-337, *Design of New Nuclear Power Plants*.

Twenty one review topics were assessed in the review of the ATMEA1 design, as listed below. Two topics, the impact of the Fukushima event on the design and reliability assessment, were added to the standard set of review topics as listed in GD-385.The topics were reviewed to confirm that fundamental safety functions — such as reactor control, reactor shutdown, reactor core cooling, and confinement of radioactive material — are provided by the design. The design also needed to meet CNSC's regulatory requirements and expectations for new nuclear power plants.

Review topics:

1. defence in depth, safety goals and objectives, dose acceptance criteria
2. classification of systems structures and components
3. reactor core nuclear design
4. fuel design and qualification
5. control system and facilities
6. means of reactor shutdown
7. emergency core cooling and emergency heat removal systems
8. containment and safety important civil structures
9. beyond design basis accident and severe accident prevention and mitigation
10. safety analysis
11. pressure boundary
12. fire protection
13. radiation protection
14. out-of-core criticality
15. robustness, safeguards and security

16. vendor's research and development program
17. management system of design process and quality assurance in design and safety analysis
18. human factors
19. incorporation of decommissioning into design considerations
20. impact of the Fukushima event on design
21. reliability assessment

2.2 Phase 1 Design Review Criteria

To assess the review topics, CNSC staff primarily used a set of criteria stated in the RD-337, *Design of New Nuclear Power Plants* - a document providing technology-neutral design expectations. A limited number of review topics were also assessed against some specific Canadian regulatory documents and standards, such as the *Radiation Protection Regulations*, the regulatory document RD-310, *Safety Analysis for Nuclear Power Plants* and the Canadian standard CSA N286-05, *Design Quality Assurance for Nuclear Power Plants*.

2.3 Phase 1 Design Review Results

CNSC staff acknowledge that, throughout the Phase 1 review, ATMEA staff were open and transparent in sharing available information, and that it responded diligently to every CNSC request for clarification and additional information.

Based on the documentation submitted for the Phase 1 pre-project design review of the ATMEA1 design, CNSC staff concluded that, in general,:

- ATMEA understands the CNSC regulatory requirements and expectations for the design of new nuclear power plants in Canada.
- At an overall level, the ATMEA1 design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plants in Canada.

For each of the review topics, issues were identified that will require further information or more detailed review to reach a firm conclusion on the compliance of the ATMEA1 design. The most significant of which are:

- instrumentation and control, where ATMEA should demonstrate compliance with the expectations on:
  - sharing of instrumentation between safety functions in section 7.6.5 of RD-337
  - sharing of measurements between safety and control systems in section 7.6.5 of RD-337
  - potential common-cause failure of software for accident monitoring instrumentation in section 7.6.1 of RD-337
- out-of-core criticality, where ATMEA should demonstrate the design complies with all requirements in RD-327

- beyond design basis accidents and severe accident prevention and mitigation, where ATMEA should:
    - demonstrate with a reasonable assurance that the core catcher and the severe accident heat removal system are able to perform their functions for all plausible accident scenarios and conditions
    - seek other design provisions, such as a system for filtered venting to prevent unfiltered release of radioactive products.

CNSC staff expect the resolution of identified issues during next phases of the design review or the licence to construct application.

2.4 Phase 1 Design Review Conclusions

Based on the documentation submitted for the Phase 1 pre-project design review of the ATMEA1 design, CNSC staff concluded that in general:

- ATMEA has understood the CNSC regulatory requirements and expectations for the design of new NPPs in Canada.
- At an overall level, the ATMEA1 design intent is compliant with the CNSC regulatory requirements and meets the expectations for new NPPs in Canada.

It should be noted that this conclusion is subject to the successful disposition by ATMEA of the review findings (in section 2.3) as well as completion of commitments of ATMEA, in particular those related to Canadian codes and standards.

Notwithstanding the observations, CNSC staff are of the opinion that these observations are likely resolvable during next phases of detailed review or during a licensing review.

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