UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 18, 1993

Project No. 679

ORGANIZATION: Atomic Energy of Canada, Ltd., Technologies (AECLT)

SUBJECT: MEETING WITH AECL TECHNOLOGIES TO DISCUSS THEIR COMMENTS ON THE STAFF'S DRAFT SECY PAPER ENTITLED, "ISSUES PERTAINING TO THE ADVANCED REACTOR (PRISM, MHTGR, AND PIUS) AND CANDU 3 DESIGNS AND THEIR RELATIONSHIP TO CURRENT REGULATORY REQUIREMENTS"

On February 2, 1993, members of the U.S. Nuclear Regulatory Commission's (NRC) Advanced Reactors Project Directorate (PDAR) met with representatives of AECL Technologies (AECLT) to discuss AECLT's comments on the staff's draft SECY paper entitled, "Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and Their Relationship to Current Regulatory Requirements." AECLT provided their comments on the draft SECY paper in a letter to the staff dated January 25, 1993. Enclosure 1 includes a list of attendees. Enclosure 2 provides the January 25, 1993, response from AECLT.

Robert Pierson, PDAR Director, stated that the purpose of the meeting was to discuss AECLT's comments in their January 25, 1993, letter (Enclosure 2). In these comments, AECLT noted that the NRC's new schedule for completion of the CANDU 3 preapplication review pushes submission of the CANDU 3 design certification application to the end of the 1995-96 timeframe. Mr. Pierson questioned AECLT what was meant by that statement. AECLT indicated that their design certification application would most likely be submitted in mid- to late 96 because they need approximately 2 years from the preapplication review to incorporate the staff's findings into the final design.

AECLT's comment letter indicated that their intent to go forward with an application for certification of the CANDU 3 design is independent of any schedule for building a CANDU 3 reference plant in Canada. Mr. Pierson indicated that, although a CANDU 3 reference plant would help the staff during the design certification stage, it is not a requirement. Mr. Pierson also indicated that because the staff is attempting to treat the CANDU 3 as an evolutionary design, it would not require an entire plant prototype. However, that does not mean that the staff would not require testing of certain aspects of the plant design, such as on-line refueling, if the staff deemed it necessary.

The cover letter on Enclosure 2 response states, "AECLT is looking to the preapplication review to resolve all issues identified during the review, in the sense that the PSER identifies the information which AECLT must

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provide in the CANDU 3 design certification application in order for the staff to successfully complete its review of that application." The PDAR staff pointed out that providing AECLT with complete issue resolution is not the purpose of the preapplication review. The intent of the preapplication review is to identify potential issues which would affect licensability of the design in the U.S., and to provide direction to the preapplicant regarding what the staff would need to resolve the issue during design certification. To that end, the staff has already identified several technical and policy issues for the CANDU 3 design. The staff will attempt to resolve issues to the greatest extent possible, but the preapplication review does not guarantee that the issue will not be revisited at the design certification stage. Furthermore, the staff cannot guarantee that all issues will be identified in the preapplication review. In addition, the preapplication review will not go into the detail the staff would expect at the design certification stage.

Attachment 1 to Enclosure 2 contains AECLT's specific comments regarding the six issues identified as applicable to CANDU 3: accident evaluation, source term, containment performance, operator staffing, positive void reactivity, and control room design. At the beginning of Attachment 1, AECLT states, "The accidents listed by the staff are not excluded from consideration in CANDU, but have little consequence because of the redundant shutdown systems." The PDAR staff reiterated the fact that even though the CANDU 3 design has two safety-grade, independent, and diverse shutdown systems, the staff is still interested in understanding the behavior of the design should both shutdown systems fail. The staff has indicated, in previous meetings with AECLT, our intent to evaluate the consequences of severe accidents in both the evolutionary LWRs and in the CANDU 3 and advanced reactor designs.

In the draft SECY paper commented on in Enclosure 2, the staff states "The CANDU 3 preapplicant, in their current safety analyses, has excluded analyses of the consequences of events with frequencies of less than 10^{-6}/year from the safety evaluation." AECLT indicated that this statement was inaccurate, because they evaluate a single loss-of-coolant accident coincident with a loss of emergency core cooling (estimated frequency of $7.6E^{-7}$). The staff maintains that except for this event, AECLT has not provided consequence analyses for events beyond 10^{-6}. However, the staff did agree to clarify the previous statement in the draft SECY paper to more accurately reflect AECLT's philosophy.

In Attachment 1 to Enclosure 2, under Accident Evaluation, AECLT stated that limits are not placed on the scope of severe accidents that may be considered in designing the CANDU 3. The staff takes issue with this statement because AECLT maintains they do not have to evaluate the consequences of events involving a failure to shut down due to the low likelihood of the event happening. The staff has been clear on the issue of severe accidents, and specifically on failure to scram events on the CANDU 3 design. The staff has requested AECLT to perform consequence analyses of severe accidents, which

would include events with failure to scram which, for CANDU 3, includes postulated event sequences resulting in substantial core damage. AECLT requested that the staff submit a written request for these analyses. The staff agreed to provide such a request.

On the issue of source term, AECLT said in Enclosure 2 that "...we do not agree that a pressurized heavy-water reactor is so fundamentally different from LWRs that it should require a different methodology for establishing source terms than that which NRC is now in the process of establishing for evolutionary LWRs." The staff's policy issues paper did not state that a different method for each design was contemplated. It is the staff's intention to apply the methodology currently being developed in NUREG-1465, "Accident Source Terms for Light Water Nuclear Power Plants," (a draft report for comment) to the CANDU 3 design to the extent possible.

Regarding containment, AECLT did not believe that this issue should apply to CANDU 3. The staff pointed out that the issue does apply to CANDU 3 because the CANDU 3 containment is not an essentially leak-tight structure as previously defined for light-water reactors. Currently, the staff accepts up to approximately 0.5 percent per day design leakage rate out of LWR containments. The CANDU 3 containment design has a test acceptance leakage rate of 2 percent per day, and use 5 percent per day leakage in the safety analysis. AECLT and the staff agreed that this issue does in fact apply to CANDU 3.

The draft SECY paper identified operator staffing as an issue for the CANDU 3 design. AECLT does not believe this is an issue because they intend to meet the NRC staffing requirements at the design certification stage. The staff agreed to propose removal of CANDU 3 from the applicability matrix in the draft SECY paper.

On the issue of positive void reactivity, AECLT stated that they do not agree with the staff's issue statement in the draft SECY paper. In addition, in Attachment 1 to Enclosure 2, AECLT states, "...the key question is whether the reactivity shutdown systems are reliable enough to reduce the frequency of reactivity insertions with a failure of all reactivity shutdown systems to an extremely low value (i.e., 10^{-7} to 10^{-10} per year)." The staff reiterated that this is not the key issue. The issue is whether or not the staff should accept a design in which the positive void reactivity increases dramatically during certain events. In order to evaluate the positive reactivity insertion events in a CANDU 3, the staff intends to require the analysis of the consequences of events which could lead to large reactivity insertions. As discussed previously, this would include events involving a failure to shutdown.

Finally, on the issue of the control room and remote shutdown area design, AECLT believes that the staff's proposed recommendations preclude the evaluation of the approach used in CANDU 3 for control room and remote

shutdown area design. The staff intends to propose the issue to the Commission for guidance, but at this time, the staff's recommendation to the Commission is to require a seismically and electrically qualified main control room.

Original signed by:

Janet L. Kennedy, Project Manager
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Associate Directorate for Advanced Reactors and License Renewal
Office of Nuclear Reactor Regulation

Enclosures:
1. List of Attendees
2. Ltr. 01/25/93 AECLT to NRC w/attch.

cc w/enclosures:
See next page

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ENCLOSURE 1

MEETING WITH NRC AND AECL TECHNOLOGIES TO DISCUSS
COMMENTS ON THE NRC'S DRAFT SECY PAPER REGARDING KEY POLICY ISSUES FOR
THE ADVANCED REACTOR AND CANDU 3 DESIGNS
FEBRUARY 2, 1993

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ENCLOSURE 2

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AECLT 93016

Project 679

January 25, 1993

Mr. Dennis M. Crutchfield
Associate Director for Advanced
Reactors and License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Commission Papers on Policy Issues and Schedules Concerning the Preapplication Reviews of Advanced Reactors and CANDU 3 Designs.

Dear Mr. Crutchfield:

This letter is in response to your letter of December 16, 1992, which provided AECL Technologies (AECLT) with two NRC Staff papers concerning the preapplication review of the CANDU 3 design. One paper was SECY-92-393 concerning "Updated Plans and Schedules for the Preapplication Reviews of the Advanced Reactor (MHTGR, PRISM, and PIUS) and CANDU 3 Designs." The other was a draft SECY paper entitled "Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and Their Relationship to Current Regulatory Requirements." We have reviewed the two papers and address each in turn.

SECY-92-393 establishes a revised schedule for completion of the preapplication review of the CANDU 3 design. According to SECY-92-393, the draft Preapplication Safety Evaluation Report (PSER) is to be issued in June 1994 and a final PSER in December 1994. This represents a significant change of twelve months over the earlier scheduled completion of June 1993 for the draft PSER. The June 1993 date provided time for AECLT to address any issues raised in the PSER and to submit its application for certification of the CANDU 3 design in the early part of the 1995-96 timeframe. AECLT has chosen the 1995-96 timeframe because it would allow a certified CANDU 3 design to be available to U.S. utilities in the expected timeframe for the placement of new orders for nuclear power plants. The new schedule of December 1994 pushes submission of the CANDU 3 design certification

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application to the end of the 1995-96 timeframe, with little to no allowance for contingency or slippage. Therefore, it is critically important that the new schedule in SECY-92-393 be faithfully adhered to and not extended.

In providing the Commission with relevant background on the CANDU 3 design, SECY-92-393 indicates that Atomic Energy of Canada Limited (AECL) is "negotiating to start construction in a Canadian province which could serve as a prototype for the CANDU 3 design in the U.S." and that AECL "would re-evaluate its design certification plans in the U.S. if Canadian construction plans did not materialize." Similarly the draft issues paper states that "a CANDU 3 reference plant is a key element in [AECLT's] plan for standard design certification." These statements require clarification in two aspects.

First, as the draft issues paper makes clear, and AECLT fully endorses, the CANDU 3 design is an evolutionary heavy-water design deriving from CANDU designs operating in Canada and elsewhere, for which there is over 200 reactor years of full power operating experience. Consequently, a prototype CANDU 3 is not required for design certification. Also, as the draft issues paper makes clear, while a reference plant built in Canada would greatly benefit the Staff's review of the CANDU 3 design, building such a plant is not necessary for certification of the CANDU 3 design. Rather, what is of importance is the relevant operating experience of the CANDU plants from which the CANDU 3 design evolved.

Second, as to potential availability of a reference plant in Canada, AECLT is pleased to inform the NRC that on December 21, 1992, the Government of Saskatchewan and AECL signed a Memorandum of Understanding (MOU). The MOU provides, among other things, for completion of the design and engineering for the CANDU 3, including the contribution of $20 million in matching funds by the Government of Saskatchewan to those being contributed by AECL. These funds are in addition to the approximately $100 million already spent by AECL over the past 5 years. In this and other respects, the relationship between the Government of Saskatchewan and AECL is similar to that between the Department of Energy and the Advanced Reactor Corporation in the U.S. First-of-a-Kind-Engineering effort. The MOU represents further progress in the advancement of CANDU technology as embodied in the CANDU 3. This progress notwithstanding, it is important to understand that our intent to go forward in the 1995-96 timeframe with an application for certification of the CANDU 3 design in the United States is independent of any schedule for building a CANDU 3 reference plant in Canada.

The draft Policy Issues Paper discusses the present scope of the CANDU 3 pre-application review, indicating that the Staff has revised the scope of the issues considered at the preapplication review stage, limiting them "to those which could affect the licensability of the proposed design." AECLT is looking to the pre-application review to resolve all issues identified during the review, in the sense that the PSER identifies the information which

AECLT must provide in the CANDU 3 design certification application in order for the Staff to successfully complete its review of that application.

AECLT is especially pleased to have the opportunity to comment on the draft Policy Issues Paper prior to its being finalized for submission to the Commission. AECLT would like to address the six substantive issues identified in the draft paper as relating to the CANDU 3 design; specifically, Accident Evaluation, Source Term, Containment Performance, Operator Staffing, Positive Void Reactivity and Control Room Design. In formulating these comments, AECLT has followed the Staff's distinction between Advanced Reactor issues and CANDU 3 issues and, consequently, addressed only those comments specifically applying to the CANDU 3 design. These issues are discussed in detail in Attachment 1 to this letter.

If you have any questions regarding this letter or the attachment, please do not hesitate to call.

Very truly yours,

A. D. Hink
Vice President/General Manager
AECL Technologies

Attachments: As stated

cc: Janet Kennedy, NRC
CANDU 3 Project Manager

ATTACHMENT 1

AECLT SPECIFIC COMMENTS ON CANDU 3 DESIGN ISSUES
AND
THEIR RELATIONSHIP TO CURRENT REGULATORY REQUIREMENTS

In this attachment, AECLT addresses the six issues which the draft Policy Issues Paper identified as pertaining to the CANDU 3 design; specifically, Accident Evaluation, Source Term, Containment Performance, Operator Staffing, Positive Void Reactivity and Control Room Design. Additionally, AECLT comments on the effects of the proposed Category 2 classification issues.

For each of the six issues, the draft Policy Issues Paper characterizes and discusses AECLT's approach to the CANDU 3 design. Based on the characterization and discussion, the paper proposes a recommended resolution of the issue. AECLT believes that the Staff's current evaluation does not give credit to the CANDU design approach.

1. The basis for ATWS in the first place was the single line of defense in LWRs against some accidents. CANDU chose to address the ATWS question by having redundant shutdown. The accidents listed by the Staff are not excluded from consideration in CANDU, but have little consequence because of the redundant shutdown systems. The whole point of redundant shutdown is to provide real safety, as opposed to providing analysis of events without shutdown. This recognition is lacking.

2. Events which would lead to core melt in conventional LWRs, namely LOCA/LOECC, do not do so in CANDU because of the presence of the moderator. To use the consequences of a severe accident to challenge the design, without examining the defenses that have to fail before those consequences occur, removes the incentive from the designer to reduce the frequency of those consequences.

AECLT corrects the characterization and the evaluation in the discussion section, as necessary. In addition, AECLT comments on the recommended resolution of the issue and, where AECLT differs with the recommendation, offers an alternative approach for consideration.

A. ACCIDENT EVALUATION

ISSUE: Identify appropriate event categories, associated frequency ranges, and evaluation criteria for events that will be used to assess the safety of the proposed designs.

AECLT COMMENT: AECLT does not believe that the draft Policy Issues Paper accurately characterizes AECLT's approach to accident evaluation. The draft paper states:

> "The CANDU 3 preapplicant, in their current safety analyses, has excluded analyses of the consequences of events with frequencies of less than 10^{-6}/year from the safety evaluation. Events which would be excluded from consideration, based on the CANDU 3 design characteristics and system reliabilities, would include anticipated transient without scram (ATWS), unscrammed loss-of-coolant-accidents (LOCAs), delayed scram events, and other events which could affect reactivity insertion (for example, from control system failures). As a result of the positive void reactivity coefficient associated with the CANDU design, events involving even a relatively short scram delay could result in a core disruption accident."

AECLT's approach, which is based on design review guides accepted by the Atomic Energy Control Board (AECB), is summarized in the points which follow. We request that the draft paper be revised in accordance with these points.

1. For the CANDU 3 design evaluation, event sequences and their End States are determined by systematic review without regard to End State frequencies. The Conceptual Probabilistic Safety Assessment (CPSA) considers End State frequencies as low as 10^{-11}/year.

2. Reactivity insertion events are not excluded from consideration. Three systems are provided for such events:

    1) The Group 1 Regulatory System with Mechanical Control Absorber Rods for Anticipated Transients.

    2) The Group 2 Shutdown System 1 with rapid shutdown rods for Accidents.

    3) The Group 2 Shutdown System 2 with rapid liquid poison injection for Accidents.

    The CPSA gives the end state frequency for the large LOCA with a failure to shutdown at 10^{-10}/year.

3. The CANDU 3 Safety Analysis has no absolute frequency cutoff. As stated in the Conceptual Safety Report, Appendix C, Section 5.2 Category B Events:

    > "The events in Category B are those for which the frequency of the event can be calculated using probabilistic tools to obtain a realistic assessment of the risk involved (public and economic risk)...

"The stepped curves in Figure 2 will be used as the acceptance criteria for Category B analyses. These are intended to be used as event-based criteria, to provide a measure of the acceptability of the consequences of a given event, which is a function of its likelihood of occurrence. As in the previous probabilistic assessments, events with frequencies less than 10^{-6} events per year are not considered to be of high enough frequency that they generally need to be considered. In those cases where they are, Figure 2 will be extrapolated as necessary."

4. The current CANDU 3 Safety Analysis focuses primarily on identifying design requirements and recommendations for design improvement and assessing the adequacy of the safety systems. The Safety Analysis establishes categories of events, along with evaluation methods and acceptance criteria for each event.

5. The events analyzed are selected because of their impact on the conceptual design, regardless of their frequency. For example, for the containment design, the event analyzed is a large loss-of-coolant accident with emergency core cooling unavailable (LOECC).

   With respect to the treatment of ATWS, unscrammed LOCAs and delayed scram events, see the discussion below in the section concerning Positive Void Reactivity.

6. The draft Policy Issues Paper also states:

   > "The CANDU 3 approach which limits the scope of severe accidents examined appears to be inconsistent with the provisions of 10 CFR 52.47."

   This statement is not accurate. As discussed above in Point No. 3, limits are not placed on the scope of severe accidents that may be considered in designing the CANDU 3.

7. In the draft Policy Issues Paper, the Staff proposes to develop "a single approach to all advanced reactor designs during the preapplication review." Although omitting mention of its applicability to the CANDU 3 design, it appears that the approach is to apply to the CANDU 3 design as well. Assuming that to be the case, the paper should be corrected.

8. The first bullet in the Recommendations section states:

   > "Events will be selected deterministically and supplemented with insights from probabilistic risk assessments of the specific designs."

   AECLT believes that the criteria which will be used in deterministically selecting the events should be identified. Also, we would like to know whether the Staff will

continue the historical requirement for conservative analysis for Design Basis Accidents (DBAs) and best estimate analyses for beyond DBAs. The NRC Staff recommendations for "deterministically" selecting events for analysis appears to be arbitrary and contrary to the spirit of NRC's existing safety goals.

As we discussed in our recent comments on the Advance Notice of Proposed Rulemaking concerning severe accident requirements, we think that assumptions and acceptance criteria should be established for severe accidents, including event cutoff frequencies and consequence acceptance limits. Attachment 2 provides a copy of the relevant AECLT comments on the ANPR, Comment #4 and Comment #8.

B. SOURCE TERM

ISSUE: Should mechanistic source terms be developed in order to evaluate the advanced reactor and CANDU 3 designs?

AECLT COMMENT: The NRC Staff position, as stated on page 7, is that:

> "The CANDU 3 will also be different from LWR designs in certain respects. The coolant contains significant amounts of tritium. Following failure of a pressure tube, there is no heavy-walled reactor vessel to contain releases (there are large volumes of water in two concentric low-pressure tanks; moderator and shield water). Consequently the timing of releases is expected to be different from LWR's. Therefore CANDU 3 also warrants a separate evaluation of source terms."

NRC Staff then recommends that the CANDU 3 source terms used for preapplication review be based upon mechanistic analyses and recommends specific guidelines for performing these analyses.

AECLT does not object to the NRC approach to evaluate our proposed source term during the preapplication review. We have a specific comment on the guidelines which is noted below. However, we do not agree that a pressurized heavy water reactor ~~such as CANDU~~ 3 is so fundamentally different from LWR's that it should require a different methodology for establishing source terms than that which NRC is now in the ~~process of est~~ablishing for evolutionary LWRs. Specifically, the NRC Staff notes on page 7 of its draft letter that NRC Staff is now in the process of "...developing for LWR's a revision to the TID-14844 source term (NUREG-1465, "Accident Source Terms for Light Water Nuclear Power Plants," draft report for comment, June 1992)." AECLT requests that NRC give consideration to applying the same methodology which is developed for Advanced LWRs to Heavy Water Reactors during design certification reviews. In this way, the CANDU 3 will be judged on the same basis as the other water reactor designs currently under licensing review by the NRC.

In support of its position, AECLT notes that differences in design between PWRs and BWRs (for example the absence of a steam generator in BWRs) must be accounted for in source term calculations and the methodology being developed by NRC must allow for these differences in design. We believe that the differences in design between CANDUs and PWRs, insofar as they affect fission product transport after an accident, are of a similar nature. We note that CANDU's use the same type of zircaloy clad uranium oxide fuel as LWRs; hence the fuel behavior aspects of source term calculations should be the same. Also, the fact that tritium levels are higher in CANDU reactors because of the use of heavy water can be easily accounted for in the source term methodology.

We recognize that NRC has not completed its development and implementation of new source term standards for LWRs and therefore we agree with the approach recommended by the Staff for the preapplication review. However, we request that NRC approach the design certification review using the new standards now being developed by NRC for application to evolutionary LWRs.

With respect to the specific guidelines for development of mechanistic CANDU 3 source terms for the preapplication review, we believe the meaning of the term "credible severe accident" is unknown; we request that NRC clarify this term.

C. CONTAINMENT

ISSUE: Should advanced reactor designs be allowed to employ alternative approaches to traditional "essentially leak-tight" containment structures to provide for the control of fission product release to the environment?

AECLT COMMENT: The CANDU 3 design utilizes a traditional dry containment very similar to those in use on licensed LWRs and proposed for advanced LWRs. Therefore, AECLT does not believe the issue, as stated by NRC, is relevant to CANDU 3.

However, in the discussion section NRC states that "...for evolutionary LWRs, the Staff, in SECY-90-016, proposed to use a conditional containment failure probability (CCFP) or deterministic containment performance goal to ensure a balance between accident prevention and consequence mitigation. During the evolutionary LWR reviews, a great deal of careful review was necessary to assure that a probabilistic CCFP would not be used in a way that could detract from a balanced approach of severe accident prevention and consequence mitigation. For advanced designs and the CANDU 3, limited experience exists in the analysis and evaluation of severe accidents which could lead to significant difficulty and uncertainty in assessing a CCFP. For this reason, the Staff recommends that a deterministic containment performance goal be adopted for the CANDU 3."

AECLT COMMENT: AECLT agrees with the Staff's conclusion that "a positive void coefficient should not necessarily disqualify a reactor design." All reactors are subject to the insertion of positive reactivity under certain transient or accident conditions. The specific transient or accident varies with the reactor type. For the CANDU 3 the total void worth is between $2 and $3. While all such insertions raise significant concerns, the key question is whether the reactivity shutdown systems are reliable enough to reduce the frequency of reactivity insertions with a failure of all reactivity shutdown systems to an extremely low value (i.e., 10^{7} to 10^{10} per year).

In order to evaluate positive reactivity insertion in the CANDU 3 design, the Staff proposes to:

> "[require the analysis of] the consequences of events (such as ATWS, unscrammed LOCAs, delayed scrams, and transients affecting reactivity control) that could lead to core damage as a result of the positive void coefficients."

AECLT has several observations regarding this recommendation; including, concerning the meaning of the terms "ATWS" and "unscrammed LOCAs" as the terms might be applied to the CANDU 3. The terms were developed in the early days of LWR reviews and have specific meaning and special significance for those reviews.

1. ATWS: If the ATWS definition is retained with respect to the CANDU 3, its significance is diminished because of CANDU 3's multiple shutdown systems; namely, the Group 1 Regulating System and the two independent, diverse and redundant Group 2 Shutdown Systems.

   For a PWR, Anticipated Transient Without Scram (ATWS) is a faulted response to an anticipated initiating event requiring control element assemblies (CEA's) insertion for reactivity control. The initiating event is defined to be the occurrence of a transient requiring reactor trip for reactivity control coupled with failure of a trip to occur due to either mechanical failure of the CEAs to insert or the failure of both the Reactor Protection System (RPS) and the Alternate Protection System (APS) to generate a trip signal.

   Although 10 CFR 50.62 defined a prescriptive solution for the ATWS scenario in terms of prevention and mitigation, the success criteria for the event is given in NUREG-0460, Volume 3.

   For the limiting ATWS scenario, the criteria relating to the pressure boundary integrity and functionality of the valves required for long term cooling are of primary interest. The concern is that if the peak pressure in the RCS exceeds Level C stress limits (approximately 3200 psia), a breach of the primary coolant pressure boundary will occur and the Safety Injection System check valves will be jammed closed. This would result in a LOCA with no RCS makeup available.

We are concerned that NRC will evaluate CANDU 3 using different criteria than the criteria being used to evaluate containment of evolutionary LWR reactor designs. We do not see a good reason for this, and request that NRC consider instead evaluating the CANDU 3 containment using the same approach and criteria used in evaluating the containment designs for evolutionary LWRs.

With regard to the specific accidents to be used by NRC to evaluate containment performance, we have the following comment:

> "The Staff proposes to postulate a core damage accident as a containment challenge event and require that containment integrity is maintained for a period of approximately 24 hours after the onset of core damage."

We believe that a more specific definition of a "core damage accident" is needed. In this regard, we note that three types of events can lead to "core damage accidents": (1) reactivity events; (2) loss of heat sink events at high pressure; and (3) loss of heat sink events at low pressure. For the CANDU 3 design, the event frequencies of types (1) and (2) events will be less than 10^{7} -- low enough to be able to be considered "incredible." Thus, for the CANDU 3 design events of these types should not have to be considered when evaluating challenges to containment. Type 3 events comprise the "core damage accident" used as the "containment challenge" for the CANDU 3 design.

F. OPERATOR STAFFING AND FUNCTION

ISSUE: Should advanced reactor designs be allowed to operate with a staffing complement that is less than that currently required by LWR regulations?

AECLT COMMENTS: The draft Policy Issues paper states:

> "The CANDU 3 preapplicant has not proposed a specific number of licensed operators, but the Staff's expectation is that CANDU 3 will meet the current LWR staffing requirements."

AECLT does not understand why this issue was addressed to the CANDU 3 in the issues matrix but not in the text.

H. POSITIVE VOID REACTIVITY COEFFICIENT

ISSUE: Should a design in which the overall inherent reactivity tends to increase under specific conditions or accidents be acceptable?

AECLT COMMENT: AECLT agrees with the Staff's conclusion that "a positive void coefficient should not necessarily disqualify a reactor design." All reactors are subject to the insertion of positive reactivity under certain transient or accident conditions. The specific transient or accident varies with the reactor type. For the CANDU 3 the total void worth is between \$2 and \$3. While all such insertions raise significant concerns, the key question is whether the reactivity shutdown systems are reliable enough to reduce the frequency of reactivity insertions with a failure of all reactivity shutdown systems to an extremely low value (i.e., 10^{-7} to 10^{-10} per year).

In order to evaluate positive reactivity insertion in the CANDU 3 design, the Staff proposes to:

> "[require the analysis of] the consequences of events (such as ATWS, unscrammed LOCAs, delayed scrams, and transients affecting reactivity control) that could lead to core damage as a result of the positive void coefficients."

AECLT has several observations regarding this recommendation; including, concerning the meaning of the terms "ATWS" and "unscrammed LOCAs" as the terms might be applied to the CANDU 3. The terms were developed in the early days of LWR reviews and have specific meaning and special significance for those reviews.

1. ATWS: If the ATWS definition is retained with respect to the CANDU 3, its significance is diminished because of CANDU 3's multiple shutdown systems; namely, the Group 1 Regulating System and the two independent, diverse and redundant Group 2 Shutdown Systems.

   For a PWR, Anticipated Transient Without Scram (ATWS) is a faulted response to an anticipated initiating event requiring control element assemblies (CEA's) insertion for reactivity control. The initiating event is defined to be the occurrence of a transient requiring reactor trip for reactivity control coupled with failure of a trip to occur due to either mechanical failure of the CEAs to insert or the failure of both the Reactor Protection System (RPS) and the Alternate Protection System (APS) to generate a trip signal.

   Although 10 CFR 50.62 defined a prescriptive solution for the ATWS scenario in terms of prevention and mitigation, the success criteria for the event is given in NUREG-0460, Volume 3.

   For the limiting ATWS scenario, the criteria relating to the pressure boundary integrity and functionality of the valves required for long term cooling are of primary interest. The concern is that if the peak pressure in the RCS exceeds Level C stress limits (approximately 3200 psia), a breach of the primary coolant pressure boundary will occur and the Safety Injection System check valves will be jammed closed. This would result in a LOCA with no RCS makeup available.

Using the same definition for CANDU 3, an ATWS would be a faulted response to an anticipated initiating event requiring the Group 1 Mechanical Control Absorber rods (MCA) to be inserted for reactivity control. If the MCAs fail to insert, either of the two Group 2 shutdown systen.. remain poised to shutdown the reactor without a severe pressure transient.

2. Unscrammed LOCA:

For an "unscrammed LOCA", defined as a large LOCA requiring the insertion of the shutdown rods of the Group 2 Shutdown System (SDS1) for reactivity control, the Group 2 Shutdown System (SDS2) will insert poison into the moderator and will shutdown the reactor without resulting in a severe pressure transient.

3. Severe Accident End State Producing Positive Reactivity Insertion: For the CANDU 3 design, the severe accident End State producing positive reactivity insertion is shown by the CANDU 3 Accident Analysis to be a Failure to Shutdown when reactor shutdown by the Group 1 Regulating System and the two Group 2 Shutdown Systems has failed to occur. Consequences could include a mismatch between power production and the heat sink, resulting in severe fuel overheating and core damage. As discussed above in our accident evaluation comments, the CPSA gives an End State Frequency of a large LOCA with failure to shutdown of 10^{10} per year.

Acceptance criteria for severe core damage End States have not yet been established. The Staff proposes to take the frequency of positive reactivity insertion events into account in analyzing the phenomenon in the CANDU 3. Specifically,

> "The Staff's review of these analyses will take into account the overall risk perspective of the designs. [A requirement to change designs] will depend on the estimated probability of the accidents as well as the severity of the consequences."

AECLT agrees that consideration of the significance of positive reactivity insertion events should take into account the overall risk perspective of the designs. AECLT notes that acceptance criteria for such events have not yet been established. AECLT recommends that they be established during the preapplication review of the CANDU 3 design. In this regard, in its recent comments on the Severe Accident ANPR, AECLT provided its views on a selection process for severe accident events. See Attachment 2.

CATEGORY 2 CLASSIFICATION

The draft Policy Issues Paper identifies two issues for which the Staff recommends no departure from current regulations; namely, the Control Room Design and SSC Safety Classification issues. AECLT notes with concern that implementation of this recommendation

will arbitrarily cut off review of new and innovative design approaches in these areas. AECLT asks that this recommendation be reconsidered. We believe that safety principles should govern and that new designs should be allowed to demonstrate how they meet such safety principles. Following such examination, the adequacy basis can be developed.

CONTROL ROOM AND REMOTE SHUTDOWN AREA DESIGN

ISSUE: Can current requirements for a seismic Category I/Class 1E control room and alternate shutdown panel be fulfilled by a Remote Shutdown Area, and a non-seismic Category I, non-Class 1E control room?

AECLT COMMENT: AECLT does not believe that the draft Policy Issues Paper accurately characterizes AECLT's approach to control room and Secondary Control Area (SCA) design. The draft paper states:

> "The main control room is not designed to be operable following an earthquake, tornado, fire, or loss of Group 1 (non-essential) electric power, but the operator must remain available to proceed to the secondary control area."

This statement is inaccurate. AECLT's approach to control room and SCA design is summarized in the points which follow. We request that the draft paper be revised in accordance with these points.

1. A CANDU 3 plant does not employ a "remote shutdown area" of the type connoted in the present NRC regulations and incorporated in current U.S. reactors. The CANDU 3 has a secondary control area (SCA) that is, in fact, a second control room. The SCA duplicates the control consoles available in the MCR for the control and monitoring of the Group 2 systems. The design basis for the man-machine interface in the SCA is a duplication to the fullest extent practical of control locations, layouts, and capabilities present in the MCR. The plant design basis requires that plant operators remain in the MCR if it is available and functional. The MCR is used to operate the plant safely under normal conditions and <u>most</u> accident conditions. Sufficient control and instrumentation are provided in both areas to shutdown the plant, achieve cold shutdown conditions, and maintain it in a safe condition under accident conditions including Loss-of-Coolant-Accidents. However, the MCR is designed for the effects of earthquakes and tornadoes to the extent of providing the operating Staff with protection from physical harm. Should the MCR become uninhabitable, control of the plant would be shifted to the SCA. The plant is designed such that all actions required to be accomplished while the plant operators shift control to the SCA are accomplished automatically. The route from the MCR to the SCA is qualified to allow its use in the event of earthquakes or tornadoes.

2. Regarding operability following a fire, AECLT wants to emphasize that no control room will remain operable following the control room fire required to be postulated by NRC fire protection requirements. However, the CANDU 3 design, which separates the plant into Group 1 and Group 2 areas, provides a significantly improved capacity to respond to fires; in that, a fire in any Group 1 area (including the MCR) will not prevent safe shutdown using Group 2 systems from the SCA and, likewise, a fire in any Group 2 area will not prevent shutdown from the MCR using Group 1 systems.

3. It is incorrect to characterize Group 1 systems as "non-essential" because it implies that Group 1 systems are "non-safety-related". The CANDU 3 design applies a graded level of design standards commensurate with the safety function to be performed in contrast to U.S. practice which applies extensive, safety-grade requirements to structures and systems that are safety-related and few, if any, requirements to those that are non-safety-related. The NRC Staff's statement in the draft SECY papers further implies that Group 1 power would be lost given a loss of offsite power. This is not correct. There are two redundant Group 1 diesel generator sets (as well as two redundant Group 2 diesel generator sets).

4. The separation of the CANDU 3 plant into Group 1 and Group 2 areas provides an enhanced capability to respond to other hazards that could render any control room inoperable. These hazards include sabotage, aircraft crashes, externally-generated missiles, smoke, and toxic gas. The CANDU 3 design also provides enhanced emergency planning capability by providing a redundant area for monitoring and control of essential plant parameters throughout all plant conditions from normal operation to cold shutdown.

In the draft Policy Issues Paper, the Staff discusses its reasons for recommending no departure from current regulations regarding control room design.

AECLT believes that the NRC Staff's evaluation approach to this issue appears to be more prescriptive regarding control room design than we believe is required by GDC-2 and GDC-17. The GDC permit a graded application of standards to structures, systems, and components commensurate with, as GDC-1 states, the importance of the safety functions to be performed. The importance of a control room in a plant that has essentially two control rooms is diminished from that in a plant with only one control room and a remote shutdown panel. Nevertheless, in either plant, the necessary functions need to be identified and the appropriate standards applied. The crux of this issue is the control room design envisioned in GDC-19. The CANDU 3 design vis-a-vis GDC-19 is discussed as follows.

The NRC Staff states that it is reluctant to approve any design that would increase the frequency of evacuation of the control room during design basis accident conditions or hamper the control or monitoring of upset conditions as the event progresses. AECLT is in general agreement with the NRC Staff position and believes that the CANDU 3 design satisfies the objective except for the low probability seismic and tornado events. As

discussed above, AECLT feels the CANDU 3 design adequately addresses the concerns identified by the Staff regarding this issue and provides benefit to public health and safety. AECLT requests that the Staff reconsider its no departure recommendation.

ATTACHMENT 2

Excerpts from AECLT Comments on
NRC Advance Notice of Proposed Rulemaking
Concerning Acceptability of Plant Performance for Severe Accidents

[ref. AECLT letter to NRC dated December 21, 1992]

General Comment No. 4

4. Specifically, in the rule and implementing guidance the following matters should be addressed:

   A. Selection Process for Severe Event Sequences Considered in the Design. The selection process should be based on event frequency. The process would establish the frequency limits to: (1)define the events requiring design changes to reduce their frequency, (2) define the events that require features to mitigate the event's consequences and (3) define events that need not be considered in the design.

   B. Consequence Limits: For each event sequence defined by A(1) and A(2) above (e.g. reactivity events, loss of heat sink at High/Low Pressure), acceptable consequences for the event frequency should be defined on an overall basis (e.g. containment stress and leakage, radiological consequence limits). In addition, a phenomenon acceptance criterion should define the acceptable consequences for each individual phenomenon (e.g. hydrogen, molten fuel, non-condensable gas) associated with the event consistent with the overall acceptance criteria and the design features that produce the phenomenon.

   C. Phenomenon Acceptance Criteria: For each phenomenon acceptance criterion, systems/features should be identified which provide the means to mitigate the consequences of the phenomenon.

   D. System/Feature Design Criteria: For each system/feature, design criteria should be established for capacity, load combinations, environmental conditions vs time, and reliability. The reliability criteria should include: redundancy, diversity, power supply, separation (from each other and from systems/features whose failures are involved in the severe accident event sequences), and environmental qualifications.

   E. System/Feature Demonstration Requirements: For each system/feature, the demonstration analysis/test requirements should be defined. These should

include assumptions, acceptance criteria, analytical methods, and test requirements.

General Comment No. 8

8. As discussed in 3 and 4 above, a severe accident rule should specify a cut-off event frequency such that events below this frequency need not be considered in the design and for which further analysis is not required.

NUREG/CR-5368, "Reactivity Accidents" reported the results of analyses of light water reactor reactivity events performed by Brookhaven National Laboratory. For that effort, Brookhaven categorized potential event sequences as being worthy of further analysis, or not. One of the screening criteria used to determine the importance of a sequence for further analysis was whether the sequence required too many low probability events to occur in combination. Brookhaven established a screening methodology with which low probability events could be eliminated from further consideration.

Event sequences with a frequency of less than 1E-7 per reactor year were considered "incredible" and not recommended for further study.

AECLT believes that the generic severe accident rule should codify similar screening criteria.