



Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures

ANP-10317 Revision 2

Technical Report

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Nature of Changes

	Section(s) or	
Rev	Page(s)	Description and Justification
000	All	Initial Issue
001	All	Page numbering and format updates, included acronyms after first use of words.
001	Section 2.2	Updated Item 1 description to remain consistent with source document, corrected Item 7 text from "Safeguards Building 2/3" to "Fuel Building", Added Design Requirements Items 11 - 16 to provide more information, changed units for last five items of Table 2-1 to remain consistent with source document, for items 5-7 "20g" update to "27g" to be consistent with Reference 2, added fire barrier protection to Item 7 to be consistent with source document. Updated Item 13 text to address RAI 565 Question 358 (in part), including reviewer comment re; the concrete sliding door.
001	Section 2.2	Figure 2-8 information was incorporated into new Figures 2-8 through 2-11 for clarity and updated barrier parameters information to remain consistent with source document.
001	Section 2.2	Added new Figures 2-12 through 2-14 to provide more information.
001	Section 2.2	Figure 2-9 was updated to Figure 2-15 and figure updated to remain consistent with source document.
001	Section 3.0	In response to RAI 565, Question 1-357, updated reference methodology from Revision 7 to Revision 8 of NEI 07-13.
002	Section 2.2	Figures 2-8 and 2-9, corrected error in previous revision. Drawings updated as intended in revision 001.
002	Section 2.2	Figures 2-11, 2-13, 2-14 and 2-15 updated to reflect recent design updates to barriers.

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Nomenclature

Acronym	Definition
NEI	Nuclear Energy Institute
FSAR	Final Safety Analysis Report
EF	Each Face
EW	Each Way
NI	Nuclear Island
RSB	Reactor Shield Building
FBSW	Fuel Building Front and Side Shield Walls
FBSR	Fuel Building Shield Roof
MLSW	Material Lock Front and Side Shield Walls
SGSW	Safeguard Building 2&3 Front and Side Shield Walls
SGSR	Safeguard Building 2&3 Shield Roof
SGW	Safeguard Buildings 1 and 4 Front and Side Structural Walls
AISW	Air-Intake Front Structural Walls
FBWB	Fuel Building Wall Buttress
FBRB	Fuel Building Roof Buttress
SGFWB	Safeguard Building 2&3 Front Wall Buttresses
SGSWB	Safeguard Building 2&3 Side Wall Buttresses
SGRB	Safeguard Building 2&3 Roof Buttresses

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1.0 PURPOSE

This report, in combination with the U.S. EPR[™] FSAR, documents the design requirements for the U.S. EPR standard plant design Aircraft Hazard Protection Structures in accordance with the regulatory requirements stated in the final rule amending 10 CFR Parts 50 and 52 (Reference 1) for a large commercial aircraft impact. The design requirements specified in this report conform to the guidance of the Nuclear Energy Institute (NEI) (Reference 2) for performing the evaluation of a large commercial aircraft impact as a beyond-design-basis event. Design requirements for the U.S. EPR aircraft hazard protection structures prevent perforation of the exterior of the Nuclear Island (NI) Common Basemat exterior structures and prevent or control areas where fuel can enter the buildings.

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2.0 DESIGN REQUIREMENTS FOR THE NI STRUCTURES

The design requirements specified in this report include aircraft hazard protection design requirements for the NI structures based on Reference 2. Fire barriers with a

[] in accordance with Reference 2 are specified in the U.S. EPR FSAR Tier 2, Appendix 9A figures.

2.1 NI Common Basemat Exterior Shield Structures

The NI Common Basemat exterior shield structures and identifiers for specific structures and structural elements are shown in Figure 2-1 and Figure 2-2. The corresponding minimum design requirements for the indicated structures and structural elements are shown in Table 2-1. Figure 2-3 through Figure 2-7 provide minimum reinforcing requirements for the exterior shield structure buttresses.

The construction (placement) of reinforcement for the specified shield structures will satisfy the following requirements:

- Flexural reinforcement layers will be tied together at each bar's intersection point.
- Shear ties or stirrups will provide confinement for the flexural reinforcement layers in the section.
- Coupling bar connectors will be used for the bar extension.

2.2 Additional Design Requirements

The following are additional design requirements:

 Shield blocks are designed to prevent perforation by the component specified in the AIA. Refer to Figures 2-8 through 2-15 for placement and additional specifications for shield blocks.

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- 2. Design requirements for specific structural elements of the Nuclear Auxiliary Building (NAB), Radioactive Waste Processing Building (RWPB), Emergency Power Generating Buildings (EPGB), and Essential Service Water Buildings (ESWB) are available for inspection. The figures related to design requirements for these areas have been determined to contain Safeguards Information, therefore, they will be made available for inspection but will not be included in this report.
- 3. The main steam relief train silencers will incorporate breakaway features above the Safeguard Building penetration seal that limit forces imposed on the main steam system in the Safeguard Building such that the safety-related main steam valves remain functional and the pressure boundary of the system is not compromised.
- 4. The main steam and main feedwater piping exterior to the Safeguard Buildings will be routed so that loads resulting from aircraft impact will provide sufficient stress in the pipe exterior to the building such that this pipe undergoes plastic deformation, before damaging the penetration support at the Safeguard Building [

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- A six inch clearance gap will be maintained between the inside face of the Reactor Shield Building and any components in the annulus. However, this clearance gap is not required if an evaluation has been performed to demonstrate that the shock induced on the containment structure or other safety-related components from a large commercial aircraft impact is less [] (Reference 2).
- The U.S. EPR is designed so that following an aircraft impact, the gap will not be closed between the inside face of the Safeguard Building 2/3 shield walls, and any components attached to the adjacent Safeguard Building 2/3 inner wall or that the shock induced on the component or Safeguard Building 2/3 inner walls from a large commercial aircraft impact is less [] (Reference 2).

7. The U.S. EPR is designed so that following an aircraft impact, the gap will not be closed between the inside face of the Fuel Building shield walls, and any components attached to the adjacent Fuel Building inner wall, or that the shock induced on the component or Fuel Building inner walls from a large commercial

aircraft impact is less [] (Reference 2).

8. **[**

]

9. Exterior doors at Elevation 0 feet for the Fuel and Safeguard Buildings that open to the outside will be recessed into the exterior wall so that there are no protrusions beyond the outside face of the wall (including hinges and door handles). An evaluation will be performed for doors located directly behind concrete barriers to verify that there is a sufficient gap for deflections of the barrier without impacting the door after aircraft impact and that any fire rating or pressure rating applied to the door is maintained after aircraft impact.

10.

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11. EPGB Removable Missile Shields:

The removable missile shields in the EPGBs, see Figure 2-12, are constructed to the same standards as the walls containing the opening for which they are providing protection and will overlap the protected opening by a minimum of 24" on all sides (e.g., 24 inch 5000 psi concrete, #8 GR 60 rebar every 8 inches, etc).

12. Minimum Concrete Wall Characteristics for Non-NI Buildings:

All concrete walls within the NAB, EPGB, and ESWB with thicknesses greater than or equal to 17 inches and less than 23 inches will utilize, as a minimum, 5000 psi concrete with #7 GR 60 rebar on a 12 inch spacing.

All concrete walls within the NAB, EPGB, and ESWB with thicknesses greater than or equal to 23 inches and less than 35 inches will utilize, as a minimum, 5000 psi concrete with #8 GR 60 rebar on a 12 inch spacing.

All concrete walls within the NAB, EPGB, and ESWB with thicknesses greater than or equal to 35 inches will utilize, as a minimum, 5000 psi concrete with two layers of #8 GR 60 rebar on a 12 inch spacing.

The concrete walls within the RWPB shown in Figure 2-15 will have a thickness greater than or equal to 24 inches and will utilize, as a minimum, 5000 psi concrete with #8 GR 60 rebar on a 12 inch spacing.

13. Radioactive Waste Processing Building Protection:

The Radioactive Waste Processing Building includes a sliding concrete door as shown in Figure 2-15. The concrete sliding door is maintained closed during operations and shutdown conditions but is periodically opened to the size of a typical personnel door for normal personnel access. The normal position of the concrete sliding door may be maintained as partially open (not to exceed the size of a typical personnel door) at the discretion of the licensee. The concrete sliding door is infrequently opened in excess of the size of the typical personnel door for equipment transit but may not be maintained open in excess of the size of a typical personnel door. The opening and closing of the concrete sliding door is controlled by site administrative procedures.

Due to the weight of the concrete sliding door, electric power, hydraulic controls, or other controls or devices are required to open and close the concrete sliding door.

14. Horizontal Roof Openings:

Horizontal roof openings are protected by raised concrete curbs to prevent unburned aviation fuel from draining into the opening following impact.

15. Exterior Buried Conduit:

Exterior buried conduit is protected by seepage-resistant manways under concrete covers on the exterior manholes to prevent unburned aviation fuel from draining into the opening following impact.

Table 2-1: Minimum Required Design Parameters for the StructuralElements (2 Sheets)

Table 2-1: Minimum Required Design Parameters for the StructuralElements (2 Sheets)







Figure 2-2: 3-Dimensional View of NI Common Basemat Structures Looking Southeast





Figure 2-4: Reinforcement Details in Safeguard Building 2&3 Front Wall Buttresses

Figure 2-5: Reinforcement Details in Safeguard Building 2&3 Side Wall Buttresses



Figure 2-7: Reinforcement Details in Safeguard Building 2&3 Roof Buttresses

Figure 2-8: SGB1 Removable Concrete Shield Blocks at Elevation 0 Ft



Figure 2-9: SGB2 Removable Concrete Shield Block at Elevation 0 Ft

Figure 2-10: SGB4 Removable Concrete Shield Block at Elevation 0 Ft

Figure 2-11: Access Building Concrete Shield Blocks at Elevation 0 Ft

Figure 2-12: EPGB Removable Concrete Shield Blocks at Elevation 0 Ft

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Figure 2-13: NAB Removable Concrete Shield Block at Elevation 64 ft

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Figure 2-14: NAB Removable Concrete Shield Block at Elevation 81 ft

Figure 2-15: [Radioactive Waste Processing Building Sliding Concrete Door at Elevation 0 Ft.]

3.0 **REFERENCES**

- 10 CFR Parts 50 and 52 Final Rule, "Consideration of Aircraft Impacts for New Nuclear Power Reactors," Federal Register, Vol. 74, No. 112, 74 FR 28146, June 12, 2009.
- NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," Revision 8, Nuclear Energy Institute, prepared by ERIN Engineering & Research, Walnut Creek, CA, April 2011.