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Your ref: Docket Number 52-006
Our ref: DCP/NRC2084

February 8, 2008

Subject: AP1000 COL Responses to Requests for Additional Information (TR 101)

In support of Combined License application pre-application activities, Westinghouse is submitting responses to the NRC requests for additional information (RAIs) on AP1000 Standard Combined License Technical Report 101, APP-GW-GLR-101, "AP1000 PRA Evaluation of External Events". These RAI responses are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Revised responses are provided for RAI-TR101-SPLA-03 and -06 as discussed in a teleconference between NRC (Bill Gleaves) and Westinghouse (Sam Adams) on December 10, 2007. These responses complete all requests received to date for Technical Report 101. Revision 0 responses for RAI-TR101-SPLA-01 through -08 were submitted under Westinghouse letter DCP/NRC2026 dated October 19, 2007.

Pursuant to 10 CFR 50.30(b), the responses to the requests for additional information on Technical Report 101 are submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of these responses should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

A. Sterdis, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

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NRO

/Attachment

1. "Oath of Affirmation," dated February 8, 2008

/Enclosure

1. Responses to Requests for Additional Information on Technical Report No. 101

cc:	D. Jaffe	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	P. Ray	-	TVA	1E	1A
	P. Hastings	-	Duke Energy	1E	1A
	R. Kitchen	-	Progress Energy	1E	1A
	A. Monroe	-	SCANA	1E	1A
	J. Wilkinson	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	R. Grumbir	-	NuStart	1E	1A
	R. Anderson	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:)

AP1000 Design Certification Amendment Application)

NRC Docket Number 52-006)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL COMBINED LICENSE INFORMATION"
FOR DESIGN CERTIFICATION AMENDMENT APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 8th day
of February 2008.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Notary Public

ENCLOSURE 1

Responses to Requests for Additional Information on Technical Report No. 101

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR101-SPLA-03
Revision: 1

Question:

Original RAI received 9/7/07:
The external events considered for evaluation are listed in page 5 of the submitted Technical Report. This list does not include external fires. It is stated that the list was based on guidelines provided in NUREG-1407, Procedures and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, June 1991 (Reference 5). However, NUREG-1407 states that "*...the [potential]... effects of external fires, other than loss of offsite power, have been evaluated during operating license (OL) review against sufficiently conservative criteria...*" Please verify that such a review is applicable to all sites interested in the AP1000 design and list the AP1000 design-specific features and site characteristics that make the risk from external fires to be insignificant.

Clarification to question received 12/10/2007:
In RAI-TR101-SPLA-03, we requested W. verify that the potential effects of external fires, other than loss of offsite power, be evaluated and reviewed during the COL application phase against sufficiently conservative criteria (stated in Chapter 2 of the DCD) to justify not performing a risk assessment of external fires. Westinghouse responded that "Per Chapter 58 of the NRC approved AP1000 PRA and DCD Chapter 19, external fires are not required to be evaluated in the AP1000 PRA." However, we have never approved every statement in the PRA and the DCD Chapter 19 section, related to external hazards, is blank in Rev 15. In addition, COL action item 19.59.10-2 requires that the COL applicant re-evaluates the quantitative screening of external events based on site specific information.

Furthermore, Section 2.2 of the AP1000 DCD (Site Characteristics) requires the COL applicant to perform analyses of site specific hazards and design changes will be required if it is found that the frequency of a hazard leading to severe consequences is greater than 1E-6/yr. Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of a hazard is less than 1E-7/yr.

Westinghouse Response:

The purpose of TR-101 is to resolve COL Item 19.59.10-2, as documented in Chapter 19 of Reference 1. This COL item states: "Based on site-specific information, the COL should also reevaluate the qualitative screening of external events (PRA Section 58.1). If any site-specific susceptibilities are found, the PRA should be updated to include the applicable external event." AP1000 Chapter 58.1 of Reference 2 provides a list of five external events that are included for AP1000 analysis:

- High winds and tornadoes
- External floods
- Transportation and nearby facility accidents
- Seismic events
- Internal fires

The first three external events, High Winds and Tornados, External Floods, and Transportation and Nearby Facility Accidents, are addressed in TR-101. Seismic events are addressed in Chapter 55 of Reference 2, and internal fires are addressed in Chapter 57 of Reference 2.

The TR-101 analysis will be modified to address the effects of external fires. Based on site specific information, the COL should reevaluate the qualitative screening of external fires. Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of a hazard is less than 1E-7/yr. If any site specific susceptibilities are found, the site specific PRA performed to address COL Holder Item 19.59.10-2 should include external fires.

References:

1. APP-GW-GL-700, "AP1000 Design Control Document", Revision 16.

2. APP-GW-GL-022, "AP1000 Probabilistic Risk Assessment", Revision 5.

Design Control Document (DCD) Revision:

Revise section 19.58.1 of the DCD as follows

19.58.1 Introduction

External events considered in the AP1000 PRA are those events whose cause is external to all systems associated with normal and emergency operations situations. Some external events may not pose a significant threat of a severe accident. Some external events are considered at the design stage and have a sufficiently low contribution to core damage frequency or plant risk.
Based upon the guidelines provided in References 19.58-1 and 19.58-2, the following is a list of ~~five~~ six external events that are included for AP1000 analysis:

- High winds and tornadoes
- External floods
- Transportation and nearby facility accidents
- Seismic events
- Internal fires
- External fires

The first three external events are addressed in this section. Seismic events and internal fires are addressed in the AP1000 PRA. Based on site specific information, the COL applicant should reevaluate the qualitative screening of external fires. Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of a hazard is less than 1E-7/yr. If any site specific susceptibilities are found, the site specific PRA performed to address COL Holder Item 19.59.10-2 should include external fires.
Chapter 2 defines the site characteristics for which the AP1000 is designed. A site is acceptable if the site characteristics fall within the AP1000 site interface parameters.

Revise section 19.58.3 of the DCD as follows

19.58.3 Conclusion

The risk due to external hazards is low for the AP1000 design for the participating sites listed in Section 3.2. The AP1000 design is shown to be highly robust against the external events discussed in this section. The design is resilient against high winds, external floods, and other external events that challenge various equipment in the plant.

Based on site specific information, the COL applicant should reevaluate the qualitative screening of external fires. Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of a hazard is less than 1E-7/yr. If any site specific susceptibilities are found, the site specific PRA performed to address COL Holder Item 19.59.10-2 should include external fires.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

PRA Revision:
None

Technical Report (TR) Revision:

Revise the last paragraph of section 2.0 on page 6 in the TR revision 1 as follows:

~~Per Chapter 58 of the NRC approved AP1000 PRA and DCD Chapter 19, external fires are not required to be evaluated in the AP1000 PRA.~~ External fires are those occurring outside the plant site boundary. Potential effects on the plant could be loss of offsite power and forced isolation of the plant ventilation and possible control room evacuation. Usually, external fires are unable to spread onsite because of site clearing during the construction phase. ~~NUREG-1407 notes that because the loss-of-offsite power is addressed in the Individual Plant Examination (IPE), it does not need to be reevaluated for Individual Plant Examination of External Events (IPEEE).~~ As it relates to the AP1000 design, loss-of-offsite power was evaluated in the AP1000 internal events PRA. Loss-of-offsite power contributes less than 1% to the AP1000 plant core damage frequency. All additional potential consequences of external fires is at this time judged to be low. Based on site specific information, the COL applicant should reevaluate the qualitative screening of external fires (PRA Section 58.1). Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of external fires is less than 1E-7/yr. If any site specific susceptibilities are found, the site specific PRA performed to address COL Holder Item 19.59.10-2 should include external fires. ~~External fires do not need to be evaluated further as their contribution to core damage frequency is expected to be less than 1% of the total AP1000 plant CDF.~~

Revise the third paragraph, second item of section 7.0 on page 20 in the TR revision 1 as follows:

2. The AP1000 is designed to flooding levels described in Chapter 2 of the DCD. The site selection criterion provides that, for an accident that has potential consequences serious enough to affect the safety of the plant to the extent that 10 CFR 100 guidelines are exceeded, the annual frequency of occurrence is less than 1.0E-06 per year. This criterion should be extended to an annual frequency of occurrence less than 1.0E-07 per year. ~~No further analysis is suggested.~~ Accordingly, based on the criteria used to screen out external hazards in the PRA, a risk evaluation should be performed if it cannot be demonstrated that the frequency of external fires is less than 1E-7/yr. If any site specific susceptibilities are found, the site specific PRA performed to address COL Holder Item 19.59.10-2 should include external fires.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR101-SPLA-06
Revision: 1

Question:

Original RAI received 9/7/07:
It is stated (pages 11 and 23) that engineering judgment was used to establish that the frequency of generating a storm surge of 18 feet is less than 1E-7 per year. Please explain the basis for this estimate. Also, please define and explain the relationship between the various heights (100, 45 and 18 feet) listed in the submittal and how were they used in the analysis to show that the flooding frequency is less than 1E-7 per year (refer to parameters in DCD Chapter 2 , as necessary).

Clarification to question received 12/10/2007:
The response to RAI-TR101-SPLA-06 (on external flooding) states that "Based on the description of a Category 5 hurricane.....a hurricane storm surge in excess of 18 feet may be classified as an extremely rare event. The ASME has recently approved changes to the ASME PRA Standard to assign a value to an "extremely rare event". That value is defined as1E-6/yr for currently operating plants. Recognizing that the AP1000 design provides additional levels of safety, TR-101 suggests a value of 1E-7/yr to define an extremely rare event for the AP1000 design." There are several "weak" points in this justification. First, a Category 5 hurricane (see APP-GW-GLR-101 Rev 1, page 8 of 65) is described as a "Storm surge generally greater than 18 ft above normal..." Second, the limiting frequency of a Category 5 hurricane (see Table 3.0-1 of APP-GW-GLR-101 Rev 1, page 11 of 65) is listed as 1E-2/yr, which is far from an extremely rare event. Third, the frequency of an event does not depend on "the levels of safety" of a design.

Westinghouse Response:

Of the surveyed sites, only one site indicated susceptibility to external floods. This site indicated potential susceptibility to hurricane storm surges. Note that it is the responsibility of the COL applicant to defend their own event applicability evaluation.

The AP1000 is protected against floods up to the 100' level. The 100' level corresponds to the plant ground level. From this point, the ground is graded away from the structures. Thus, water will naturally flow away from the structures. Additionally, all seismic Category I SSCs are designed to withstand the effects of flooding. The seismic Category I SSCs below grade (below ground level) are protected against flooding by a water barrier consisting of waterstops and a waterproofing system. None of the non-safety SSCs were found to be important based on flooding considerations (Reference 1, Section 3.4.1.1).

The Saffir-Simpson hurricane scale notes that Category 5 hurricanes have the ability to generate storm surges in excess of 18 feet. Hurricane Camille (1969) generated a storm surge of 25 feet along the Mississippi Gulf Coast (Reference 2a). According to the NOAA National Hurricane Center, Reference 2b, the Katrina (2005) storm surge levels exceeded the record of hurricane Camille. During Katrina, many of the local area tide gauges were destroyed, making it difficult to get accurate storm surge estimates, however, NOAA's storm surge model predicted during the storm that Katrina's storm surge could reach 18 to 22 feet above normal tide levels, locally as high as 28 feet. Reference 2c confirms (one year after the storm) that the the maximum high water mark observation of the Katrina storm surge was 27.8 ft at Pass Christian, on the immediate Gulf coast just east of St. Louis Bay breaking the previous storm surge record of Camille(1969).

Based on historical information, a hurricane storm surge in excess of 28 feet may be classified as an extremely rare event. The ASME has recently approved changes to the ASME PRA Standard to assign a value to an "extremely rare event". TR-101 suggests a value of 1E-07 /year to define an extremely rare event for the AP1000 design.

The site described in the first paragraph is located at an elevation of 45' above sea level. Therefore, the AP1000 100' level, for this site, corresponds to 45' above sea level. Per DCD Section 3.4.1.1, the ground will be graded away from the structures beginning at the 100' level and sloping downward away from the structures. Thus for the potential AP1000 sites surveyed no further analysis is needed.

TR-101 Revision 1 will be revised to clarify the discussion.

References:

1. APP-GW-GL-700, "AP1000 Design Control Document", Revision 16.

2. 2a. NOAA - National Weather Service National Hurricane Center, "The Saffir-Simpson Hurricane Scale", June 22, 2006, Available: http://www.nhc.noaa.gov/aboutsshs.shtml.

   2b. NOAA Home Page - NOAA Magazine Online (Story 178), "STORM SURGE: A "RISING" CONCERN AMONG COASTAL RESIDENTS", Available: http://www.magazine.noaa.gov/stories/mag178.htm.

   2c. NOAA - National Weather Service National Hurricane Center: Richard D. Knabb, Jamie R. Rhome, and Daniel P. Brown, "Tropical Cyclone Report - Hurricane Katrina", Updated 10 August 2006 for tropical wave history, storm surge, to access use Katrina link at Reference 2 online link (http://www.nhc.noaa.gov/aboutsshs.shtml).

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:
Revise the fourth paragraph of DCD section 19.58.2.2 as follows:

Category 5 hurricanes, per the Saffir-Simpson scale, are capable of storm surges greater than 18 feet. The storm surge of record for a hurricane is 27.8 feet recorded for Katrina (2005). Based on historical information, a hurricane storm surge above the 28 foot level may be classified as an extremely rare event. ~~However, the probability of generating a storm surge of 18 feet, combined with the frequency of a Category 5 hurricane, results in a small event frequency. Even conservatively assuming a storm surge of 18 feet, the frequency of an event capable of generating this storm surge is small.~~ Engineering judgment is used to establish that the frequency of this type of flood is significantly less than the 10^{-7} per year criterion for initiating event frequency.

PRA Revision:
None

Technical Report (TR) Revision: Revision to TR-101 Revision 1

Revise Section 4.0 in TR-101 revision 1 as follows:

An external flooding analysis was performed to account for any significant contribution to core damage frequency resulting from plant damage caused by storms, dam failure, and flash floods.

The analysis for External Floods begins with an examination of the Design Basis for the plant, which is documented in Section 2.0 of the AP1000 DCD (Reference 1). The AP1000 is protected against floods up to the 100' level. The 100' level corresponds to the plant ground level. From this point, the ground is graded away from the structures. Thus, water will naturally flow away from the structures. Additionally, all seismic Category I SSCs are designed to withstand the effects of flooding. The seismic Category I SSCs below grade (below ground level) are protected against flooding by a water barrier consisting of waterstops and a waterproofing system. None of the non-safety SSCs were found to be important based on flooding considerations (Reference 1).

Only one site indicated susceptibility to external floods, due to hurricane surge water. That site is located at an elevation of 45 feet above sea level. Therefore, the AP1000 100' level, for this site, corresponds to 45' above sea level. Per DCD Chapter 3.4.1.1, the ground will be graded away from the structures beginning at the 100' level and sloping downward away from the structures.

The Saffir-Simpson hurricane scale notes that Category 5 hurricanes have the ability to generate storm surges in excess of 18 feet. Hurricane Camille (1969) generated a storm surge of 25 feet along the Mississippi Gulf Coast (Reference 7a). The Katrina (2005) storm surge levels exceed the record of hurricane Camille. During Katrina, many of the local area tide gauges were destroyed, making it difficult to get accurate storm surge estimates, however, NOAA's storm surge model predicted during the storm that Katrina's storm surge could reach 18 to 22 feet above normal tide levels, locally as high as 28 feet. Reference 7c confirms (one year

after the storm) that the the maximum high water mark observation of the Katrina storm surge was 27.8 ft at Pass Christian, on the immediate Gulf coast just east of St. Louis Bay breaking the previous storm surge record of Camille (1969).

Based on historical information, ~~the description of a Category 5 hurricane in the Saffir-Simpson hurricane scale,~~ a hurricane storm surge in excess of ~~18~~ 28 feet may be classified as an extremely rare event. TR-101 suggests a value of 1E-07 /year to define an extremely rare event for the AP1000 design.

As a sensitivity study, the 1.0E-07 events/yr initiating event frequency is taken as the frequency of an event that may challenge the non-safety structures in the plant. This sensitivity study also considers failure of the switchyard due to flooding. A LOSP with failure of the non-safety systems CCDP was developed. Equation 1 was used to determine the resultant CDF.

As expected, the risk due to a flooding event is very low for the AP1000. The resultant CDF of 5.85E-15 events/yr is an insignificant contribution to total plant CDF.

For other sites, the AP1000 is designed to site characteristics described in Chapter 2 of the DCD. The site selection criterion provides that, for an accident that has potential consequences serious enough to affect the safety of the plant to the extent that 10 CFR 100 guidelines are exceeded, the annual frequency of occurrence is less than 1.0E-06 per year. As explained in Section 2.0, this criterion should be extended to an annual frequency of occurrence less than 1.0E-07 per year. As none of the surveyed sites indicated susceptibility to floods due to dam failure and/or flash floods, those events should be considered on a site-by-site basis.

Revise Reference 7, Section 8.0 in the TR revision 1 as follows

7. 7a NOAA National Weather Service National Hurricane Center, "The Saffir-Simpson Hurricane Scale", June 22, 2006,
Available: http://www.nhc.noaa.gov/aboutsshs.shtml.

7b. NOAA Home Page - NOAA Magazine Online (Story 178), "STORM SURGE: A "RISING" CONCERN AMONG COASTAL RESIDENTS",
Available: http://www.magazine.noaa.gov/stories/mag178.htm.

7c. NOAA - National Weather Service National Hurricane Center: Richard D. Knabb, Jamie R. Rhome, and Daniel P. Brown, "Tropical Cyclone Report - Hurricane Katrina", Updated 10 August 2006 for tropical wave history, storm surge, to access this data use the Katrina link at Reference 2 online link (http://www.nhc.noaa.gov/aboutsshs.shtml).