



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

SL-0539

April 10, 2006

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Diaz:

SUBJECT: SUMMARY REPORT - 530th MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, MARCH 9-11, 2006, AND OTHER RELATED ACTIVITIES OF THE COMMITTEE

During its 530th meeting, March 9-11, 2006, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters and completed the following reports, letter, and memoranda:

REPORTS:

Reports to Nils J. Diaz, Chairman, NRC, from Graham B. Wallis, Chairman, ACRS:

- Review and Evaluation of the NRC Safety Research Program, dated March 15, 2006
- Final Review of the Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Final Safety Evaluation Report, dated March 24, 2006
- Report on the Safety Aspects of the License Renewal Application for the Browns Ferry Nuclear Plant Units 1, 2, and 3, dated March 23, 2006
- Generic Safety Issue 191 — Assessment of Debris Accumulation on PWR sump Performance, dated ~~March 24, 2006~~ April 10, 2006 (Rev.)

LETTER:

Letter to Luis A. Reyes, Executive Director for Operations, NRC, from Graham B. Wallis, Chairman, ACRS:

- Draft Final Revision 4 to Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," dated March 28, 2006

MEMORANDUM:

Memorandum to Luis A. Reyes, Executive Director for Operations, NRC, from John T. Larkins, Executive Director, ACRS:

- Resolution of Generic Safety Issue 188, "Steam Generator Tube Leaks or Ruptures Concurrent with Containment Bypass from Main Steam Line or Feedwater Line Breaches," dated March 17, 2006

HIGHLIGHTS OF KEY ISSUES1. Final Review of the Clinton Early Site Permit Application

The Committee heard presentations by and held discussions with representatives of Exelon Generation Company, LLC (Exelon) and the NRC staff regarding the Early Site Permit (ESP) application for the Clinton site and the associated NRC staff's final Safety Evaluation Report (SER). The Committee had previously met with the NRC staff and applicant during the September 2005 ACRS Full Committee meeting and prepared an interim letter on this application and the associated draft SER on September 22, 2006. This ACRS meeting focused on the geologic and seismic aspects of the Clinton ESP application.

Exelon's ESP application is based on the now familiar "plant parameter envelope" approach since the applicant has not identified the particular reactor technology that will be adopted. Exelon noted that the staff has accepted its proposed alternative, performance-based, method for the determination of the Safe Shutdown Earthquake (SSE) ground motion spectrum. The geotechnical approach used, and the seismic evaluation conducted, to determine the SSE ground motion were summarized for the Committee. The performance-based approach uses a target mean frequency of $1E-5$ per year for seismically induced onset of significant inelastic deformation. This is in contrast to the Regulatory Guide 1.165 approach which uses a reference probability based on not exceeding the median seismically-induced core damage frequency from 29 Individual Plant Examinations for External Events.

The NRC staff provided the Full Committee with a more detailed discussion of the geologic and seismologic review of the Clinton ESP application. The NRC staff concluded that the performance-based approach used by Exelon was technically sound, that the seismic design using the performance-based SSE achieves a safety level generally higher than currently operating plants, and that the performance-based SSE adequately reflects the local ground motion hazard. The NRC staff explained its basis for reaching each of these conclusions. Overall, the NRC staff concluded that the site is acceptable from a geologic and seismologic standpoint and meets the requirements of 10 CFR 100.23.

The final SER documents the staff's technical review of the applicant's site safety analysis report and emergency planning information. Overall, the staff concluded that the level of safety and emergency planning associated with the Clinton ESP is acceptable and meets the regulations.

Committee Action

The Committee issued a report to Chairman Diaz dated March 24, 2006, concluding that the ESP application and final SER show that the site adjacent to the existing Clinton Nuclear Power Station is an acceptable site for nuclear power plants that meet the plant parameter envelope proposed by the applicant. The Committee also concluded that the staff has thoroughly reviewed a performance-based method proposed by the applicant for determining SSE ground motion and recommended that the staff consider the development of a regulatory guide dealing with the alternative, performance-based method for assessing the seismic hazard of a site.

2. Staff's Evaluation of the Licensees' Responses to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors" and Results of the Chemical Effects Tests Associated with PWR Sump Performance

The staff discussed licensee responses to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," and presented the results of efforts by the Office of Nuclear Regulatory Research to understand several phenomenological issues that have arisen as part of the GSI-191 effort, including chemical effects, downstream effects, and head loss correlations through debris beds. The responses to the GL and the results of the recent research have raised new questions. Present plans by licensees to increase the size of their sump screens will reduce the head loss across these screens, but the staff's ability to assess the adequacy of the reduction may be limited by uncertainties in the available knowledge base. In addition downstream effects may be exacerbated by some screen designs and configurations.

The staff reported that exploratory chemical effects tests have revealed that some chemical species can be produced under certain conditions that can have a substantial effect on screen pressure drop. The staff has concluded that plant-specific evaluations of the response to this phenomenon are required. Additional experiments to reproduce previous screen head loss data have produced significantly different results, and these results indicate that the structure of the debris bed and the way in which it is formed can have a huge influence on the head loss. Unless the assumption of a homogeneous bed can be justified, it will be necessary to develop an adequate model for these effects or find a way to scale them in the proof tests now planned by industry.

With regard to debris that passes through the screens into the reactor coolant system, the staff and industry representatives stated that they thought that the core would be adequately cooled in a number of scenarios, however, they presented no physical models or analytical predictions to show a validated, quantitative basis for these conclusions. The Committee believes that additional research is needed to develop an adequate understanding of the effects of the various debris species which enter the reactor vessel and reach the core.

Committee Action

The Committee issued a report to Chairman Diaz dated March 24, 2006, recommending that additional work is required to provide the technical basis by which the staff can assess the

adequacy of the planned modifications to PWR sump screens. Improved predictive methods and guidance should be developed for particle/fiber mixtures and chemical reaction products that are deposited on sump screens. Methods for predicting the quantity and properties of debris that bypasses the sump screens should be developed, and their potential adverse effects on downstream components should be evaluated. Equilibrium chemistry models should be validated further and guidance should be developed for their use. The results of tests of coating debris formation and transport should be included in the assessment of core coolability as they become available, which should include the development of adequate predictive capability for the effects of coating debris on screen pressure drop and bypass.

3. Final Review of the License Renewal Application for Browns Ferry Units 1, 2, and 3

The Committee met with the NRC staff and representatives of the Tennessee Valley Authority (TVA) to review the License Renewal Application (LRA) for Browns Ferry Units 1, 2, and 3 and the associated final SER. TVA has requested approval for continued operation of each unit for a period of 20 years beyond the current license expiration dates of December 10, 2013 for Unit 1, June 28, 2014 for Unit 2, and July 2, 2016 for Unit 3. The three Browns Ferry Units are General Electric BWR 4 reactors in Mark I containments with nearly identical materials, systems, components, and environments. TVA will eliminate the differences between the current licensing basis of Unit 1 and Units 2 and 3 prior to Unit 1 restart in May 2007. To address concerns raised by the Committee in its interim report, TVA described the applicability of operating experience from Units 2 and 3 to Unit 1 and the attributes of the Unit 1 Periodic Inspection Program. The objective of this aging management program is to verify that no latent aging effects are occurring in Unit 1 piping components that were in layup but were not replaced prior to restart. TVA also described the process for tracking license renewal commitments, the status of the implementation of aging management programs, and the implementation of the Maintenance Rule for Unit 1. The staff provided highlights of its review of this LRA and described the EDO response to the Committee's interim report. The final SER issued in January 2006 describes the resolution of four open items and two confirmatory items. In March 2006, the staff reopened one of the open items based on new information provided by TVA regarding drywell inspection results. Ultrasonic inspections identified a small inclusion in the drywell liner of Unit 1. The staff will document its evaluation of this information in a supplemental SER.

Committee Action

The Committee issued a report to the NRC Chairman dated March 23, 2006, recommending that the license renewal application for Browns Ferry Units 1, 2, and 3 be approved under two conditions. The first condition is that the drywell refueling seals should be included within scope of license renewal and subjected to periodic inspections or the drywell shells should be subjected to periodic volumetric inspections to detect external corrosion. The second condition is that if an extended power uprate is implemented before the period of extended operation, the staff should require that TVA evaluate Units 1, 2, and 3 operating experience at the uprated power level and incorporate lessons learned into their aging management programs prior to entering the period of extended operation.

4. Draft Final Revision 4 (DG-1128) to Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants"

The Committee heard presentations by and held discussions with representatives of the staff regarding the draft final Revision 4 Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants." The staff provided a summary of the comments received during the public comment period along with its responses to those comments. The staff explained the changes to the draft final Regulatory Guide based on the public comments. The Committee expressed a concern with Regulatory Position 1, which states, "If a current operating reactor licensee voluntarily converts to the criteria in Revision 4 of this guide, the licensee should perform the conversion on the plant's entire accident monitoring program to ensure a complete analysis." The Committee stated that this position is too restrictive.

Committee Action

The Committee issued a letter to the EDO, dated March 28, 2006, recommending that the staff not issue the draft final Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4. The Committee recommended that the staff revise Regulatory Position 1 to allow licensees to adopt the IEEE 497-2002 Standard to modify individual accident monitoring instruments without a complete analysis of all accident monitoring instrumentation. The Committee agreed that licensees should not be allowed to partially use the new Standard to eliminate or reclassify accident monitoring instrumentation required by earlier standards unless Revision 4 of the Regulatory Guide is adopted in its entirety.

5. Evaluation of Precursor Data to Identify Significant Operating Events

The Committee heard presentations by and held discussions with representatives of the staff regarding the evaluation of Accident Sequence Precursor (ASP) data to identify significant operating events. The staff provided a background of the ASP program, status of ASP analyses, ASP program accomplishments, interesting 2004 analyses, potentially interesting fiscal year 2005 analyses, and ASP trends from SECY-05-0192, "Status of the Accident Sequence Precursor Program and the Development of Standardized Plant Analysis Risk Models." There were no significant precursors (conditional core damage probability greater than or equal to 1×10^{-3}) in fiscal years 2003, 2004, or 2005.

Committee Action

This was an information briefing and no Committee action was required.

6. Draft Final ACRS Report on the NRC Safety Research Program

The ACRS provides the Commission a biennial report, presenting the Committee's observations and recommendations concerning the overall NRC Safety Research Program. During the March meeting, the Committee discussed its draft final 2006 report to the Commission on the NRC Safety Research Program.

Committee Action

The Committee forwarded an advance copy of its 2006 report on the NRC Safety Research Program to the Commission on March 15, 2006. The final report will be issued as NUREG-1635, Vol. 7.

RECONCILIATION OF ACRS COMMENTS AND RECOMMENDATIONS/EDO COMMITMENTS

The Committee considered the EDO's response of February 9, 2006, to comments and recommendations included in the January 4, 2006 ACRS report on the proposed Vermont Yankee Extended Power Uprate. The Committee decided that it was satisfied with the EDO's response.

The EDO response noted that the letter included some additional comments from several ACRS members which addressed a proposed approach for consideration of uncertainties as part of an assessment of crediting containment overpressure. The NRC staff will consider the ACRS comments as it develops more explicit guidance as part of the ongoing revisions to Regulatory Guide (RG) 1.82. Based on discussions with the ACRS, during NRC staff presentations related to the proposed revisions to RG 1.82, the staff understands that the ACRS would prefer that licensees use a statistical approach for the analysis related to crediting containment overpressure. The staff is currently developing guidance for this new approach and will bring the revised RG 1.82 to the Committee in the future.

OTHER RELATED ACTIVITIES OF THE COMMITTEE

During the period from February 9, 2006, through March 8, 2006, the following Subcommittee meetings were held:

- Thermal-Hydraulic Phenomena — February 14-16, 2006

The Subcommittee heard presentations from the staff concerning licensee responses to Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors, and the results of efforts by the Office of Nuclear Regulatory Research to understand several phenomenological issues that have arisen as part of the GSI-191 effort, including chemical effects, downstream effects, and heat loss correlations through debris beds.

- Early Site Permits — March 8, 2006

The Subcommittee reviewed the application for an early site permit for the Clinton site, and the associated NRC staff's final Safety Evaluation Report. The Subcommittee discussed at length the applicant's performance-based seismic hazard analysis methodology.

- Planning and Procedures — March 8, 2006

The Subcommittee discussed proposed ACRS activities, practices, and procedures for conducting Committee business and organizational and personnel matters relating to ACRS and its staff.

LIST OF MATTERS FOR THE ATTENTION OF THE EDO

- The staff committed to provide to the Committee the Supplemental Safety Evaluation Report related to the license renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3
- The Committee plans to review the staff's resolution of issues raised by the Committee regarding Revision 4 to Regulatory Guide 1.97.
- The Committee plans to continue to work with the staff on PWR sump performance issues.

PROPOSED SCHEDULE FOR THE 531st ACRS MEETING

The Committee agreed to consider the following topics during the 531st ACRS meeting, to be held on April 5-8, 2006:

Safeguards and Security Matters
 Application of TRACG Code to ESBWR Stability
 Hazards Analysis Associated with the Grand Gulf Early Site Permit Application and the Associated NRC Staff's Evaluation
 Safety Conscious Work Environment/Safety Culture
 Draft Final Regulatory Guide, "Risk-Informed, Performance-Based Fire Protection for Existing Light Water Nuclear Power Plants"
 Review of 1994 Addenda for Class 1, 2, and 3 Piping Systems to the ASME Code Section III and the Resolution of the Differences Between the Staff and ASME

Sincerely,

/RA/

Graham B. Wallis
 Chairman