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

January 15, 2008

MEMORANDUM TO: S. Abdel-Khalik, Chairman, ABWR Subcommittee

FROM: Maitri Banerjee, Senior Staff Engineer, ACRS **\RA**

SUBJECT: THE MINUTES OF THE MEETING OF THE SUBCOMMITTEE ON ABWR REGARDING INFORMATION BRIEFING ON CERTIFIED DESIGN, PROPOSED DESIGN CHANGES, AND LEAD PLANT APPLICATION ON DECEMBER 5, 2007, IN ROCKVILLE, MARYLAND

A working copy of the minutes for the subject meeting is attached for your review. Please review and comment on them at your earliest convenience. If you are satisfied with these minutes please sign, date, and return the attached certification letter.

Attachments: Certification Letter
Minutes

cc w Attachments: ACRS Members

cc w/o Attachments: F. Gillespie
C. Santos
S. Duraiswami
A. Dias
J. Delgado

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MEMORANDUM TO: Maitri Banerjee, Senior Staff Engineer, ACRS

FROM: S. Abdel-Khalik, Chairman, ABWR Subcommittee

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I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on December 5, 2007, are an accurate record of the proceedings for that meeting.

\RA **1/16/2008**
S. Abdel-Khalik, Date
ABWR Subcommittee Chairman

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE MEETING OF THE SUBCOMMITTEE ON ABWR REGARDING
INFORMATION BRIEFING ON CERTIFIED DESIGN, PROPOSED DESIGN CHANGES, AND
LEAD PLANT APPLICATION ON DECEMBER 5, 2007,
IN ROCKVILLE, MARYLAND

On December 5, 2007, the ACRS Subcommittee on Advanced Boiling Water Reactor (ABWR) held a meeting in Room T-2B3, 11545 Rockville Pike, Rockville, Maryland. The purpose of the meeting was to receive an information briefing from the staff and General Electric Hitachi Company (GEH) regarding the ABWR design, the proposed changes to the design, and the lead plant application from the South Texas Project (STP). The meeting was convened at 12:30 p.m. and adjourned around 4:30 p.m. The meeting was open to the public. No written comments or requests to make oral statements were received from the public related to this meeting.

Attendees:

ACRS Members	**ACNW&M Members**	**NRC Staff Presenters**
Said Abdel-Khalik (Chairman)	Michael Ryan	M. Tonacci, NRO
Otto Maynard	Ruth Weiner	**NRC Staff**
William Shack	James Clarke	Mike Gartman
Michael Corradini	Allen Croff	Jerry Wilson
J. Sam Armijo	**ACRS Staff**	Don Dube
Jack Sieber	Maitri Banerjee (DFO)	Mike Eudy
Mario Bonaca	**GEH Presenters**	**Public/Other**
	Dennis Henneke	Alan Levin (Areva)
	J. Alan Beard	Altheia Wyche (Bechtel)
	Joe Savage	Brad Maurer (Westinghouse)

The presentation slides and handouts used during the meeting are attached to the Office Copy of these minutes. The presentation to the Subcommittee is summarized below.

Chairman Abdel-Khalik convened the meeting by introducing the ACRS and ACNW&M members present. Dr. Abdel-Khalik stated that the purpose of the meeting was to receive an information briefing from the staff and the industry to prepare the Subcommittee to review the ABWR Combined Operating License application (COLA). He then called upon the NRO Project Manager, Mark Tonacci, to begin the staff presentation.

Mr. Tonacci introduced the NRC staff and management, and the GEH presenters. He noted the COLA jointly submitted by the NRG Energy and South Texas Project (STP) on September 24, 2007 was for a dual unit ABWR at the STP site where two Westinghouse units currently operate. After a short description of the chronology of events and the licensing process, he turned over the presentation to GEH. The members were interested about finality of the NRC

staff's safety evaluation (SE) on the recently submitted licensing topical reports (LTR). These LTRs provide for certain COL specific supplemental information and certain departures from the certified ABWR design. Mr. Tonacci clarified that the LTR SEs could be challenged during the STP COLA review (provided it referenced those LTRs) as without rulemaking the LTR SEs do not have finality like the certified design. As no other entity has come forward with an intent to make a second ABWR COLA submittal, the staff has no plans at this time to incorporate the LTRs by amending the design certification rule (revision 4 of the design) codified in 10 CFR Part 52 Appendix A. However, once the STP is issued a COL, the STP licensing process approves the departures which reference the LTRs as part of the application, and the COL has finality. A second applicant may reference the STP COL (if Appendix A is not amended) and take the same departures and justify why the departures are applicable. Although, the LTRs themselves do not have finality, a precedent for acceptability and approval of the departures that reference the LTRs has been established with the reference COL.

Upon member's question, Mr. Savage explained that STP has contracted Toshiba to provide the engineering, procurement and construction support (although GE submitted the ABWR design that was certified in 1997). GE and Hitachi combined to form a new unified company GEH that has been supporting review of the LTRs and the COLA, and contract negotiations are currently taking place between the Companies regarding vendor support.

Mr. Alan Beard began the GEH presentation by describing the evolution of the BWR design, the main features of the ABWR that are different from the current BWR fleet, improvements being made to the certified ABWR design that included departures, site specific design elements, and over 40 years of operating experience in Japan that resulted in some changes to the certified design. Although, the ABWR was designed with SI units (the modern metric system of measurement), STP has an option of selecting between the SI or English units or both, for example, for the control room instrumentation and display. He also mentioned that the operating experience of four ABWR units in Japan indicate very few unplanned scrams. Although the Japanese ABWRs are built with seismic scram (because of higher susceptibility of earthquake), that is not a feature in the US design.

Because of members' interest, Mr. Beard also pointed out some of the differences of the ABWR design (active) from that of the more recent ESBWR (passive) design. He also discussed the general arrangement of the main buildings and areas that provide for separation between the safety divisions. Regarding one of the many improvements in the ABWR compared to a BWR, the reactor internal pumps (RIPs) that replace the external recirculation pumps are designed for their environment, and reportedly, require very little maintenance. The members were interested to know how the RIPs are accessed and removed for maintenance purposes. Also, the steam dryers and separators are of improved design from the operating fleet of BWRs.

Mr. Beard described the ECCS improvements made in the ABWR design that ensures core submergence for analyzed conditions. The design is automated to the extent that no operator action is required for the first 72 hours after an accident. Three divisions of ECCS (both high and low pressure) are housed in three completely separate areas with reinforced concrete walls and qualified fire doors and seals (three hour rated in lieu of 20 feet physical separation allowed for currently operating plants). The HVAC systems are designed to prevent propagation of smoke to other areas due to fire in one area. For almost all of the transients and accidents, the ECCS has an N–2 capability (except for a break that disables RCIC). Three emergency diesel generators are similarly housed separated inside the reactor building.

Dr. Shack asked about the SBO capability. The ABWR design provides for an alternate AC power from a large (20 MWe, non-seismic) combustion turbine generator (CTG) that would auto-start with manual alignment to failed buses. Additionally, the steam driven RCIC provides for eight hour worth of SBO capability. Mr. Beard described the electrical system lineup as members were interested to know how the design avoids the CTG and the emergency diesels (EDGs) picking up the same load groups. Mr. Beard then described the RCIC system modifications, and how a consolidated monobloc pump/turbine unit with variable speed/flow control (with operator intervention) could eliminate pump cycling during a transient. The ACRS members had several questions on the RCIC system regarding pump speed/flow control and GEH committed to provide the answers following the meeting. To minimize debris and corrosion products in the suppression pool and hence the concern about loss of ECCS pump suction pressure, the normally wetted surface of the pool is stainless steel clad. The N-2 capability at high pressure reduces challenges to ADS which incorporates improved safety relief valves from the Japanese design. Upon Chairman Abdel-Khalik's questions, Mr. Beard stated that a turbine trip without bypass is the limiting pressurization transient for these valves, sizing of which is based on ATWS mitigation and not the steam bypass capacity.

Mr. Beard described the improved and automated ATWS mitigation features and the ABWR passive features that mitigate severe accidents. The members asked many exploratory questions regarding the design features and operational conditions. In case of a core melt accident, eight thermally activated fusible valves would open to provide cooling water from the suppression pool to the corium on the basaltic concrete floor with freeze channels underneath the reactor. He also described the features that would provide containment overpressure protection, scrubbing and retention of fission products. The potential for steam explosion was addressed (note: it was also a question from the ACRS during the certification review). Although the certified design (Revision 4) includes an inerted containment and hydrogen recombiners, GEH submitted an LTR that proposed to remove the recombiners based on the changes to the NRC's combustible gas control regulation. The presentation also included the electrical and the support systems, their design bases and proposed changes to the certified design.

Mr. Dennis Henneke of GEH presented an overview of the ABWR probabilistic risk assessment (PRA). He supports the fire PRA writing group as its Chairman. He indicated that the PRA insights were factored into the ABWR design. The design PRA provides for a bounding analysis for pretty much every site in the US with considerable conservatism (e.g., in large LOCA frequency) such that there is room for the core damage frequency (CDF) number to go down once more realistic site specific information is used. Using a PRA early in the design process provides for maximum safety benefit as it is easier and more cost effective to make the recommended changes at that stage. The ABWR PRA considers the internal and external events, internal flood, fire, seismic, full power and shutdown. The PRA is level 3 for at-power internal events only. Some of the external events were addressed via screening (e.g., fire) or margin analysis (e.g., seismic). When the seismic margin analysis is developed into a seismic PRA, GEH expects to show capability above 0.6g. A screening analysis was performed for STP using site-specific supplemental information. As required by regulations, STP will submit an updated PRA to meet the standards before fuel load.

Mr. Henneke discussed the design improvements and procedure guidance that resulted from PRA considerations and design features that lower risk. Some of the design and procedure improvements made to the STP from PRA insights include a single switch to backup an EDG with the CTG to lower SBO risk, manual operation of some critical motor operated valves to

enhance the plant's seismic response, improved capability of the ADS, and additional level instruments in the control building to isolate piping for internal flood mitigation.

Dr. Bonaca questioned how the 15 year old design certification PRA will be updated and the impact of improvements in design and operation. He was also concerned that large conservatism in some areas may mask some PRA outcomes. Mr. Henneke indicated that there is no plan to update the design certification PRA as any change, even to update to today's technology, will be considered a departure. However, as the COL applicants update their PRA before fuel load it will also include the technology updates, e.g., the common cause failure, to meet the current standards. He mentioned that the recent Lungmen (Taiwan) PRA resulted in a comparable overall risk number to the design certification PRA. Although, the impact from human factors related update is expected to be minimal, the common cause failure consideration is expected to have a measurable effect.

Mr. Henneke showed the pie chart with components the comprise the total overall CDF number. This number is expected to increase slightly and be around 2.5E minus 7 after considering the STP site specifics and some generic departures. Mr. Henneke also explained how the overall CDF number decreased for SBO after incorporating current data that modified recovery time and frequency for loss of offsite power. However, as the current data indicate an increase of the recovery time estimate, risk associated with events greater than eight hours recovery time has gone up. Dr. Corradini wanted to know if considerations for seismic events could impact the CDF pie chart. The answer was that for STP, given the large seismic margin, it is not expected to have much of an impact.

Mr. Henneke discussed the major elements of the reliability assurance program which uses the PRA results to determine the appropriate reliability and maintenance actions. For example, for STP, PRA considerations resulted in the requirements for early reservoir break detection and closure of the control room door to lower the risk of core damage from external flooding.

The PRA consideration was part of the development of the departures including the ones in the LTRs. In Mr. Savage's discussion of the ABWR licensing overview, he discussed the departures the STP COLA is taking from the certified design and their impact on the CDF number. Some of these departures are site specific (e.g., site parameters, ultimate heat sink), some are improvements based on industry experience, initiatives and technology. Upon member's questions, he stated how defense in depth was addressed in the instrumentation and controls (I&C) design with respect to diversity and consideration for common cause failures. In the certified design, to address common cause failures, certain hardwired capability will be provided for scram initiation, MSIV closure, high pressure core flooder initiation. Further discussions included diversity in algorithm, failure modes, functional separation, and instrument response time.

Mr. Savage discussed the reasons for the departures the STP COLA is taking, the desired outcome and benefits. These included the new SRV designs and setpoint methodology, miscellaneous changes to RPS control system and logic, safety related trip of the condensate pumps upon a feedwater line break, additional division of I&C power, major updates to computer based controls due to obsolescence, design impact from site features and parameters, and elimination of hardware in RCIC monobloc pump/turbine design among others. The accident analyses and technical specification impacts were also evaluated before deciding on the departures. He also mentioned the Tier 2 changes, technical specification form, format and bases control related changes. Although the design is for a 60 year life, the regulations

allow applying for an operating license for only 40 years. He also discussed the LTRs submitted by GEH for NRC review that are referenced in the STP COLA. Mr. Savage was closing his presentation by stating that many years of US and foreign operating experience has been factored into the design and departures, when a discussion ensued regarding the similarity between the certified design, and Japanese and Lungmen designs. At that point, chairman Abdel-Khalik called upon Mr. Tonacci, the NRO Project Manager, to start his presentation.

Mr. Tonacci mentioned that STP would be the reference plant for any future ABWR COLAs but at present there is only one ABWR applicant (the STP). GEH may in the future apply to get the design certification revised (future Rev. 5) to incorporate the generic departures (including the LTRs). The members asked how does a subsequent plant use a reference plant's COL and is it challengeable or does it have finality? Subsequent to the meeting the staff responded that a subsequent plant's application (SCOL) may use information from the reference plant's application (RCOL). However, there is no incorporation by reference by the SCOL of RCOL material. Any departures from information in the DCD must be addressed. For operational programs which may not be described in the DCD, the SCOL may place the same material in their application as was used in the RCOL. The benefit for the SCOL is that the staff has already seen and approved the material once, so there is an efficiency gain and there is precedent set in the approval. However, there is no finality and the departures and other information that were approved for the RCOL may be challenged during the review of the SCOL.

Regarding the schedule of the staff's LTR review, as most of them were submitted many months prior to the STP COLA, the review is running ahead of the COLA, although there are a few LTRs which will be reviewed simultaneously. The staff safety evaluation on some of the LTRs are expected to be completed by the first quarter of 2008 and provided to ACRS for review, although this schedule appeared to be somewhat flexible. (Subsequent to the meeting additional information was provided that the LTRs will not be coming to ACRS in the first quarter). The STP COLA references these LTRs, hence ACRS will have an opportunity to review the LTR application with the STP COLA review also. The staff planned for two rounds of ACRS review of the STP COLA, one at the draft SER with open items stage and the other one after the open items are closed. The STP COLA was docketed, but the staff could not provide a review schedule with the docket letter because of need for additional information.

Mr. Tonacci discussed the information items a COLA must address. These are items left open in the design certification due to the nature of the information that would not be available until one finalizes the design details. GEH attempted to address them in some LTRs as much as possible based on the Japanese plant design and experience. However, one of the four closure options allowed in the Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants," may be used if the information item cannot be closed when the application is submitted. These include: using an existing inspections, tests, analyses, and acceptance criteria (ITAAC); proposing a new ITAAC; proposing a license condition; or the applicant's commitment for future action.

Chairman Abdel-Khalik then proceeded to ask the members for their comments or any remaining questions. The current ACRS members, who were not involved with the original design certification in the mid 1990s, stated the presentation by GEH and the staff was very helpful. The importance of planning the ACRS review of the LTRs and the COLA for streamlining and improving its efficiency was also mentioned. Dr. Clarke from ACNW&M thanked the ACRS for inviting the ACNW&M members to the meeting. Chairman Abdel-Khalik

adjourned the meeting by thanking GEH and the staff for their presentation.