ACR Licensing Reviews in Canada and the USA

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CNSC Licensing Review

- **Objective**
  - Obtain a positive statement from the CNSC on the licensability of the ACR design in Canada
- **Proposed Timeline**
  - April 2004 – issues and success paths identified
  - April 2005 – interim licensability report
  - April 2006 – final licensability report

NRC Licensing Review

- Objective
  - Obtain a Standard Design Certification (SDC) for the ACR-700
- Proposed Timeline
  - August 2004 – CANDU-specific issues addressed and success paths identified (SER)
  - Fall 2004 – AECLT applies for SDC for ACR-700
  - Mid-2005 – NRC RAI's
  - End 2005 – draft SER for SDC
  - End 2006 – final SER for SDC

CNSC/NRC Licensing Reviews

- Although the objectives and time scales for the reviews are somewhat different, there are major opportunities for regulatory synergy between the CNSC and the NRC on the ACR (i.e., technical and resourcing)
  - Integrated review of common submissions
  - CNSC approach to the assessment and acceptance of the CANDU design
    - Especially applicable to the CANDU-specific aspects of the ACR not dealt with by current NRC criteria (e.g., pressure tubes)
  - NRC experience with previous/current reviews of new reactor designs

Integrated Review of Common Information Submitted in 2003

- ACR Technical Basis Document
- ACR Technical Description
- PRA Methodology for ACR
  - Generic PRA Methodology
  - PRA Methodology for ACR
  - Highlights of design-assist PRA
  - Design assist internal events PRA results
- Event Classification, Rationale and Acceptance Criteria
- Safety Analysis Basis
- ACR Anticipatory R&D

Integrated Review of Common Information Submitted in 2003

- Technology of fuel channels
- Technology of on-power fueling
- Safety Computer Code Validation
  - Manual and validation reports on CATHENA and physics codes
  - CATHENA code, input files and file description
  - Physics code suite
  - Safety analysis code validation methodology
- Severe accidents
  - MFMI test program
  - Severe accident progression in ACR
  - Severe accident R&D program

Integrated Review of Common Information Submitted in 2003

- System classification (i.e., Safety related systems, definition and design requirements)
  - ACR approach to safety related systems
  - Safety Design Guides
  - Codes and standards used in the ACR design
- CANDU Generic Action Items
  - Summary of ACR position on generic action items in Canada

Integrated Review of Common Information Submitted in 2003

- ACR fuel design and technology base
- ACR Safety Analysis
  - Safety analysis methods
  - ACR Safety Analysis Report (highlights of results)
- Control system design and safety critical software
- Security and safeguards

CNSC Approach to the Assessment and Acceptance of the CANDU Design

- Most of the focus topics for NRC pre-application review are areas where the CNSC have established a licensing approach for CANDU reactors, or have determined a path forward
- Discussion of these focus topics will follow

NRC Experience With Reviews of New Reactor Designs

- Extensive role of PRA in design and safety assessment
- Approach to assessment of severe accidents
- Validation of safety analysis computer codes
- Risk-informed regulation
- Plant Security

Focus Topics for Pre-Application Review

1. Class 1 pressure boundary design
2. Design basis accidents and acceptance criteria
3. Computer codes and validation adequacy
4. Severe accident definition and adequacy of supporting R&D
5. Design philosophy and safety-related systems
6. Canadian design codes and standards
7. Distributed control systems and safety critical software

Focus Topics for Pre-Application Review (continued)

8. On-power fueling (including safeguards and fuel design)
9. Confirmation of negative void reactivity
10. Preparation for Standard Design Certification Docketing
11. ACR PRA Methodology
12. ACR Technology Base

Focus Topic #1
Class 1 Pressure Boundary Design

Desired outcome:

The NRC staff accepts the principal design features of the ACR RCS pressure boundary (i.e., the use of Zr-2.5wt%Nb pressures tubes, rolled joints, closure plugs, 403SS end fittings, and fueling machines as components of a Class 1 pressure boundary).

Of note:

- **CSA standards, fitness for service guidelines, PT inspection**
- **Extensive technology base**
- **Extensive operating experience**

Focus Topic # 2
Design Basis Accidents and Acceptance Criteria

Desired outcome:

The NRC staff accepts the definition of ACR design basis accidents and the associated ACR safety acceptance criteria.

Of note:

- **Nature of a pressure tube reactor - single channel events will require different acceptance criteria from PV reactors**
- **Need a common technical rationale for event classification and acceptance criteria**

Focus Topic #3
Computer Codes and Validation Adequacy

Desired outcome:

The NRC staff accepts the computer codes used in the ACR safety analysis and the adequacy of their validation as sufficient for the purpose of providing a safety analysis for the ACR in the US.

Of note:

- **Similar approach to code validation in Canada and the US (PIRT, validation matrices etc.)**
- **Extensive work on formal code validation in recent years in Canada**

Focus Topic #4
Severe Accident Definition and Adequacy of Supporting R&D

Desired outcome:

The NRC staff accepts the definition of severe accidents for the ACR and considers the nature and extent of R&D support provided by the existing and planned R&D program to be sufficient to support the licensing of the ACR in the US.

Of note:

- **LOCA+LOECC historically analysed as part of design basis, therefore this is an extensive, existing R&D database**
  - **Currently proposed as a limited core damage accident**
- **Many large, passive sources of water inside containment**

Focus Topic #5
Design Philosophy and Safety-Related Systems

Desired outcome:

The NRC staff accepts the ACR's safety design philosophy and the ACR treatment of safety-related systems, including the approach to seismic considerations.

Of note:

- **A common (CNSC/NRC) technical basis for the definition and treatment of safety related systems for ACR is the goal.**

Focus Topic #6
Canadian Design
Codes and Standards

Desired outcome:

The NRC staff accepts the use of Canadian design codes and standards to address the CANDU-unique features of the ACR (especially where there are no applicable NRC criteria)

Of note:

- **Normally follow ASME, unless CANDU-specific design aspects require a more appropriate Canadian standard**
- **CSA Standards will not be issued without CNSC approval**
- **However, the standards may not cover all the CNSC requirements**

Focus Topic #7
Distributed Control Systems and Safety Critical Software

Desired outcome:

The NRC staff accepts ACR's use (i.e., range of application and approach to design) of distributed digital control systems and safety critical software.

Of note:

- **Extensive experience with application and regulation of safety critical software in current operating CANDUs**
- **Extensive application of, and experience with Canadian standards**

Focus Topic #8
On-Power Fueling (Including Safeguards and Fuel Design)

Desired outcome:

The NRC staff accepts the ACR CANFLEX fuel design and the process of on-power refueling. The NRC staff has no significant (i.e., insurmountable) safeguards issues with on-power refueling for the ACR.

Of note:

- **Extensive successful experience with various CANDU fuel designs.**
- **ACR CANFLEX based on proven technologies.**
- **Extensive successful experience with on-power fueling.**
- **ACR designed to improve fuel safeguards**

Focus Topic #9
Confirmation of Negative Void Reactivity

Desired outcome:

The NRC staff accepts that the ACR has a negative void reactivity.

Of note:

- **Anticipatory test program underway to provide ACR-specific validation data for physics code suite to be used for ACR analysis**

Focus Topic #10
Preparation for Standard Design Certification Docketing

Desired outcome:

The NRC staff will have a good understanding of the safety aspects of the ACR and have identified any issues that could pose a risk to, or a delay in, licensing the ACR in the US.

Of note:

- **Extensive use of detailed familiarization meetings to promote early feedback from the NRC on the ACR**
- **Pre-application review topics focus on CANDU-genealogy aspects of ACR**

Focus Topic #11
ACR PRA Methodology

Desired outcome:

The NRC staff accepts AECL's PRA methodology as sufficient for the purpose of assessing the ACR for licensing in the US.

Of note:

- **ACR approach consistent with international and US practice**
- **Severe core damage accident and large release frequency goals are the same as for other new reactor designs in the US**

Focus Topic #12
ACR Technology Base

Desired outcome:

The NRC staff finds the technology base for the ACR to be comprehensive and essentially complete.

Of note:

- **Extensive use of detailed familiarization meetings to promote NRC understanding of scope and depth of CANDU/ACR technology base**
- **All AECL R&D data available to the NRC staff for their review and/or use in their independent assessments of ACR**

Familiarization Meeting Status

- CNSC ACR familiarization complete
- NRC CANDU technology and ACR familiarization in progress

NRC Familiarization Status

ACR Familiarization Meetings held to date:

- Design and Technology Base (Sept. 25, 26, 2002)
- Physics, Fuel Channels and QA (Dec. 4, 5, 2003)
- Thermal Hydraulics (February 5, 6, 2003)
- Constructability (February 24, 25, 2003)
- Safety Design Philosophy (March 27, 2003)
- Severe Accidents and PRA (May 6 to 8, 2003)
- Analysis Methodology and Computer Codes (May 15, 16, 2003)

NRC Familiarization Status

ACR Familiarization Meetings planned:

- Details of RD-14M Results (June 4, 5, 2003)
- CANFLEX Fuel Design (July 2003)
- On-Power Fueling (August 2003)
- The ACR-700 Design (September 2003)
- SDS Design and Safety Critical Software (Oct. 2003)
- ECCS and Containment Design (November 2003)

NRC Familiarization Status

Request NRC Management feedback on familiarization meetings:

- **Are these familiarization meetings helping the NRC staff understand CANDU technology as applied to the ACR?**
- **Suggestions for fine-tuning?**

Summary

- Parallel ongoing licensing reviews of the ACR offer an excellent opportunity for regulatory synergy between the CNSC and the NRC
  - Common major documents for review
  - Similar time frames for reviews
  - Co-operation between internationally-respected, well-established, mature regulatory bodies (i.e., avoid overlap of effort)
- Opportunity to integrate the extensive licensing experience of the CNSC and the NRC to develop a common North American <u>technical basis</u> for licensing the ACR-700 in both Canada and the US

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