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June 17, 2004

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U.S. Nuclear Regulatory Commission,
Document Control Desk,
Washington, D.C. 20555

Attention: Ms. B. Sosa
Project Manager, ACR

References:

1. Letter V.J. Langman to B. Sosa, "Response to NRC's Requests for Additional Information (RAIs) #4 on PRA Analysis Basis", April 15, 2004.
2. E-mail J. Kim to V. Langman, "ACR-700 RAI #5 PRA Analysis Basis", January 20, 2004.

Re: **Response to NRC's RAI 37 on PRA Analysis Basis**

Further to our response (Reference 1) to NRC's request for additional information set # 4 on PRA analysis basis (Reference 2) and in support of the NRC's pre-application review of the ACR (i.e., specifically focus topic # 11 - ACR PRA Methodology), attachment 1 provides AECL's response to RAI # 37.

If you have any questions on this letter and/or the enclosed material please contact me at (905) 823-9060 extension 4596.

Yours sincerely,

for

Dr. Victor G. Snell
Director, ACR Safety and Licensing

/Attachment:

1. Response to RAI 37 on PRA Analysis Basis

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Attachment 1
(Letter V.G. Snell to B. Sosa, "Response to NRC's RAI 37 on PRA Analysis Basis", June 17, 2004)

Responses to RAI 37 on PRA Analysis Basis

AECL's response to NRC's requests for additional information #37 on PRA Analysis Basis is provided below following the NRC's question:

37. Section 1.1, Page 1-2: This section states that the PSA will satisfy ASME Capability Category I. Based on Table 1.3-1 in ASME RA-S-2002 (which provides the bases for PSA capability categories), Section 2.2.3 of Regulatory Guide 1.174, Section III.2.2.4 in Chapter 19 of the Standard Review Plan (SRP), and Section 1.3 of Regulatory Guide 1.200, the NRC staff believes that most elements of the ACR-700 PSA should meet or exceed Capability Category II. The ACR-700 PSA should identify the relative importance of dominant contributors at the component level, using design-specific data and models to the extent practicable. Any departures from realism should have a small impact on the conclusions and risk insights. The NRC staff notes that ASME RA-S-2002 does not provide a means to determine the overall capability of a PSA; rather, different capability categories are used for various PSA elements. Please provide a self-assessment of the ACR-700 PSA that indicates the expected ASME capability category for each supporting requirement, and provide justification for acceptance of PSA elements that not meet ASME Capability Category II.

AECL Response:

The Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications (ASME RA-S-2002) sets forth requirements for probabilistic risk assessments (PRAs) used to support risk-informed decisions for commercial nuclear power plants, and prescribes a method for applying these requirements for specific applications.

This Standard applies to PRAs used to support applications of risk-informed decision making related to design, licensing, procurement, construction, operation, and maintenance.

This Standard is intended for a wide range of applications that require a corresponding range of PRA capability. The Standard defines the PRA into three capability categories I, II and III. Table 1.3-1 of the Standard identifies the bases for PRA Capability Categories.

Category I is generally understood as corresponding to the PRA for the risk ranking category, Category II is understood as corresponding to the PRA for risk informed decision making, and Category III as the risk based decision making.

The requirements of the PRA Standard are organized by nine- PRA elements that comprise internal-events, at-power, Level-1 and Level-2/LERF PRA. They are as follows:

(a) Initiating Events Analysis (IE)
(b) Accident Sequence Analysis (AS)
(c) Success Criteria (SC)
(d) Systems Analysis (SY)
(e) Human Reliability Analysis (HR)
(f) Data Analysis (DA)
(g) Internal Flooding (IF)
(h) Quantification (QU)
(i) Large Early Release Frequency (LERF) Analysis.

There are a set of objectives and High Level Requirements (HLRs) provided for each of these PRA elements. The HLRs are the minimum requirements for meeting this Standard.

The Supporting Requirements (SRs) for each of the nine PRA elements define the minimum requirement necessary to meet that Capability Category. By meeting all the SRs under a given HLR, a PRA will meet that HLR.

The ACR™ * design is intended to satisfy the current licensing basis of the NRC. The major objectives of the ACR-700 PRA are:

- to have a reasonable estimation and understanding of the severe core damage frequency and large release frequency,
- to identify relative importance of accident sequences and the accident sequence progression,
- to rank Structures, Systems and Components in terms of significance to the severe CDF and large release frequency (LRF), and thus provide risk insights on the ACR-700 design for feedback to the design and for use in operation and maintenance when the plant is constructed and operated.

A preliminary self-assessment of the compliance of the ACR-700 PRA, which is mainly playing the role of design assist, was conducted and the results for the following PRA elements are shown in Table 1.

The self-assessment statements are:

1. "meet the paragraph" - The ASME PRA standard has a paragraph that applies to all 3 capability categories.
2. "meet the section" - When the ASME PRA standard has statements with sub items a, b, c, etc., the self-assessment statement refers to meeting the sub items, unless otherwise noted in Table 1.

* ACR™ (Advanced CANDU Reactor™) is a trademark of Atomic Energy of Canada Limited (AECL).

3. "Meet Cat x" - When the ASME PRA standard has explicit statements under the capability category, the self-assessment refers to the text under that category.
4. "Not applicable" - the paragraph or section is not applicable to the ACR-700 PRA because the ACR-700 reactor is not presently in operation, or the paragraph is not applicable to the ACR-700 design.

Table 1: Compliance of the ACR-700 PRA with ASME RA-S-2002

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
Initiating Event (IE)		
HLR-IE-A	IE-A1	Meet the paragraph.
	IE-A2	Meet paragraph except ACR-700 does not postulate excessive LOCAs as initiating events e.g., multiple random LOCAs.
	IE-A3	Meet the paragraph. AECL reviews the initiating event lists of other CANDU PRAs. AECL reviews CANDU operating experience in deriving the IE frequency.
	IE-A4	Meet Cat. 1. To perform FMEA requires detailed design information.
	IE-A5	Meet the paragraph.
	IE-A6	Meet Cat. 2. Operations input provided by AECL O&M consultant and the feedback monitoring system (FMS); the PRA representative attends the FMS meetings.
	IE-A7	Meet Cat. 1.
	IE-A8	Meet Cat. 1. AECL will analyse one ACR-700 alignment for PRA. Other alignments will be assessed when plant operation and maintenance information is available.
	IE-A9	Meet Cat. 2. Support systems as initiating events is part of the PRA scope.
	IE-A10	Meet the paragraph. Multi-unit initiators will be assessed.
HLR-IE-B	IE-B1	Meet the paragraph. Initiating events will be grouped.
	IE-B2	Meet the paragraph. Grouping process for initiating events is systematic.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	IE-B3	Meet Cat. 2.
	IE-B4	Meet the paragraph. This assessment is done at the end of the Level 1 PRA to ensure IE grouping is consistent and the rationale for grouping still holds.
HLR-IE-C	IE-C1	Meet the paragraph.
	IE-C2	Meet Cat. 1.
	IE-C3	Meet the paragraph.
	IE-C4	Meet the paragraph.
	IE-C5	Meet Cat. 2. Time trend analysis is not required.
	IE-C6	Meet the paragraph.
	IE-C7	Meet the paragraph.
	IE-C8	Meet the paragraph.
	IE-C9	Meet Cat. 2. If fault tree modeling is used, AECL will use design specific information for the models.
	IE-C10	Meet the paragraph.
	IE-C11	Meet Cat. 2.
	IE-C12	Meet Cat. 2.
HLR-IE-D	IE-D1	Meet the section.
	IE-D2	Meet the section.
	IE-D3	Meet the section, except item (h) on time dependent aspects on initiating event frequencies.
	IE-D4	Meet the paragraph.
Accident Sequence Analysis (AS)		
HLR-AS-A	AS-A1	Meet the paragraph.
	AS-A2	Meet the paragraph.
	AS-A3	Meet the paragraph.
	AS-A4	Meet the paragraph - Post IE Operator actions are explicitly modelled in the Event Tree.
	AS-A5	Paragraph will be met when plant specific EOPs are produced. This section will be met during the COL stage.
	AS-A6	Meet the paragraph.
	AS-A7	Meet Cat. 2.
	AS-A8	Meet the paragraph.
	AS-A9	Meet Cat. 2.

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High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	AS-10	Meet Cat. 2.
	AS-11	Meet the paragraph.
HLR-AS-B	AS-B1	Meet the paragraph.
	AS-B2	Meet the paragraph.
	AS-B3	Meet the paragraph.
	AS-B4	Meet the paragraph.
	AS-B5	Meet the paragraph.
	AS-B6	Meet the paragraph.
HLR-AS-C	AS-C1	Meet the paragraph.
	AS-C2	Meet the paragraph.
	AS-C3	Meet the paragraph.
	AS-C4	Meet the paragraph except for item (f) on ACR-700 Operations Experience.
Success Criteria (SC)		
HLR-SC-A	SC-A1	Meet the paragraph.
	SC-A2	Meet the paragraph.
	SC-A3	Meet the paragraph.
	SC-A4	Meet the paragraph.
	SC-A5	Meet the paragraph.
	SC-A6	Meet the paragraph. Operating philosophy will be defined during the COL stage.
HLR-SC-B	SC-B1	Meet Cat. 2.
	SC-B2	Meet Cat. 2. Use expert judgement when needed.
	SC-B3	Meet the paragraph.
	SC-B4	Meet the paragraph.
	SC-B5	Meet the paragraph.
	SC-B6	Meet Cat. 1.
HLR-SC-C	SC-C1	Meet Cat. 1.
	SC-C2	Meet the paragraph.
	SC-C3	Meet the paragraph.
	SC-C4	Meet the paragraph. Also, AECL will include design information to define success criteria.

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High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
Systems Analysis (SY)		
HLR-SY-A	SY-A1	Meet the paragraph.
	SY-A2	Meet the paragraph, except for collection of information on "As-built and as-operated". "As built" information will be collected during plant commissioning stage.
	SY-A3	Meet the paragraph, except plant information on maintenance and plant operation procedures, which will be reviewed when the PRA is updated after COL stage.
	SY-A4	Meet Cat. 1. Plant walk-downs and plant operator interviews can occur after COL stage. However, system designers are consulted on a continuous basis during the design process.
	SY-A5	Meet the paragraph.
	SY-A6	Meet the paragraph.
	SY-A7	Meet the paragraph.
	SY-A8	Meet the paragraph.
	SY-A9	Meet the paragraph.
	SY-A10	Meet the section.
	SY-A11	Meet the section.
	SY-A12	Meet the paragraph.
	SY-A13	Meet the paragraph.
	SY-A14	Meet the section.
	SY-A15	Meet Cat. 2.
	SY-A16	Post IE human errors are modelled in the event trees, not the system reliability. The benefit of this approach is that the post IE HRA will be modelled based on the specific accident sequence.
	SY-A17	Meet the section.
	SY-A18	Meet the section. Component unavailability due to maintenance will be modelled.
	SY-A19	Meet Cat. 2.
	SY-A20	Meet the paragraph.
	SY-A21	Meet the paragraph.
	SY-A22	Meet the paragraph. Normally, CANDU PRA models do not apply a support state approach.
	SY-A23	Meet the paragraph.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
HLR-SY-B	SY-B1	Meet Cat. 1. There is no CANDU component operating experience data on common cause failure. AECL will apply UPM CCF methodology.
	SY-B2	Meet Cat. 2. No requirement to model inter-system CCF.
	SY-B3	Meet the section. AECL will apply the unified partial methodology (UPM) CCF methodology.
	SY-B4	Meet the paragraph.
	SY-B5	Meet the section, by fault tree linking. Support systems fault trees (FTs) are merged with front line system FTs.
	SY-B6	Meet the paragraph. Engineering input will be used to justify success criteria of support systems that reflect variability of conditions.
	SY-B7	Meet Cat. 2. AECL will use design centred input as much as possible.
	SY-B8	Meet the paragraph on identifying environmental hazards. However, to identify spatial hazards requires "as built" information and a plant walk-down. Spatial hazards will be identified in the latter stages of commissioning and subsequent plant operation.
	SY-B9	Containment vent effects do not apply to ACR-700. Containment failure effects will be addressed in the Level 2 PRA. The Level 1 PRA will address impact of containment challenge on component operation inside the containment for steam line break inside R/B, SSE, etc.
	SY-B10	Meet the section.
	SY-B11	Meet Cat. 2 for COL stage. For design certification stage PRA will meet Cat. 1.
	SY-B12	Meet the paragraph.
	SY-B13	Meet the paragraph.
	SY-B14	Meet the paragraph.
	SY-B15	The ACR-700 PRA will not credit the function of SSCs if they are required to operate beyond their environment qualification. If the ASQ results do not meet the PRA frequency targets, then these SSCs will be identified for improvement.
	SY-B16	Meet the paragraph.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
HLR-SY-C	SY-C1	Meet the section, except: Item (e) - there is no operating experience on ACR-700. Item (h) - during design certification stage there are no test and maintenance procedures. These procedures will be available during the commissioning of the plant.
	SY-C2	Meet the paragraph.
	SY-C3	Meet the paragraph.
Human Reliability and Analysis (HR)		
HLR-HR-A	HR-A1	Meet this paragraph partially. Procedures will be reviewed during the latter stages of commissioning. Review of "practices" will be performed after the plant has been on operation.
	HR-A2	Meet the paragraph partially. See response to HR-A1 above.
	HR-A3	Do not meet the paragraph. ACR-700 is not operating yet. Therefore work practices cannot be reviewed. The analysts will make assumptions on maintenance and testing. These assumptions and subsequent implementation during operation will support reducing the likelihood of multiple train failures.
HLR-HR-B	HR-B1	Meet Cat. 1.
	HR-B2	Meet the paragraph.
HLR-HR-C	HR-C1	Meet the paragraph.
	HR-C2	Meet Cat. 1. There will be ACR-700 plant specific operating experience after the plant is in operation.
	HR-C3	Do not meet the paragraph. Calibration errors are not modelled in ACR-700 PRA.
HLR-HR-D	HR-D1	Meet the paragraph.
	HR-D2	Meet Cat. 1.
	HR-D3	Meet Cat. 1. Written procedures will be prepared during the latter stages of ACR-700 commissioning.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	HR-D4	Meet the section, except the PRA will be assuming recovery actions.
	HR-D5	Meet the paragraph.
	HR-D6	Meet the paragraph.
	HR-D7	This paragraph cannot be met. There is no operational ACR-700 experience yet. Reasonableness of HEPs will be checked against the HEPs of other CANDU PRAs.
HLR-HR-E	HR-E1	Meet item (b) of the section. Specific emergency operating procedures will be reviewed during the latter stages of commissioning.
	HR-E2	Meet Cat. 1 for design certification stage. The ACR-700 operators will need several years of ACR-700 training on the plant simulator or actual plant operating experience to develop a "skill of the craft" to recover a failed function.
	HR-E3	Meet Cat. 1 for design certification stage. During plant commissioning the PRA team will have access to ACR-700 plant operations staff to receive their input based on their "hands-on" experience with ACR-700 systems.
	HR-E4	Meet Cat. 1 for design certification stage. There is no plant simulator manufactured for the ACR-700 during design certification stage.
HLR-HR-F	HR-F1	Meet the paragraph.
	HR-F2	Meet Cat. 1 for design certification stage. To achieve Cat. 2 the AOMs/EOPs have to be validated and verified using the plant simulator.
HLR-HR-G	HR-G1	Meet Cat. 1. To meet Cat. 2 requires first round PRA accident sequence quantification and access to licensed authorized nuclear operators (ANOs) and plant simulator.
	HR-G2	Meet the paragraph.
	HR-G3	Meet Cat. 1. Access to licensed ANOs and written OMs and EOPs are needed for Cat. 2.
	HR-G4	Meet Cat. 1. Detailed plant specific thermal hydraulic analyses or simulations will not be available for HEP derivation

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	HR-G5	Meet Cat. 1. Plant walk-down and talk-throughs with ANOs are not feasible for a plant under construction. This task will be performed at the back-end of the commissioning process with fuel already in the core.
	HR-G6	Meet the paragraph partially because there is no ACR-700 plant experience yet.
	HR-G7	Meet the section.
	HR-G8	Meet the paragraph.
	HR-G9	Meet the paragraph.
HLR-HR-H	HR-H1	Meet Cat. 2. Recovery actions will be applied to the cutsets that meet specific failure criteria, not only dominant sequences.
	HR-H2	ACR-700 PRA will credit recovery actions that are feasible and will recommend that recovery procedures be written.
	HR-H3	Meet the paragraph.
HLR-HR-I	HR-I1	Meet the section as much as possible for a plant being designed and later under construction. Certain EOPs and SAM guides may not have been written or validated at the time of plant construction.
Data Analysis (DA)		
HLR-DA-A	DA-A1	Meet the section.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-A2	Meet the section. Where failures are considered to be predominantly time-based, i.e., the underlying mechanisms that cause a component to fail are a function of time, the times to failure distributions are assumed to be Exponential. Where failures are considered to be predominantly demand-based, i.e., the underlying mechanisms that cause a component to fail are a function of the number of demands, the failure distribution is assumed to be Binomial. ***The above applies to operating, standby and poised components. That is, the distribution is based on what is considered to be the predominant underlying failure mechanism and not merely whether the component is operating, on standby or poised (i.e., subject to surveillance test).*** (Note that in either case the mean of the distribution is assumed to be Log Normally distributed when performing uncertainty analysis.)
	DA-A3	Meet the section.
HLR-DA-B	DA-B1	Meet Cat. 1.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-B2	Meet Cat. 2. The generic data, which are the source data for the ACR-700 PRA, are mostly based on operating experience at Ontario Power Generation's Pickering NGS A and Bruce Power's Bruce NGS A. In compiling the CANDU operating experience-based data, as much as practical, components were grouped based on system and function. This also meant in most instances that components were grouped according to design, environmental and service conditions. For example, components in the engineered safety systems and standby safety support systems (e.g., emergency power and water supply systems) were grouped in this manner. Other components like valves were also grouped by application but in more general terms, i.e., as NI (nuclear island) and BOP, and within each category by type and size, factors that were considered to influence the failure behavior.
HLR-DA-C	DA-C1	Meet the section. The generic parameter estimates used in the ACR-700 PRA are obtained from recognized sources for CANDU power plants. The sources include, in order of preference, operating experience data from Ontario Power Generation's four-unit Pickering NGS A plant and Bruce Power's Bruce NGS A plant, fossil plants for some BOP components, IEEE Standard 500-1984 and NPRDS. It is assumed that the operating, maintenance and surveillance regimes of the ACR-700 plant would be very similar to the Ontario Power Generation and Bruce Power plants, and that the parameter estimates would apply even where there are slight deviations from those regimes.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-C2	Meet the paragraph. The data used for PRA performed in support of design certification and first operating license are, out of necessity, generic. The component boundary definitions and parameter estimates are consistent with the generic data. Once a plant begins operation it is expected that the utility would implement a data collection and analysis process that would allow them to meet Category 3.
	DA-C3	Meet the paragraph. ACR-700 PRA has used generic data that was practical to obtain (see DA-C1 and DA-C2). The generic data, when it was compiled, was based on as extensive operating experience as was available. The CANDU operating experience-based data was compiled, as much as practical, with regard to component design, environmental and service conditions (see DA-B2). Once a plant begins operation it is expected that the utility would implement a data collection and analysis process that would allow them to meet Category 3.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-C4	Meet the section. Component failure events were categorized by their failure modes, which were defined as observed symptoms. For example, for pressure transmitters, these symptoms included high output, erratic output, no output and no change in output. For power operated valves, these symptoms included external leak, internal leak, and fail to operate. The generic database, however, presents parameter estimates for failure modes that are typically used in PRA models. For example, for pressure transmitters, output fails low prior to IE; and, for power-operated valves, stuck closed and stuck open. Thus, where operating experience was used, the parameter estimates were derived by appropriately combining the observed failure events. For example, the parameter estimates for pressure transmitter output fails low prior to IE were based on failure events with observed symptoms of low output, erratic output, no output and no change in output, while the parameter estimates for pressure transmitter output fails high prior to IE were based on failure events with observed symptoms of high output, erratic output, and no change in output. Once a plant begins operation it is expected that the utility would implement a data collection and analysis process that would allow them to meet Category 3.
	DA-C5	Do not meet the paragraph. It is not possible to address how failure clusters, i.e., repeated failures within a short period of time, were addressed in compiling the generic database. However, given that most of the basic events in the PRA model assume a Poisson distribution for failure, i.e., times to failure are exponentially distributed, counting all the failures in a cluster would only be conservative with respect to component failure probability. Once a plant begins operation it is expected that the utility would implement a data collection and analysis process that would allow them to meet the paragraph.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-C6	Do not meet the section. The generic data are based on the assumption that failures of operating, standby and poised components are the results of predominantly time-based failure mechanisms. Consequently, the number of demands were not counted. Consistent with the available data, most of the basic events in the PRA model assume a Poisson distribution for failure, i.e., time to failure is exponentially distributed. Once a plant begins operation it is expected that the utility would implement a data collection and analysis process that would allow them to meet the section.
	DA-C7	Meet Cat. 1. Surveillance testing and planned maintenance will be estimated. The ACR-700 is not yet in operation, and therefore actual practice will not be feasible until after the ACR-700 is operating.
	DA-C8	Meet Cat. 1. There are no ACR-700 operational records to derive the time of standby status.
	DA-C9	Cannot meet this section, because there is no ACR-700 operational practice yet. AECL will estimate surveillance test practices on past CANDU operation. To meet Cat. 2, test practices will be known when the ACR-700 is in operation.
	DA-C10	Cannot meet PRA attribute on surveillance testing for design certification. ACR-700 test procedures will be prepared during plant commissioning. ACR-700 PRA will make assumptions on surveillance testing.
	DA-C11	Meet the paragraph.
	DA-C12	ACR-700 PRA will meet Cat. 1. The actual time of equipment unavailability cannot be known for ACR-700, until the plant is in operation. ACR-700 PRA will estimate the time the equipment is unavailable for design certification.
	DA-C13	There is no actual ACR-700 plant operating experience yet.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	DA-C14	ACR-700 plant instances component repair is not available because the ACR-700 is not yet in operation. ACR-700 PRA will use the MTTR information from past CANDU operating plants, for components of similar design.
	DA-C15	This paragraph is not feasible for a plant under design and construction. However this information will be collected during plant operation.
HLR-DA-D	DA-D1	Meet Cat. 1. There is no ACR-700 operating data.
	DA-D2	Meet the paragraph.
	DA-D3	Meet Cat. 1. For LRF there will be qualitative discussion on the uncertainties.
	DA-D4	Meet Cat. 1. ACR-700 is using primarily OPG and Bruce Power component reliability data.
	DA-D5	Meet Cat. 1. AECL will be applying the UPM methodology for CCF.
	DA-D6	ACR-700 PRA will apply the UPM methodology for CCF. Design specific information will be used in deriving the CCF value. ACR-700 will meet Cat. 1 as a minimum.
	DA-D7	Meet Cat. 1. There is no operating practice of ACR-700 to justify limiting the use of old data. Updating the old data for dominant contributors requires a PRA first and then reassessment of the data. In order to achieve Cat. 2, a completed PRA and an operating plant are required. Design changes and their effect on the PRA are normally analysed on a case-by-case basis.
HLR-DA-E	DA-E1	Meet the section.
Internal Flooding (IF)		
HLR-IF-A	IF-A1	Meet the section.
	IF-A2	Meet the paragraph.
	IF-A3	Meet the paragraph.
	IF-A4	Cannot meet the section because a plant walk-down is not feasible for a plant being designed

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
HLR-IF-B	IF-B1	Meet the section except item (c). Identification of external sources of water (rivers and reservoirs) requires site-specific information.
	IF-B2	Meet the section except item (b), which requires operating manuals (OMs) for review. These OMs will be available for review during the latter stages of commissioning.
	IF-B3	Meet the section except item (a) on the "form" of the water release.
	IF-B4	Cannot meet this section for design certification stage, because the location and capacity of floor drains will not be known until the latter stages of construction. Assumptions will be made (locations/capacity) on the floor drains.
HLR-IF-C	IF-C1	Meet the paragraph, except identification of flood propagation path. The information will not be available until the detailed design is completed. Assumptions will be made on flood propagation path.
	IF-C2	The information will not be available until the detailed design is completed. Assumptions will be made.
	IF-C3	ACR-700 PRA will make assumptions on SSC flood mitigation.
	IF-C4	Meet the paragraph, except verification of information used in the analysis during walk-down.
	IF-C5	Meet the section.
	IF-C6	Meet Cat. 1.
HLR-IF-D	IF-D1	Meet the paragraph.
	IF-D2	Meet Cat. 1. Plant specific event precursors will not be reviewed, since the plant is not operating yet.
	IF-D3	Meet Cat. 1. There is a need for ACR-700 plant operators to attain Cat. 2.
	IF-D4	Meet Cat. 1. ACR-700 will treat flood events on multi-units qualitatively.
	IF-D5	Meet Cat. 1. To attain Cat. 2 ACR-700 plant specific operating information is required.
HLR-IF-E	IF-E1	Meet the paragraph.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	IF-E2	Meet the paragraph.
	IF-E3	ACR-700 PRA will make assumptions on SSC flood mitigation.
	IF-E4	To meet paragraph requires ACR-700 equipment supplier information. ACR-700 PRA will make assumptions on equipment capability for flood and these assumptions will form part of the equipment specification.
	IF-E5	Assumptions will be made in the flood PRA on human reliability. These assumptions will be an input to the preparation of emergency operating procedures.
	IF-E6	Assumptions will be made in the flood sequence quantification, to be later verified by equipment specifications, during the ACR-700 detailed design phase.
	IF-E7	Assumptions will be made in the flood PRA on human reliability. These assumptions will be an input to the creation of emergency operating procedures and severe accident management (SAM) guides.
HLR-IF-F	IF-F1	Meet the paragraph.
	IF-F2	Meet the section.
Quantification (QU)		
HLR-QU-A	QU-A1	Meet the paragraph.
	QU-A2	Meet the paragraph.
	QU-A3	Meet the paragraph. Accident sequence quantification is based on the merging of the event trees and fault trees. The level of resolution of the sequence cutsets is commensurate with the fault tree level of resolution.
	QU-A4	Meet the paragraph.
HLR-QU-B	QU-B1	Meet the paragraph. ACR-700 PRA will be using CAFTA for Windows for fault tree and event tree modeling.
	QU-B2	Meet the paragraph.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	QU-B3	Meet the paragraph.
	QU-B4	Meet the paragraph. PRAQUANT and UNCERT are used for accident sequence quantification and uncertainty analysis. These in turn use cutsets in performing quantification using CAFTA, which in turn employs the conservative Min Cut Upper Bound calculation method.
	QU-B5	Meet the paragraph. Circular logic will be broken in the fault trees before accident sequence quantification is started.
	QU-B6	Meet the paragraph.
	QU-B7	Meet the paragraph.
	QU-B8	Setting of Logic flags will be either True or False in most cases.
	QU-B9	Meet the paragraph.
HLR-QU-C	QU-C1	Meet the paragraph.
	QU-C2	Meet the paragraph. The degree of dependency between multiple HFEs in a cutset will be quantified.
	QU-C3	Meet the paragraph. Sequence transfers between event trees include sequence characteristics (plant response).
HLR-QU-D	QU-D1	Meet the paragraph, except review for operational consistency, since the ACR-700 plant is not operating yet.
	QU-D2	Meet the paragraph, except questioning with respect to plant procedures, since plant procedures are not prepared yet at this stage.
	QU-D3	Meet Cat. 1. There are no similar ACR-700 plants to compare results.
	QU-D4	Meet the paragraph. Cutset review of all PDS sequences will be performed for the first 200 cutsets to determine recovery actions. This review determines if the cutsets are reasonable.
	QU-D5	Meet Cat. 1. It is not feasible to examine the importance of contributors to initiating events when the frequency is based on CANDU operating experience.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
HLR-QU-E	QU-E1	Meet the paragraph.
	QU-E2	Meet the paragraph.
	QU-E3	Meet Cat. 1.
	QU-E4	Meet Cat. 1.
HLR-QU-F	QU-F1	Meet the section.
	QU-F2	Meet Cat. 2. The key contributors to severe core damage frequency will be described.
	QU-F3	Meet Cat. 2.
	QU-F4	Meet the paragraph. Asymmetries in quantitative modeling will be documented (e.g., one moderator pump is running and the other pump is on standby).
	QU-F5	Meet the paragraph. The verification of CAFTA will be described.
	QU-F6	A general description will document the limitations of the PRA in terms of selected applications.
LERF Analysis (LE)		
HLR-LE-A	LE-A1	Meet the section.
	LE-A2	Meet the section.
	LE-A3	Meet the paragraph.
	LE-A4	Meet the paragraph.
	LE-A5	Meet the paragraph.
HLR-LE-B	LE-B1	Meet Cat. 2. NUREG/CR-6595 does not apply to ACR-700.
	LE-B2	Meet Cat. 2. NUREG/CR-6595 does not apply to ACR-700.
	LE-B3	Meet Cat. 2. ACR-700 does not have a reactor pressure vessel (RPV). ACR-700 has fuel channels.
HLR-LE-C	LE-C1	Meet Cat. 2.
	LE-C2	Meet Cat. 2. EOPs/SAMGs are not available for the ACR-700. They will be available during commissioning. ACR-700 PRA will make assumptions with respect to operator actions during a severe core damage event.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	LE-C3	Meet Cat. 2.
	LE-C4	Meet Cat. 1. Realistic containment success criteria will not be ready for design certification.
	LE-C5	Meet the paragraph.
	LE-C6	Meet the paragraph.
	LE-C7	Meet the paragraph.
	LE-C8	Meet Cat. 1. Environmental impact inside containment will be treated conservatively.
	LE-C9	Meet Cat. 1. Containment failure impact on equipment operation and operator actions will be treated conservatively.
	LE-C10	Meet Cat. 2.
HLR-LE-D	LE-D1	Meet Cat. 2.
	LE-D2	Meet Cat. 1. Containment failure location is not expected to change the results.
	LE-D3	Meet Cat. 2. Interfacing system LOCA frequency will be derived.
	LE-D4	Meet Cat. 2. MSIV isolation will be evaluated for SG tube failure.
	LE-D5	Meet Cat. 2.
	LE-D6	Meet Cat. 2.
HLR-LE-E	LE-E1	Meet the paragraph.
	LE-E2	Meet Cat. 1. MAAP-CANDU simulations will try to be as realistic as possible.
	LE-E3	Meet the paragraph. Uncertainties will be documented in a separate report.
HLR-LE-F	LE-F1	Meet Cat. 2.
	LE-F2	Meet Cat. 2. Uncertainties will be documented in a separate report.
HLR-LE-G	LE-G1	Meet the section.
	LE-G2	Meet the section for items applicable to ACR-700.
	LE-G3	Meet the section. The ACR-700 PRA will make assumptions on equipment survivability.
	LE-G4	Meet the section. It is expected that containment failure location will not affect the results.
	LE-G5	Meet the section. Uncertainty analysis will be documented in a separate report.

High Level Requirement	Supporting Requirement	Self-assessment of ACR-700 PRA Capability Category
	LE-G6	Meet Cat. 2.
	LE-G7	Meet the paragraph. Uncertainties will be documented in a separate report.
	LE-G8	Meet the paragraph. The limitations will be documented in a separate report.

Table 2 provides a summary status of compliance of ACR-700 PRA attributes with the ASME PRA standard (ASME RA-S-2002).

Table 2 Summary Table of ACR-700 PRA Compliance with ASME PRA Standard

PRA Attribute	Meet the Paragraph	Meet the Section	Meet the Cat.	Cannot Meet the Standard Until Several Years of ACR-700 Plant Operation or Because of ACR-700 Design Uniqueness
Initiating Events (IE)	16	3	Cat.1- 4 Cat.2- 7	0
Accident Sequence Analysis (AS)	17	0	Cat.1- 0 Cat.2- 3	0
Success Criteria (SC)	12	0	Cat.1- 2 Cat.2 - 2	0
Systems Analysis (SY)	23	5	Cat.1- 2 Cat.2- 5	3
Human Reliability (HR)	14	4	Cat. 1- 12 Cat. 2- 1	4
Data Analysis (DA)	2	6	Cat.1- 9 Cat.2- 1	8
Internal Flooding (IF)	13	6	Cat.1- 5 Cat.2- 0	8
Quantification (QU)	24	1	Cat. 1- 4 Cat. 2- 2	0
LERF Analysis (LE)	10	7	Cat. 1- 5 Cat. 2- 15	0