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Your ref: Docket No. 52-006
Our ref: DCP_NRC_003005

August 6, 2010

Subject: AP1000 Response to Request for Additional Information (SRP 19)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 19. These RAI responses are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Responses are provided for:

RAI-SRP19F-AIA-01

Enclosure 1 contains sensitive unclassified non-safeguards information relative to the physical protection of an AP1000 Nuclear Power Plant that should be withheld from public disclosure pursuant to 10 CFR 2.390(d). Enclosure 2 provides the redacted version (public version).

Questions or requests for additional information related to the content and preparation of this response 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,

Robert Sisk

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

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NRO

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1. Security Related Information – Withhold Under 10 CFR 2.390
   RAI-SRP19F-AIA-01

2. Redacted Version – Withheld Under 10 CFR 2.390
   RAI-SRP19F-AIA-01

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ENCLOSURE 2

Redacted Version – Withheld Under 10 CFR 2.390

RAI-SRP19F-AIA-01

REDACTED VERSION – WITHHELD UNDER 10 CFR 2.390

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP19F-AIA-01
Revision: 0

Question:

SRI

Westinghouse Response:

SRI

SRI

Design Control Document (DCD) Revision:

For clarity purposes a markup of the complete Appendix 19F has been provided in this response. The response to OI-SRP19F-SPLA-01 sent 03-19-10 modified Appendix 19F from DCD Revision 17; the markup below is made on this modified version.

These changes reflect the responses in RAI-SRP19F-AIA-01 to RAI-SRP19F-AIA-10.

To assist in the review, a second version of Appendix 19F is provided showing all changes accepted.

APPENDIX 19F MALEVOLENT AIRCRAFT IMPACT

19F.1 Introduction and Background

A design-specific assessment of the effects on the AP1000 of the beyond design basis impact of a large commercial aircraft has been performed in accordance with 10 CFR 50.150(a) to identify design features and functional capabilities that demonstrate with reduced use of operator actions: (i) the reactor core remains cooled, the containment remains intact, and (ii) spent fuel pool integrity is maintained. The specific assumptions regarding the aircraft impact were based on guidance provided by the NRC and the Nuclear Energy Institute, including the loading function derived from the aircraft impact characteristics for use in assessments of aircraft impact effects.

This appendix describes those design features and functional capabilities identified in the assessment, and discusses how the identified design features and functional capabilities show that with reduced use of operator actions, the reactor core remains cooled and the containment remains intact, and spent fuel pool integrity is maintained. In the following discussion, the identified design features are designated as "key design features."

19F.2 Scope

The evaluation of plant damage caused by the impact of a commercial aircraft is a complex analysis problem involving phenomena associated with structural impact, shock-induced vibration, and fire effects. The assessment of the aircraft impact also considers structural damage, such as that caused by the impact/penetration of hardened components (e.g., engine rotors, landing gear).

An assessment of the effects of aircraft fuselage and wing structure is also performed.

An assessment of the effects of shock-induced vibration on systems, structures, and components is performed.

An assessment of the impact/penetration of hardened aircraft components, such as engine rotors and landing gear is performed.

Perforation of analyzed structural components, including the containment vessel and the spent fuel pool liner, is not predicted; therefore, realistic assessments of the damage to internal systems, structures, and components caused by 1) burning aviation fuel and 2) secondary impacts are not required.

19F.3 Assessment Methodology

Methods described in NEI 07-13, Revision 7 (Reference 1) were followed to assess the effects on the structural integrity of the primary containment and spent fuel pool, and to assess the physical, fire, and vibration effects of the aircraft impact on the core cooling capability of the existing and enhanced design.

19F.4 Results/Conclusions

A detailed aircraft impact assessment was performed for AP1000 in accordance with the guidance in NEI 07-13 (Reference 1). The assessment concludes that an aircraft impact would not inhibit AP1000's core cooling capability, would not impact containment integrity, and would not impact spent fuel pool integrity based on best-estimate calculations.

The assessment resulted in the identification of the following design features and functional capabilities; changes to which are evaluated and reported in accordance with 10 CFR 50.150(d).

19F.4.1 Shield Building and Spent Fuel Pool

The shield building, as described in Chapter 3, is a key design feature for the protection of the safety systems located inside containment from the impact of a large commercial aircraft. The assessment concludes that a strike upon the shield building would not result in perforation of the shield building so damage to the containment vessel would not occur. Therefore, the systems and equipment within the containment vessel are not damaged from the impact or from exposure to jet fuel.

The assessment finds that safety-related components inside containment, including the reactor pressure vessel and passive core cooling system, remain intact and maintain their intended capabilities following the shock-induced vibrations resulting from the impact of a large commercial aircraft based on applying the methodology in Reference 1.

This assessment also concludes that a strike upon the auxiliary building would not result in loss of spent fuel pool liner integrity. Both the structural design of the shield building and the auxiliary building, as described in Chapter 3 are considered key design features.

19F.4.2 Site Arrangement

The assessment credits the design and arrangement of certain building features, depicted in Figures 3.7.2-12 and 3.7.2-19, to limit the effects of a potential aircraft impact on the auxiliary building. These key features are as follows:

- The design of the wall along the south end of the turbine building at column line 11.2, as described in subsection 3.7.2.8.3, is a key design feature for the protection of the auxiliary building from the impact of a large commercial aircraft.
- The design of the wall along the east side of the annex building at column line E, as depicted in Figure 3.7.2-19, is a key design feature for the protection of the auxiliary building from the impact of a large commercial aircraft.

- The design and location of the spent fuel pool in the southern portion of the auxiliary building, as depicted in Figure 3.7.2-12 and described in subsection 9.1.2.2, is a key design feature for the protection of the spent fuel from the effects of an impact of a large commercial aircraft. The spent fuel pool is located in Area 6 of the auxiliary building. The spent fuel pool liner is protected from the east, south, and west by a minimum of 7'-3" of concrete and from the north by the location of the shield building. Therefore, the liner is not impacted and the spent fuel pool integrity is maintained.

- The locations of the main control room (MCR), remote shutdown station, and secondary diverse actuation system (DAS) panel are a key design feature for the protection against the physical and fire damage resulting from the impact of a large commercial aircraft. The detailed aircraft impact assessment shows that an aircraft impact cannot destroy all three of these locations due to the number of barriers associated with these locations. The main control room is located in room 12401, the remote shutdown station is located in room 12303, and the secondary DAS panel is located in Room 12554. The assessment determined that any impact scenario would not destroy all three of these locations, and from any one of these locations passive safety injection and recirculation for long-term core cooling can be initiated.

19F.4.3 Core Cooling and Containment Integrity

If necessary, core cooling can be maintained by actuating the passive safety injection portion of the Passive Core Cooling System (PXS) and Reactor Coolant System (RCS) as described in DCD Section 6.3. The portions of the PXS and RCS required for safety injection are located inside containment and are key design features. Their location protects them from damage due to an aircraft impact because the containment vessel remains intact and has no structural damage. The following valves are key design features and need to actuate for passive safety injection and recirculation for long term core cooling:

- ADS Stage 4 squib valves, RCS-V004A/B/C/D (3 of 4)
- In-Containment Refueling Water Storage Tank injection line squib valves, PXS-V123A/B, PXS-V125A/B (1 of 4)
- Recirculation line squib valves, PXS-V118A/B, PXS-V120A/B (1 of 4)

The steel containment vessel is protected by the shield building and is a key design feature. Based on beyond design basis calculations, the steel containment vessel is not impacted as a result of an aircraft impact on the shield building. If necessary, containment integrity is maintained by portions of the Passive Containment Cooling System (PCS). Containment integrity is maintained via air-only cooling by the passive containment cooling system. As discussed in Chapter 19.40 of the DCD, with air only cooling (without design-basis cooling), containment failure within 24 hours is predicted to be highly unlikely. If the Passive Containment Cooling Water Storage Tank (PCCWST) is lost as a result of an aircraft impact, water can be delivered directly to the water distribution bucket on top of containment from either PCS L027 or PCS L007 as depicted on DCD Figure 6.2.2-1 (Sheet 1 of 2). These two lines are routed separately to the PCS water distribution bucket from either side of containment. The PCS water distribution bucket on top of containment, PCS L027 and PCS L007 are key design features.

If an aircraft impact occurs during shutdown, the limiting mode of operation would be during mid-loop conditions. In this mode of operation reactor coolant is being taken outside of containment and being cooled using the normal residual heat removal system (RNS). The in-containment refueling water storage tank (IRWST) would not yet have been drained. An aircraft strike on the southern portion of the auxiliary building could have the potential to damage portions of the RNS outside of containment. One set of RNS containment isolation valves would need to be closed and the IRWST would need to drain to provide core cooling. The RNS has two sets of containment isolation valves inside containment as depicted on DCD Figure 5.4-7. One set of the following isolation valves would need to be closed to isolate the RNS:

- RNS Inner Containment Isolation Valves, RNS-V001A/B
- RNS Outer Containment Isolation Valves, RNS-V002A/B

These valves can be isolated from the main control room. An aircraft impact that would potentially damage the integrity of the RNS is unlikely to affect the main control room or supporting equipment due to the spatial separation. These RNS valves and the spatial separation between them are a key design feature. The IRWST injection squib valves, as identified above, are also a key design feature during plant shutdown.

19F.4.4 Reactor Trip

The reactor trip equipment is a key design feature. This equipment includes the sensors and manual inputs, protection and safety monitoring system cabinets, and reactor trip switchgear as described in DCD subsection 7.2.1. In the event of an aircraft impact, it is likely that ac power will be lost. On a loss of ac power, the control rods are de-energized and fall by gravity into the reactor core. If ac power is not lost, plant shutdown will be controlled by the intact protection and safety monitoring system or initiated manually from the main control room, remote shutdown room, or the reactor trip switchgear. Additionally, if PMS is not intact as a result of the impact, the reactor trip breakers will open due to undervoltage. This results in the control rods being de-energized and falling into the reactor core. If the reactor trip switchgear or rod drive motor-generator sets are not intact, the rods also are de-energized and fall by gravity into the reactor core.

19F.4.5 Supporting Power, Instrumentation, and Control Equipment

The supporting equipment for the main control room, remote shutdown station, and secondary DAS panel are key design features. These include the class 1E batteries, the supporting PMS control and instrumentation cabinets and cabling for the equipment identified in Section 19F.4.3, the transfer switch to isolate the MCR and transfer controls to the remote shutdown room, and the DAS cabling for the squib valve control cabinet. These key design features enable the actuation of safety injection through operation of the squib valves. The functional capabilities of the secondary DAS panel are described in DCD Section 7.7.1.11and is referred to as the DAS squib valve control cabinet. These key design features are protected by their spatial separation as described in Section 19F.4.2.

19F.4.6 Fire Barriers

The design and location of 3-hour fire barriers within the auxiliary building are key design features for the protection of equipment needed to manually actuate the systems and equipment potentially required for core cooling following the impact of a large commercial aircraft. The assessment credited the design and location of fire barriers (including doors) as described in Appendix 9A to limit the effects of fire damage created by the impact of a large commercial aircraft. Penetrations through specific barriers in the auxiliary building are rated to withstand a differential pressure of 5 psid based on the methodology in Reference 1. These barriers are identified in DCD Section 9.5.1.2.1.1.

19F.5 References

1. NEI 07-13, Revision 7, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs."

PRA Revision: None

Technical Report (TR) Revision: None

Following is the additional copy of Appendix 19F with all changes accepted:

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