

ACRS Meeting Minutes/Summary of the  
Improved LWRs Subcommittee  
July 11, 1990  
Bethesda, Maryland

8-8-90  
Wylie

PURPOSE:

The purpose of this subcommittee meeting was to review the draft SERs for Chapters 1 through 5 of the EPRI Requirements Document.

ATTENDEES:

ACRS:

C. Wylie, Chairman  
I. Catton, Member  
C. Michelson, Member  
C. Siess, Member  
D. Ward, Member

Others:

E. Kintner, GPU  
L. Fidrych, S. Levy, Inc.  
X. Pouget, EPRI  
K. Jamali, NUS  
D. Noonan, Bechtel  
L. Rib, AECL  
W. Pasadag, DOE  
D. Chapin, MPR  
J. Trotter, EPRI  
D. Leaver, Tenera  
S. Additon, Tenera

NRC:

J. Burns, Jr., RES  
R. Correia, NRR  
J. Tsao, NRR  
C. Hinson, NRR  
S. Kim, NRR  
H. Brammer, NRR  
A. Taboada, RES  
T. Kenyon, NRR  
B. Hardin, RES  
J. Lyons, NRR  
I. Yashida, NRR  
H. Pastis, NRR  
D. Shum, NRR  
C. Nichols, NRR  
D. Scaletti, NRR  
S. Brewer, NRR  
G. Schwenk, NRR  
J. Lazevnick, NRR

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Meeting Highlights, Agreements and Requests

1. Mr. Wylie, Subcommittee Chairman, stated the purpose of the subcommittee meeting and introduced the other ACRS members.
2. Mr. T. Kenyon, Project Manager/NRR, stated that the NRC staff has prepared draft SERs to discuss its review of the EPRI Requirements Document on a Chapter-by-Chapter basis. In September 1987, the staff issued the first DSER which addressed the Requirements Document Executive Summary and Chapter 1, "Overall Requirements" regarding the overall objectives and requirements of the ALWR program. Chapter 2, "Power Generation Systems" was evaluated in the second DSER, which was issued in February 1988. The third DSER was issued in May 1988, covered Chapter 3, "Reactor Coolant System and Reactor non-safety Auxiliary Systems." The fourth DSER was issued in June 1988, covered Chapter 4, "Reactor Systems." The fifth DSER was issued in February 1990. Key issues in the Chapter 5 review include:
  - o EPRI's ALWR public safety goal
  - o Severe-accident prevention and mitigation
  - o Severe-accident containment performance criteria
  - o Hydrogen generation and control
  - o Source term issues
  - o Fire protection
  - o High/Low-interface design
  - o ATWS issues
  - o Operation of RHR system with reduced reactor coolant system inventory
  - o Station blackout
  - o Core-concrete interaction
  - o High pressure core-melt ejection
  - o Equipment survivability
  - o Inservice testing of pumps and valves
  - o Resolution of certain generic safety issues

Mr. Kenyon indicated that the Standard Review Plan (SRP) was used as guidance, but the level of detail did not permit a completeness review. The staff has assumed that all current regulatory requirements would be met by a design that complied with the EPRI ALWR Requirements Document, except where deviations are identified in the document and if the staff identified a potential incompatibility between EPRI-proposed design requirements and current regulatory requirements.

As a result of the NRC review, a number of items discussed in the DSERs on Chapters 1 through 5 remain outstanding. Currently, there are approximately 160 open items. The staff



indicates this is due to the fact that either the review is not totally completed or the staff has reached a conclusion different from EPRI on these issues. These issues fall into one of four categories.

- o issues that require satisfactory resolution before the staff can complete its review of that particular chapter of the Requirements Document,
- o issues for which staff review of other related chapters of the Requirements Document has not yet been completed,
- o confirmatory issues for which the staff will ensure follow-up of commitments in the Requirements Document,
- o issues that require satisfactory resolution and in support of a vendor/or utility-specific application

Mr. Kenyon indicated that EPRI is modifying its Chapter 1 in a roll-up document to identify areas of compliance with the Commission's regulatory requirements. The roll-up document is expected by end of Summer 1990. The staff is attempting to complete DSERs on Chapters 6, 7, 8, 9, 12 and 13 by end of Summer 1990. Schedules for DSERs on Chapters 10, 11 and Appendix A to Chapter 1 will be determined following EPRI's response to the requested additional information. The staff is currently requesting two (or one if the ACRS desires) more interim letters on this subject. Mr. Kenyon noted that the ACRS interim letter is needed to allow incorporation into roll-up document and to assist the staff with preparation of final SER. The final SER is expected to be completed by late Spring of 1991.

3. Mr. E. Kintner, Chairman of the ALWR Utility Steering Committee, briefed the Subcommittee regarding the EPRI ALWR Requirements Document. He indicated that there is a growing momentum towards the EPRI ALWR program. A nuclear power oversight committee (NPOC) Subcommittee has been created to coordinate the ALWR activities. Six year and 200 + million dollars program initiated by DOE to fund detailed design development and certification of GE and Westinghouse passive plant designs. There is a growing domestic and international support for EPRI - coordinated design reviews of passive plant designs. EPRI is relying on the NRC in defining appropriate process and priorities for review of standard plant designs. The goals of the ALWR program for future nuclear generation are:

- o real improvements in safety for both public acceptance and investor confidence
- o stabilized regulatory basis
- o standardized designs that meet utility requirements
- o design development and certification schedules that meet urgent utility baseload capacity requirements and
- o potential for reduced capital costs

Mr. Kintner indicated that EPRI is concentrating on simplification throughout the plant emphasizing significant additional engineering margins (e.g. thermal margins and negative reactivity requirements). The EPRI ALWR Requirements Document is intended to create a sound technical foundation for the next generation of LWRs. It is a mechanism to resolve issues and provides a basis for dialogue and technical honesty in the decision for future plants. The philosophy of the EPRI Requirements Document differs from the past and current approach to safety. In the past, the approach to safety has been one which is fundamentally to protect the public against accidents once they occur and, therefore has concerns rated very heavily on accidents after they have occurred. The EPRI program focuses on avoiding accident initiators that present any kind of a threat to the public, and concentrates on designing a more reliable and safer nuclear plant rather than on reducing the consequences of accidents.

4. Mr. J. Trotter, EPRI, presented the Subcommittee with an overview of the EPRI Requirements Document. He indicated that the EPRI Requirements Document consists of three volumes. Volume I, the Executive Summary is a management-level synopsis of the Requirements Document, including the design objective and philosophy, the overall physical configuration and features of a future nuclear plant design and the steps necessary to take the proposed ALWR design criteria beyond the conceptual design state to a completed, functioning power plant. Volume II addresses the evolutionary (approximately 1350 MWe) plant requirements that include overall performance and design requirements (Chapter 1) and requirements for systems and structures (Chapters 2 through 13). Volume III, addresses the passive (approximately 300-600 MWe) plant ALWR requirements. The EPRI Requirements Document applies to the entire nuclear plant and incorporates resolutions of generic safety issues and optimization issues. The document reflects the industry consensus on principal safety, performance, and design issues. Mr. Trotter indicated that there has been modest changes from the process defined in NUREG-1197, to update process for EPRI Requirements Document treatment of issues (original cutoff date was July 1, 1986, was changed to January 1, 1990). The roll-up will proceed with all chapters and is expected by the end of August 1990.



5. Mr. D. Leaver, EPRI, discussed Chapter 5 source term and severe accident issues. He indicated that the EPRI criterion for hydrogen detonation is that containment mixtures of 13% hydrogen or less are sufficient to avoid detonability. Design reflood and depressurization rates bound in-vessel hydrogen generation during recovery or attempted recovery, and thus 75% clad oxidation is a conservative bound for in-vessel events. The RCS depressurization and cavity flooding combine to bound ex-vessel hydrogen generation within margin afforded by unrecovered cases. Rapid debris quenching limits oxidation for credible core debris initial discharge fractions.

Mr. Leaver noted that using a conditional containment failure probability (CCFP) criterion for the containment performance criteria would be an unnecessary and counterproductive regulatory requirement for ALWR. A rugged containment is required regardless of calculated core damage frequency.

EPRI believes that a containment vent for severe accident protection is an unnecessary, undesirable, and potentially unworkable design feature. The ALWR Requirements Document offers extensive accident prevention features to meet regulatory and investment protection objectives.

Some of the extensive EPRI ALWR accident prevention features are a significant reduction in transient initiation frequency, improved reliability and diversity of on-site AC sources (e.g., third emergency diesel generator for third safety division for BWRs), improved decay heat system reliability, higher pressure RHR and improved depressurization capability.

Some of the EPRI Requirements Document features for improving mitigation capability rely on preventing direct containment heating, cavity configuration to capture, contain, and cool core debris, and cavity flooding capability via direct path from proximate water source.

The EPRI ALWR requirements will meet the NRC safety goals, with margin, via existing requirements. The EPRI public safety criterion is more stringent. A dose of 25 rem is a low dose, causing no observable health effects. Mr. Leaver indicated that the ALWR will be a fundamentally better plant through the EPRI Requirements Document and there is a strong utility consensus to standardize future plants around the EPRI requirements. Some of the potential issues are source term and the technical basis for EPZ reduction.

6. Mr. X. P. Abadie, EPRI, presented EPRI Requirements Document, chapter 5 overview. He indicated that Rev. 1 of Volume II is still in the review process and will be submitted at the end of August 1990.

For Systems Overview - PWR; the RHR consists of two divisions (each with a motor-driven pump and heat exchanger) and circulates water from RCS through heat exchanger to RCS. The emergency feedwater (EFW) system consists of two divisions, each with two pumps (1 motor and 1 steam turbine driven). The EFW supplies water to steam generators from dedicated supply tanks following loss of main and startup feed pumps. The safety Injection (SI) system consists of two divisions, each with two high head motor-driven pumps, and delivers water from in-containment refueling water storage tank (IRWST) and accumulators to RCS. It applies direct vessel injection that eliminates branch lines/valves and reduces required flow. The ADS consists of two divisions, each with the valves in series, vents RCS fluid to IRWST. The containment spray system (CSS) consists of two divisions, each with a motor-driven pump and heat exchanger. It supplies water from IRWST to containment spray headers, or back to IRWST for long-term post-LOCA cooling. The containment is a large dry with sufficient volume to meet 75%/13% hydrogen limits. The design pressure is based on LDB events.

For systems overview - BWR; the ADS would include safety/relief valves and permits RCS flooding by DHR pumps. It is initiated by low RCS water level and high drywell pressure. The reactor core isolation coolant (RCIC) has one steam turbine-driven high pressure pump, with water supply from dedicated condensate reservoir or suppression pool. The standby liquid control (SLC) has two high pressure pumps and two parallel electrically-operated injected valves. For containment spray, it includes spray of both wetwell and drywell regions and water supply from suppression pool. The containment is a vapor suppression type. The hydrogen control system requires an igniter system (preferred by utilities) with inserting system has been demonstrated in previous designs and GE ABWR.

7. Mr. L. Fidrych, EPRI, summarized some of BWR/DSER issues. He indicated that specific requirements have been added to Chapter 5 of the EPRI Requirements Document to deal with such subjects as automatic standby liquid control, effective distribution of boron injection, safety classification of containment spray, MSIV leak rate, BWR suppression pool fission product scrubbing, etc. These specific requirements have been added to satisfy regulatory requirements (such as the ATWS rule) and to invoke performance requirements such as adequacy of boron mixing. Additional requirements in Chapters 2, 3, and 13 were added to clarify seismic and quality group classification of main steam line to support use of main steam line and condenser for hold-up and plate-out instead of leakage control system.



8. As a result of the Subcommittee's discussion, some of the Subcommittee members expressed concern in regard to the following:
- o Dr. Catton expressed some concern regarding the use of computer codes such as MAAP in the ALWR program and indicated that the documentation for these codes has been very poor and is not readily available.
  - o Dr. Catton expressed concern that in the NRC staff's review, it does not seem that there is an approved method or study to determine how to handle the hydrogen stratification in containment for the new designs and how to certify it.
  - o Mr. Michelson expressed concern regarding the legal standing (if any) of the EPRI Requirements Document, and what are the staff's commitments regarding this issue.
  - o Mr. Michelson questioned if the staff has truly studied the leak-before-break issue for the evolutionary designs.
  - o Mr. Michelson questioned EPRI's compliance with NUREG-1197 and cut-off date.
  - o Dr. Siess requested additional information to investigate the trade-off philosophy between the continuous monitoring and the relaxation of leakage tests in the containment.
  - o Mr. Michelson commented that it is not clear if the fire or internal flood events are considered as severe accident issues in the EPRI Requirements Document.
  - o Mr. Michelson noted that additional information is needed to investigate more about the environmental qualifications of the advanced, control complex for the future designs.

Future Action

The Subcommittee Chairman is planning to brief the full committee at the July 12-14, 1990 ACRS meeting regarding this subject. Representatives of the NRC and EPRI will also brief the full Committee on the same subject. The Committee may wish to write a report to the Commission on the subject matter.

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NOTE: Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 2120 L Street, NW, Washington, DC 20006, (202) 634-3273, or can be purchased from Ann Riley and Associates, Ltd., 1612 K Street, NW, Suite 300, Washington, DC 20006, (202) 293-3950.