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Your ref: Docket No. 52-006
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Subject: AP1000 Response to Request for Additional Information (SRP3)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 3. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI COL03.05.01.04-1 R2

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,

D.A. Lindgren /FOR

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/Enclosure

1. Response to Request for Additional Information on SRP Section 03

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 3

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI COL03.05.01.04-1
Revision: 2

Question:

In FSAR Section 3.5.1.4 (VCS SUP 3.5-2), the applicant states that a postulated automobile missile is considered for all elevations of Summer Units 2 and 3 facilities and not just limited to elevations up to and including 30 feet above grade. Since this is a change from the standard AP1000 DCD, please provide the following information:

• Identify all structures, systems, and components (SSCs) that are located on the exterior of the facilities (i.e., intakes, exhausts, vents, valves, piping, etc.) that are higher than 30 feet above grade and require tornado missile protection.

• Provide the location of these SSCs by building, elevation and General Arrangement Drawing.

• Delineate how these SSCs will be further protected against the postulated impact of a postulated automobile missile, without impairing the safety-related functions of these SSCs.

• Since this additional tornado missile protection has the potential of causing additional static and dynamic loads during a postulated seismic event, please provide a preliminary assessment on how these additional loads affect the seismic integrity of the facilities.

Question Revision 1:

During the NRC audit of tornado missile responses the following additional questions were asked about this response

1. Why is the passive containment cooling water tank excluded from the automobile missile? No justification is clearly given why this structure is excluded.
2. The response references Westinghouse's APP-GW-GLR-133. There is no mention in this document of excluding the passive containment cooling water tank. The summary of APP-GW-GLR-133 states: *"Based on the results of the performed calculation, it can be stated that the massive high-kinetic-energy missile (4000-pound automobile) identified in DCD Section 3.5.1.4 is no longer limited to 30 feet above grade. The information contained herein can be used by any Combined License applicant to justify that the nuclear island structure remains satisfactorily intact after being impacted at any elevation by an automobile."*
3. In Westinghouse's APP-GW-GLR-133, Figure 1 (page 4) has the y-axis label blacked-out. What is it?

4. The document states that temporary blockage of the air-inlets in the shield building are not a concern because of the large number of them. However, there is no limitation on the number of tornado missiles, so justification is needed for this statement.

5. In reviewing the GA's on the roof of the North Auxiliary Building appears to be the vents for the main steam safety valves. If an automobile missile impacts these vents, is this a problem?

6. While this has not been made clear, in order to meet the tornado wind loading and pressure drop criteria, I'm assuming that tornado dampers are present in these openings. If these dampers are being used, are they protected from the tornado missiles so that the tornado pressure spike will not be felt inside the plant structures?

7. The Westinghouse response provides a change to DCD Subsection 3.5.4.1. However, whatever change is finally made to DCD Subsection 3.5.4.1, will also require a change to WCAP-15799 (APP-GW-GL-001), SRP 3.5.1.4; and APP-GW-GLR-020, Section 2.2.4 (page 7). [Note, there is an inconsistency between APP-GW-GLR-020, R3 and APP-GW-GL-001, R1. On page 8 of APP-GW-GLR-020 the document references SRP 3.5.3, R3. However, APP-GW-GL-001 states that the AP1000 meets SRP 3.5.3, R1.]

8. Evaluate the global effect of an automobile impact on the shield building including stress transferred to joints. May be bounded by seismic loads

Question Revision 2:

During review of the response for Revision 1 the NRC staff requested that conformance with the SRP for height of the automobile missile be addressed.

Westinghouse Response:

The following is the generic Westinghouse response to the Summer Units 2 and 3 RAI provided above.

NUREG 0800, for Subsection 3.5.1.4 and RG 1.76 recommends that the automobile tornado missile be considered up to 30 feet above all grade levels within a 1/2 mile of the plant structures. COL applications that reference the AP1000 design certification include sites that have grade elevations within a 1/2 mile of the plant structures higher than the plant grade elevation of 100 ft. The information in the DCD addresses an automobile impacting the auxiliary building or shield building at an elevation up to 30 feet above plant grade elevation of 100 ft. Westinghouse completed an evaluation of the impact of an automobile tornado missile to support the response from SCE&G for Summer Units 2 and 3 at elevations higher than 30 feet above design plant grade. This evaluation is generic and evaluates impact of a wind driven automobile tornado missile at all elevations of the auxiliary and shield buildings up to the junction of outer wall of the passive containment cooling water storage tank with the roof of the shield building, approximately Elevation 293 ft. This includes evaluation of impact of the automobile on the roof of auxiliary building. The evaluation summary report (TR-133) is documented in APP-GW-GLR-133 (Reference 1).

The evaluation of the response of the AP1000 structures to tornado missiles is part of the standard design of the AP1000 and is included in the review of the design certification design. As a result Westinghouse is revising the DCD to include applicability of the evaluation described above to the certified design. COL applications with postulated automobile tornado missiles at elevations as identified above do not require a departure from the standard AP1000 DCD.

- There are no structures, systems, and components (SSCs) located on the exterior of the AP1000 standard design facilities at any elevation that require protection from tornado missiles. The systems and components required to shut down the reactor, address transient conditions, and mitigate postulated accidents are protected by the reinforced concrete walls of the shield building and auxiliary building. Openings created by doors are on the East side of the Nuclear Island. The Annex building provides protection, and the roll-up door at the fuel handling area has no systems in the vicinity that are required for safe shutdown. The air-inlets in the shield building are smaller than the automobile, and therefore, it could not pass through the shield building. Temporary blockage of the air-inlet would not be an issue because of large number of them. Further, secondary missiles that could be potentially created at openings could not cause damage to systems required for safe shutdown due to proximity and low energy of the missile. The PCS ancillary water tank is located at ground level adjacent to the Northwest corner of the auxiliary building and provides water for use by the passive containment cooling system from 72 hours after actuation to 7 days after actuation. This tank must be protected from hurricane missiles; not tornado missiles. A tornado is a local event not a regional event and the plant can count on external resources such as back up power and additional water in the post 72 hour period.

- Systems and components located in the turbine building, annex building, radwaste building, diesel generator building, and associated with external tanks are not required to be protected from impact of tornado missiles. The plot plan for the AP1000 is provided in DCD figure 1.2-2 and shows the arrangement of the buildings.

- Plant specific design modifications to the AP1000 standard plant for tornado missile protection are not required for postulated automobile tornado missiles at all elevations of the auxiliary and shield buildings up to the junction of outer wall of the passive containment cooling water storage tank with the roof of the shield building, approximately Elevation 293 ft

- Evaluation of the postulated automobile missile has not resulted in additional tornado missile protection (enhancements) to the structures. Therefore, there are no additional static or dynamic loads imposed during a seismic event, with no affect on the seismic integrity of the facilities.

Response Revision 1:

1. The PCS tank in the roof of the shield building is above postulated elevation of tornado auto missiles for known sites. Evaluation of the impact of the missile on the tank is more complicated than evaluation of simple barrier. Although the thickness of concrete for the outside wall and roof of the tank exceed the minimum concrete thickness in Standard Review Plan Section 3.5.3 those minimum thicknesses do not factor in the effect on the stainless steel liner of the tank.

2. Report APP-GW-GLR-133 will be revised to note that the PCS tank is not included in the missile evaluation.

3. The y-axis label for APP-GW-GLR-133, Figure 1 should be force-kips. Report APP-GW-GLR-133 will be revised to fix the label

4. There are more than 230 air inlets in the shield building that provide for air flow over the containment vessel for passive cooling of the containment. The air inlets are located around the entire circumference of the shield building. Given the large number of air inlets and their location around the shield building on both the windward and leeward side relative to tornado winds, it is not credible to cover or obstruct a large fraction of the air inlets with tornado missiles or debris. There is considerable margin in the number of vents provided compared to the vent area needed for passive containment cooling. The rise in temperature and boiling of the water placed on the containment shell by the passive containment cooling system provides the primary mechanism for the cooling of the shell. The function of the air is to remove the water vapor from the area.

5. The steam line safety valves located in the MSIV compartments are not directly connected to the vent pipes that conduct the steam through the roof. Each of the safety valves exhausts through two openings that are directed to the vents that carry the steam through the roof. These vent pipes are open at the bottom of the pipe. The 10-inch discharge pipes for each safety valve discharge pipe exhausts into a 24 inch diameter vent pipe. The vent pipe is 0.38 inch thick and would require considerable force to crush kink or otherwise close off the top of the pipe above the roof. If the vent pipes are blocked or otherwise obstructed above the roof, the discharge of the safety valves will vent into the MSIV compartment. Steam discharged into the MSIV compartment vents to the outside through separate vents.

6. There is a tornado damper in the intake serving the Main Control Room/Control Support Area and the 1E Electrical Division A & C air handling units. The tornado damper is included in this intake to prevent a reduced pressure in the control room in relation to surrounding portion of the building. There are no other tornado dampers in the HVAC systems serving the Nuclear Island. The tornado damper in the Main Control Room/Control Support Area and the 1E Electrical Division A & C intake is located below the roof line in the HVAC ductwork. There is also security damper (a set of steel bars) between the intake opening in the roof and the tornado damper. These bars are sized to limit the size of an

object that can pass through the duct. Therefore the damper is not directly subject to damage from a missile impact.

The auxiliary building is designed to withstand the tornado depressurization. The design tornado load pressure drop is 2.0 psi, and the rate of pressure change is 1.2 psi/sec. The AP1000 nuclear island designed to meet the requirements 1) "Seismic Category II structures shall be analyzed for the tornado to demonstrate that the primary structural elements do not fail under tornado loads calculated in accordance with the Design Guide for Wind and Tornado for the AP600 Structures.", 2) "The tornado differential pressure load for the nuclear island structures is based on a fully enclosed structure (288 psf).", and 3) tornado loads are included as part of the seismic ductwork design. Therefore, tornado loads would potentially damage seismic Category II ductwork, but if ductwork were damaged the ductwork would not burst, fall, or fail in such a way interfere with any safety equipment operation located in the vicinity of the ductwork.

Equipment and instrumentation relied on to shutdown the reactor and maintain it in a safe condition is largely located in the containment. The systems and components located in containment are not subject to the tornado depressurization experienced by portions of the auxiliary building. The systems included in the auxiliary building used to monitor and control the reactor are not sensitive to a tornado depressurization. The control and protection systems use solid state electronics and integrated circuits. The AP1000 does not include pneumatic control systems. The batteries that supply power to the PMS are not sensitive to tornado depressurization. The AP1000 does not include HVAC systems penetrating the containment shell that are relied on to maintain safe operation or shutdown of the reactor. The HVAC systems that maintain the habitability for the control room are protected with tornado dampers.

In summary, the nuclear island building structures are designed to withstand the maximum tornado loads. Tornado dampers are not required in the HVAC systems, except for the portions supplying the control room, since the nuclear island structure is designed for the maximum pressure differential.

The ductwork in the nuclear island is restrained so that if there is any duct damage it will not interfere with safety systems, or it is in areas that have no safety equipment so duct damage from tornado pressures will not interfere with plant safe shut down.

7. WCAP-15799 (APP-GW-GL-001, AP1000 Conformance with SRP Acceptance Criteria) will not be changed. The conclusion of the conformance assessment for SRP3.5.1.4 remains correct and is not altered. The information provided about the elevated automobile is in excess of what is required to show conformance with SRP 3.5.1.4 for the AP1000 certified design. WCAP-15799 does not generally include statements about exceeding the criteria of the SRP.

   APP-GW-GLR-020, AP1000 Wind and Tornado Site Interface Criteria, provides criteria for the evaluation of site parameters related to tornados. The criteria and information to be provided by the COL applicants are not altered by the evaluation of an elevated auto tornado missile. APP-GW-GLR-020 will not be revised to include the elevated automobile tornado missile.

8. The force on the Nuclear Island from the impact of an automobile tornado missile is used in the evaluation of the global effect of an automobile impact on the shield building. It is shown that the effect of an automobile impacting the shield building will not govern the shield building design. The maximum horizontal impact load, using a dynamic load factor of 2, is used. This load is equal to 770 kips. This load is derived from a time history forcing function of an automobile crash under frontal impact. The automobile is the deformable missile, and the object (structure) impacted is a rigid target. It is the same forcing function that was used in the evaluation of the Nuclear Island for the tornado missile automobile impact above 30'

   The automobile is considered to impact the shield building just below the PCCS tank (El. 293' 9"). This location is chosen so that the largest moment and maximum shear at the RC/SC connection is obtained. The resulting shear force and moment in the vicinity of the RC/SC connection (~ EL. 145') are compared to the seismic demand (shear and moment) at this location.

   The automobile tornado impact loads at the RC/SC location are:

   Shear = 385 x 2 = 770 kips
   Moment = 770 x (293' 9" -145') = 114,540 k-ft

   The seismic demand at this location is given below for the six site cases: hard rock (HR); firm rock (FR); soft rock (SR); upper bound soft to medium (UBSM), soft to medium (SM), and soft soil (SS).

Site Cases	**Shear** 10^3 kips	**Moment** 10^3 k-ft
HR	38.24	4246
FR	37.79	4204
SR	37.61	4349
UBSM	41.04	4831
SM	44.11	4874
SS	23.4	2898

   Comparing the seismic demand to the tornado loads it is seen that the seismic shear load is more than 30 times greater than the automobile tornado impact load, and the resulting moment from the seismic demand is more than 25 times greater. Therefore, the global impact of the automobile on the shield building during a tornado will not govern the shield building design.

Response Revision 2:

The DCD mark-up is revised to address conformance with the missile spectrum identified in the SRP. A sentence on automobile missile impact at grade elevations up to 30 feet previously deleted is returned to confirm conformance with the SRP missile spectrum. In addition a sentence is added to specify the elevation covered for parked automobiles within ½ mile of the Nuclear Island.

Reference

1. APP-GW-GLR-133, Summary of Automobile Missile 30′ Above Grade, July 2007.

Design Control Document (DCD) Revision:

Revise the first bullet under Subsection 3.5.4.1 as follows:

- A massive high-kinetic-energy missile, which deforms on impact. It is assumed to be a 4000-pound automobile impacting the structure at normal incidence with a horizontal velocity of 105 mph or a vertical velocity of 74 mph. This missile is considered at all plant elevations up to 30 feet above grade. In addition, to consider automobiles parked within half a mile of the plant at higher elevations than the plant grade elevation; the evaluation of the automobile missile is considered at all plant elevations up to the junction of outer wall of the passive containment cooling water storage tank with the roof of the shield building. This elevation is approximately 193 feet above grade. This evaluation bounds sites with automobiles parked within half a mile of the Shield building and Auxiliary Building at elevations up to the equivalent of 163 above grade.

This mark-up was revised in Revision 2 of the response. The sentence on grade elevations up to 30 feet previously deleted is returned. In addition Revision 2 adds the last sentence.

PRA Revision: None

Technical Report (TR) Revision: None