



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

September 20, 2010

The Honorable Gregory B. Jaczko  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**SUBJECT:     REPORT ON THE SAFETY ASPECTS OF THE SOUTH TEXAS PROJECT  
              NUCLEAR OPERATING COMPANY APPLICATION TO AMEND THE  
              CERTIFIED U.S. ABWR DESIGN TO INCORPORATE THE AIRCRAFT IMPACT  
              ASSESSMENT RULE**

Dear Chairman Jaczko:

During the 575<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, September 9-11, 2010, we reviewed the staff's Safety Evaluation Report (SER) related to the South Texas Project Nuclear Operating Company (STPNOC) application to amend the certified U.S. Advanced Boiling Water Reactor (ABWR) design. The purpose of the amendment is to address the requirements of the Aircraft Impact Assessment (AIA) Rule specified in 10 CFR 50.150. Our ABWR Subcommittee held a meeting on August 18, 2010, to review the application, the AIA performed by the applicant, and the staff's SER and AIA inspection report. During these meetings, we had the benefit of discussions with representatives of the NRC staff and STPNOC and their supporting contractors. We also had the benefit of the documents referenced. This report fulfills the requirement of 10 CFR 52.53 that the ACRS report on those portions of the application which concern safety.

**CONCLUSIONS AND RECOMMENDATIONS**

1.     The STPNOC application to amend the ABWR design certification rule and the staff's SER are acceptable subject to satisfactory closure of the issues identified in the Notice of Violation and Recommendation 2.
  
2.     The staff should ensure that the applicant demonstrates and documents that the temperature within the fire-protected area where the Alternate Feedwater Injection (AFI) system instrument rack is to be located will not exceed the instruments' environmental qualification conditions.
  
3.     The staff should ensure that the assumptions and initial conditions credited in the applicant's AIA are properly incorporated into the amended Design Control Document (DCD).
  
4.     The staff should ensure that Combined License (COL) applicants referencing this amendment have an appropriate process to assure the reliability of the AFI system.

5. The staff should complete a lessons-learned review of this application to identify any deficiencies in the AIA Inspection Procedure (IP) 37804 and the AIA methodology prescribed in Nuclear Energy Institute (NEI) 07-13, Revision 7. Resolution of these deficiencies should be communicated to the industry and incorporated into the staff's future reviews.

## **BACKGROUND**

The ABWR design was certified by the NRC on May 12, 1997. On June 30, 2009, STPNOC submitted an application to amend the ABWR design certification rule to address the requirements of the AIA rule specified in 10 CFR 50.150. The application was revised on May 12, 2010, and June 17, 2010. After incorporating responses to the NRC requests for additional information, STPNOC submitted the final application on July 12, 2010, which is the basis for this review and the staff's SER. Subsequent to the issuance of the SER, STPNOC submitted other revisions of their application to address deficiencies identified in the staff's inspection report and Notice of Violation.

As required by 10 CFR 50.150, applicants for new nuclear power plants must perform an assessment of the effects of the impact of a large, commercial aircraft on the designed facility. Using realistic analyses, applicants must identify and incorporate into the design those design features and functional capabilities needed to show that, with reduced use of operator action, (1) the reactor core remains cooled or the containment remains intact and (2) spent fuel cooling or spent fuel pool integrity is maintained (referred to as the acceptance criteria).

Applicants are required to submit a description of the design features and functional capabilities identified as a result of the AIA and a description of how those features and capabilities show that the acceptance criteria are met. Since the impact of a large, commercial aircraft is a beyond-design-basis event, applicants may use non-safety-related features or capabilities to satisfy the requirements of 10 CFR 50.150.

The Statement of Considerations for 10 CFR 50.150 states that the COL applicant is not required to submit the AIA to the NRC, but the assessment will be subject to inspection by the NRC, and must, therefore, be maintained by the applicant. On May 17-21, 2010, the staff conducted an inspection of the AIA at the applicant's supporting contractor facility. The inspection was performed in accordance with IP 37804, "Aircraft Impact Assessment," dated April 27, 2010. The AIA was made available to us by the applicant for review prior to our ABWR Subcommittee meeting of August 18, 2010.

If the proposed amendment is approved, applicants for a COL that reference the ABWR standard design can address the requirements of 10 CFR 50.150 by referencing the amended ABWR standard design.

## **DISCUSSION**

The certified ABWR design in Appendix A of 10 CFR Part 52 does not address the AIA rule as it predates the rule. The AIA performed by the applicant uses, without exceptions, the industry guidance in NEI 07-13, Revision 7, endorsed in Draft Regulatory Guide DG-1176. The results of the AIA show that the modified ABWR design described in the STPNOC application meets the acceptance criteria of the AIA rule by maintaining core cooling and integrity of the spent fuel pool.

The key design features identified by STPNOC to satisfy the requirements of 10 CFR 50.150 include: the primary containment structure; arrangement and design of the control, turbine, and reactor building structures; design and location of the spent fuel pool; physical separation of Class 1E emergency diesel generators; pressure-rated and non-pressure rated fire barriers; physical separation and design of the emergency core cooling systems; design of the containment overpressure protection system; and the AFI system.

Guided by the results of the AIA, the changes made to the certified ABWR design include: the addition of the AFI system and associated auxiliaries; addition of barriers at six large openings in the reactor building; addition or upgrades to 16 fire/watertight doors in the reactor building; definition of the structural characteristics of exterior and four interior walls on two floors in the reactor building; replacement of two gratings with concrete hatches; and enhancement of all three-hour fire barriers, including piping penetration seals, to a rating of 5 psid. The staff's review concluded that these changes will have no adverse impacts on conclusions reached in their review of the original ABWR design certification. We agree.

The AFI system provides an alternate means of water injection in the reactor pressure vessel (RPV). The AFI system has a dedicated high pressure pump sized to remove decay heat based on scram from full power. The AFI pump is installed in and can be started from a pump room located outside the strike-affected zone. The water source for the AFI system is also located outside the strike-affected zone. The water supply capacity for the AFI system is sufficient to remove decay heat by evaporation for nearly 24 hours. Piping from the AFI system is routed underground and is protected from damage by the aircraft impact. Water is injected into the feedwater lines and the tie-in points are in the steam tunnel. A reliable AC power supply, not affected by the aircraft impact, is to be provided for the pump. Additionally, a dedicated DC power supply is provided in the AFI pump room.

Since existing instrumentation may fail due to fires in the reactor building and control building, a shock-mounted AFI instrument rack has been added in a fire-protected area of the reactor building. A minimal set of instrumentation with a read-out in the AFI pump room is provided to allow the AFI system operator to monitor the RPV water level, RPV pressure, containment pressure, and suppression pool level. The instrument lines from the primary containment penetrations to the instrument rack are protected from plane wreckage and other debris by barriers. Power to the rack is provided from the AFI pump room so it is also protected from an aircraft impact.

[

] A limited set of operator actions is required to start the AFI system and control the RPV water level from the AFI pump room.

The analyses presented by the applicant demonstrate that for all of the assumed aircraft strike locations, core cooling will be maintained. A detailed structural analysis shows that even when limited credit is taken for the reactor building walls, the primary containment walls will not be perforated. [

] For the other strike scenarios, the AFI system is required to provide adequate core cooling. Analyses show that by placing the AFI system in service within 30 minutes of event initiation, the RPV water level can be maintained well above the top of active fuel. Since the core does not uncover, no fuel damage is expected. Removal

of decay heat is accomplished by discharging steam through the RPV safety relief valves (SRVs) to the suppression pool. As the suppression pool gradually heats up, the primary containment pressure rises reaching the Containment Overpressure Protection System (COPS) setpoint (90 psig) within 20 hours of event initiation. The COPS automatically relieves the containment overpressure by venting the wetwell. The COPS relief capacity is well in excess of the core boil-off rate when the COPS setpoint is reached.

The spent fuel pool is located entirely within the reactor building. All pipes are configured to prevent drainage below the minimum water level. Structural analyses performed by the applicant show that for all of the assumed strike scenarios, without accounting for the reactor building exterior walls, the spent fuel pool liner will not be perforated, and the integrity of the spent fuel pool and its support structures will be maintained.

Based on the analyses performed by the applicant, we conclude that the enhanced ABWR design described in the STPNOC application will meet the acceptance criteria specified in 10 CFR 50.150 by maintaining core cooling and spent fuel pool integrity. However, several assumptions were made in the analyses because of insufficient design detail. For example, the original ABWR DCD does not specify routing of electrical cables. However, the AIA assumes that cable routing maintains divisional separation thereby limiting the damage resulting from different strike scenarios. It is therefore necessary to ensure that the assumptions and initial conditions credited in the applicant's AIA are properly incorporated into the amended DCD.

The AFI instrument rack is located in a fire-protected area of the reactor building. Guided by the results of the AIA, fire doors have been upgraded to prevent the spread of fire in that area. However, the AIA does not include an analysis to estimate the maximum temperature within that area, if it were to be surrounded by fire. It is necessary that such an analysis be performed and documented in the AIA to demonstrate that the conditions in which the AFI instruments may operate following an aircraft impact are consistent with their environmental qualification conditions.

The impact of a large, commercial aircraft is a beyond-design-basis event so that both safety and non-safety related structures, systems and components may be credited in the realistic assessment to address the AIA rule. The AFI system specified in the amendment is a non-safety system; all tie-ins to the AFI system are also non-safety related. There are no technical specifications associated with the AFI system. Considering the importance of the AFI system [ ] the system must be reliable. The staff should ensure that COL applicants referencing this amendment have an appropriate process to assure the reliability of the AFI system.

The staff performed a thorough inspection of the applicant's AIA. The same headquarters personnel involved in the review of the application were also involved in the inspection. Maintaining the same personnel with the high level skill sets in the review of the application and the inspection significantly enhances the quality of the review process. We commend the staff for this action.

The staff's inspection report noted that NEI 07-13, Revision 7 is silent on specific characteristics of the fire barrier configuration such as the separation distance and pressure dissipation. Additionally, NEI 07-13, Revision 7 discusses the effect of an impact on the polar crane but not the gantry crane. These were among the deficiencies identified in the Notice of Violation. The staff's inspection report also noted that NEI 07-13, Revision 7 was not intended to be an all

inclusive instruction and the fact that it is silent in some areas cannot be considered justification for excluding those areas from the scope of the AIA. Therefore, it is important for the staff to identify any deficiencies in IP 37804 and the AIA methodology prescribed in NEI 07-13, Revision 7. The staff has initiated a lessons-learned review of this application to identify such deficiencies. This review should be completed in a timely fashion so that the resolution of such deficiencies can be communicated to the industry and incorporated into the staff's future reviews.

The STPNOC application to amend the ABWR design certification rule and the staff's SER are acceptable subject to satisfactory closure of issues related to the Notice of Violation and our Recommendation 2.

Sincerely,

*/RA/*

Said Abdel-Khalik  
Chairman

References:

1. Memorandum to Edwin M. Hackett, Advanced Final Safety Evaluation Report Regarding the Advanced Boiling Water Reactor Design Certification Review, 07/19/2010 (ML102000599)
2. Letter to Scott M. Head, South Texas Project Nuclear Operating Company Aircraft Impact Assessment Inspection, NRC Inspection Report No. 05200001/2010-202 and Notice of Violation, 08/13/2010 (ML102100218)
3. Federal Register Notice (74 FR 28112), "Aircraft Impact Assessment Rule Consideration of Aircraft Impacts for New Nuclear Power Reactors," 06/12/2009
4. Draft Regulatory Guide DG 1176, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," 07/31/2009 (ML073170252)
5. NEI 07-13, Revision 7, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," 05/31/2009 (ML093570239)
6. Inspection procedure IP 37804, "Aircraft Impact Assessment," 04/27/2010 (ML100680701)
7. Letter to Chairman Jaczko, Draft Final Regulatory Guide 1.217, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," 02/18/2010 (ML100470861)

Revision 7. The staff has initiated a lessons-learned review of this application to identify such deficiencies. This review should be completed in a timely fashion so that the resolution of such deficiencies can be communicated to the industry and incorporated into the staff's future reviews.

The STPNOC application to amend the ABWR design certification rule and the staff's SER are acceptable subject to satisfactory closure of issues related to the Notice of Violation and our Recommendation 2.

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Said Abdel-Khalik  
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Letter to the Honorable Gregory B Jaczko, Chairman, NRC, from Said Abdel-Khalik, Chairman, ACRS, dated September 20, 2010

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