

## Vogle PEmails

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# Non-Proprietary Version of the Presentation



# AP1000 Auxiliary Building Wall 11 Tornado Missile Protection Closed Meeting (Non-Proprietary)

September 3, 2015



# Agenda

- LAR-30 Scope & Meeting Purpose
- Summary of the Proposed Change
- Background Information Plant Layout
- Auxiliary Building Wall 11 Design
- Evaluation of Wall 11 Openings
- Turbine Building First Bay Design
- Proposed Resolution
- Supporting Technical Documentation, LAR Schedule & Construction Activities

# LAR-30 Scope & Meeting Purpose

LAR-30 consists of the following changes:

- Reconfiguring Wall 11 reinforcement bar:
  - Close the openings in Aux Building Wall 11 at Elevation 148'-9" to the Main Steam Isolation Valve (MSIV) compartments with reinforced concrete consistent with the surrounding wall.
  - Modify the Wall 11 reinforcement design in the vicinity of the main steam line penetration.
- Protecting Wall 11
  - Credit the Turbine Building Wall 11.2 for providing protection from a postulated high energy line break in the turbine building
  - Credit the Turbine Building First Bay for providing limited tornado missile protection for openings in the Auxiliary Building Wall 11



The purpose of this meeting is to discuss tornado missile protection

# Summary of the Proposed Change

- The Auxiliary Building concrete structure protects the nuclear island from all design basis tornado missiles
- Openings through the Auxiliary Building concrete structure are to be evaluated for tornado missiles on a case-by-case basis
  - As discussed with the NRC staff during design certification, the Annex Building provides protection for openings in the East Auxiliary Building Wall (Wall I)
    - The intent of the AP1000 DCD was to allow nonsafety-related SCII structures to provide tornado missile protection
    - However, the tornado missile protection for openings in the Auxiliary Building structure is not clearly described in the licensing basis
  - Similar to Wall I, NRC approval will be requested to credit the Turbine Building First Bay for protecting openings in the North Auxiliary Building Wall (Wall 11)
    - LAR-30 will include changes to specify that an adjacent seismic category II non-safety related building may provide limited tornado missile protection on a case-by-case basis for openings in the nuclear island
  - The tornado missile protection change is involved with the Tier 2\* LAR-30 reinforcement bar changes because if the tornado missile protection proposal were not approved, Wall 11 rebar redesign could be needed



# Background Information Plant Layout



# Site Plan Showing Location of Wall 11

Security-Related Information, Withhold Under 10 CFR 2.390d



Figure 1.2-2  
Site Plan

# Auxiliary Building Wall 11 Location

Security-Related Information, Withhold Under 10 CFR 2.390d



Figure 1.2-9  
Nuclear Island General Arrangement  
Plan at Elevation 117'-6" with Equipment

# Turbine Building Wall 11.2 and First Bay Location

Security-Related Information, Withhold Under 10 CFR 2.390d

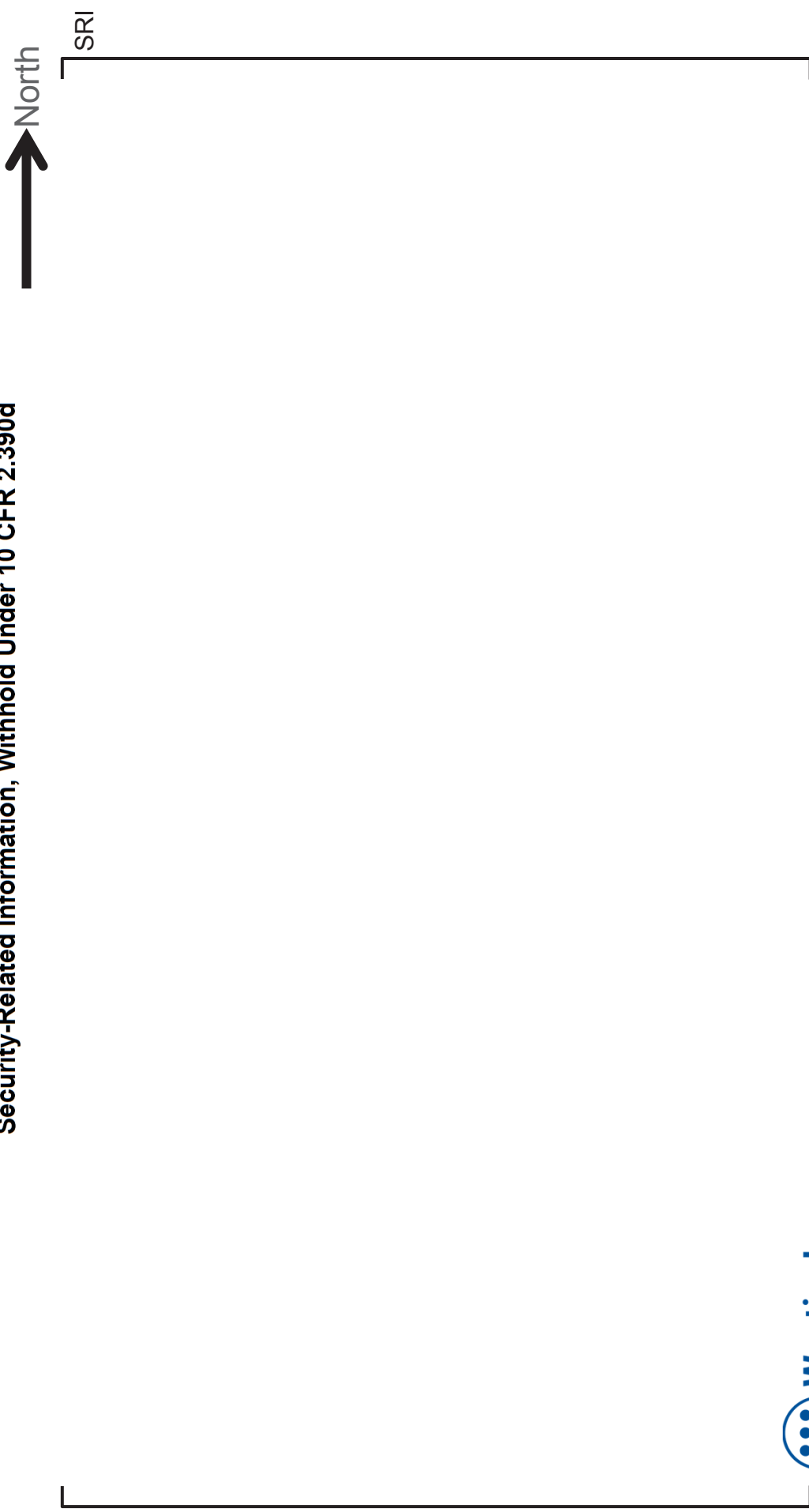
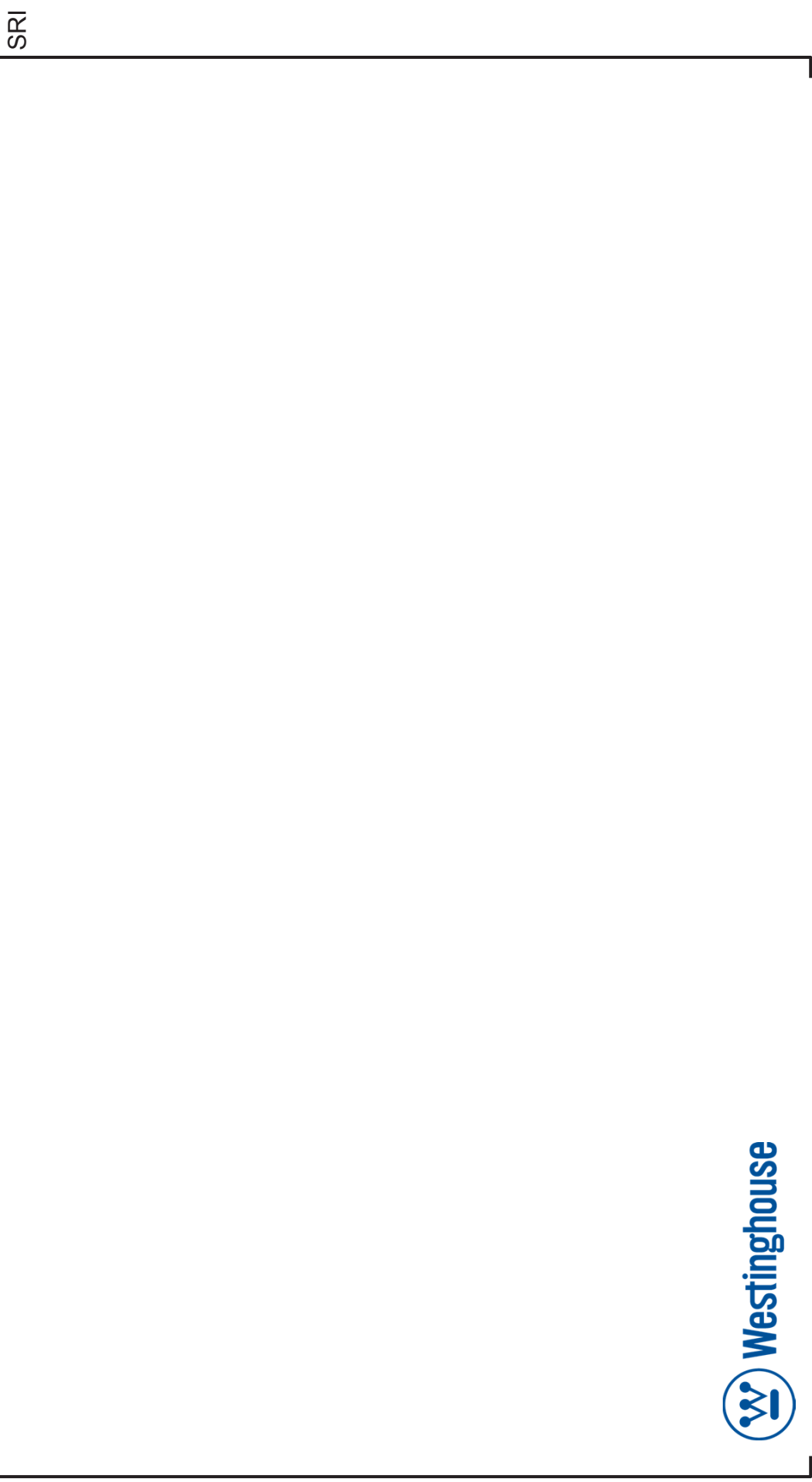


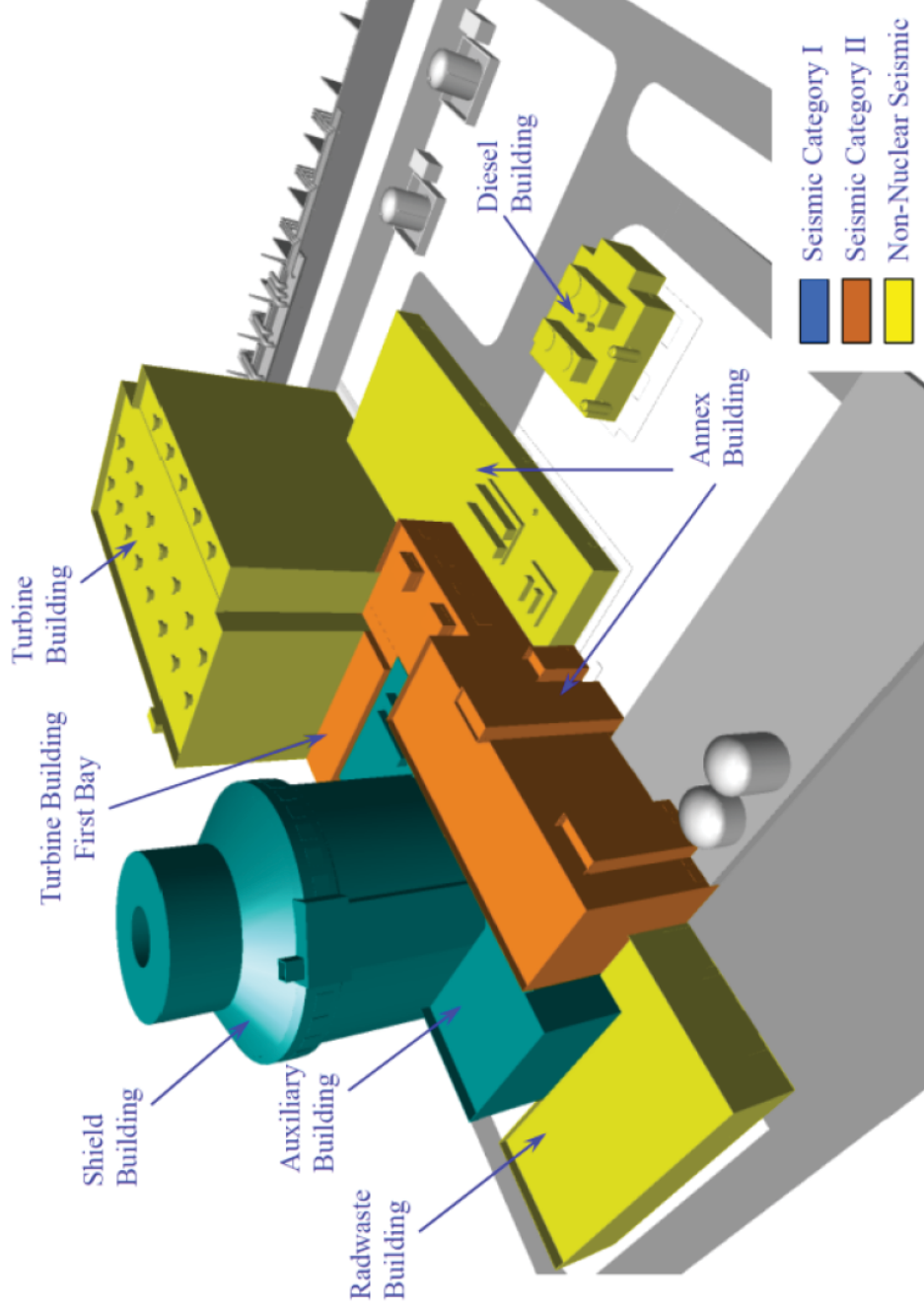
Figure 1.2-24  
Turbine Building General Arrangement  
Plan at Elevation 120'-6"

# Turbine Building First Bay Layout (El. 117'-6")

Security-Related Information, Withhold Under 10 CFR 2.390d



# Turbine Building First Bay Location



# Auxiliary Building Wall 11 Design



# Auxiliary Building Wall 11 Design

- North Wall of the Auxiliary Building
  - contains penetrations for the main steam and main feedwater lines
- Protects safety-related equipment in the nuclear island
- Seismic Category I Structure
- Designed, analyzed, and constructed to ACI 349
- Critical Section described in UFSAR Section 3H.5.1.4 and shown in UFSAR Figure 3H.5-5



# Design Basis Tornado Missiles

- Tornado missiles are defined in UFSAR Section 3.5.1.4:
  - A massive 4000 pound automobile high-kinetic-energy missile, which deforms on impact.
  - A rigid 275 pound eight inch armor-piercing artillery shell to test penetration resistance
  - A small 1” solid steel sphere missile to pass through any openings in protective barriers.



**Wall 11 Concrete Structure is capable of stopping all design basis missiles.**

# Auxiliary Building Wall 11 Layout

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SRI



Wall 11 Concrete Structure is capable of stopping all design basis missiles.

# Auxiliary Building Wall 11 Openings (Looking South)

Security-Related Information, Withhold Under 10 CFR 2.390d



5 doorways and 2 vent openings in  
Wall 11 are evaluated for tornado  
missile protection

# Door to Valve/Piping Room

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SRI



Figure 1.2-7  
Nuclear Island General Arrangement  
Plan at Elevation 100'-0" & 107'-2"

# Door to Lower VBS Equipment Room & MSIV Room Pressure Relief Vent / Flooding Drain

Security-Related Information, Withhold Under 10 CFR 2.390d

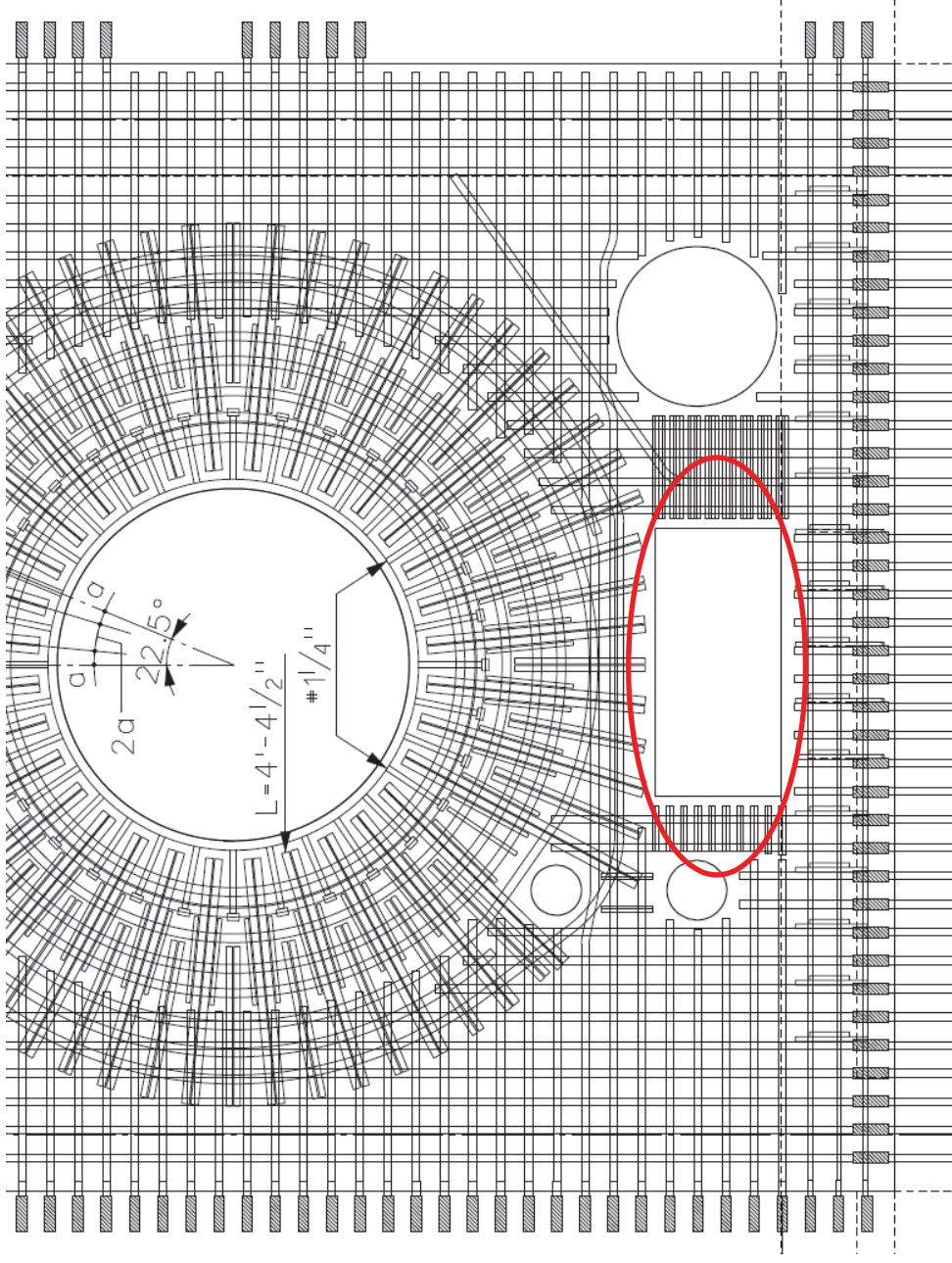


SRI



Figure 1.2-8  
Nuclear Island General Arrangement  
Plan at Elevation 117'-6" & 130'-0"

# MSIV Room Pressure Relief Vent / Flooding Drain



# Door to Upper VBS Equipment Room & Doors to MSIV Rooms A & B

Security-Related Information, Withhold Under 10 CFR 2.390d



Figure 1.2-10  
Nuclear Island General Arrangement  
Plan at El. 135'-3"

# Evaluation of Auxiliary Building Wall 11 Openings





# Evaluation of Auxiliary Building Wall 11 Openings

- 5 doors and 2 vents in Wall 11 are evaluated for the following tornado missiles with a horizontal velocity of 105 mph, as described in the UFSAR Section 3.5.1.4:
  - A massive 4000 pound automobile high-kinetic-energy missile, which deforms on impact.
  - A rigid 275 pound eight inch armor-piercing artillery shell to test penetration resistance
  - A small 1” solid steel sphere missile to pass through any openings in protective barriers.



Discussion of the missile protection for each of these openings is provided in the following slides

# Evaluation of Five Auxiliary Building Wall 11 Doors



# Protection from the Sphere and Artillery Shell for the Five Auxiliary Building Wall 11 Doors (Looking South)

Security-Related Information, Withhold Under 10 CFR 2.390d



5 safety-related SCI Wall 11 doors will be capable of stopping the sphere and the artillery shell without credit for the First Bay.

# Nuclear Island & Turbine Building First Bay

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SRI



# Turbine Building First Bay

Security-Related Information, Withhold Under 10 CFR 2.390d

SRI



# Valve/Piping Room Door Protection for Postulated Automobile (El. 100'-0")

Security-Related Information, Withhold Under 10 CFR 2.390d



Wall 11

First Bay

Tornado Missile Barrier

Potential Car Path

Wall 11 Door



1. Sphere and Shell Stopped by Wall 11 door
2. Car stopped by First Bay & Tornado Missile Barriers
3. No direct Line of Sight from Wall 11.2 First Bay Door
4. No credit taken for intervening equipment or Wall 11.2 First Bay Door
5. Valve/Piping Room Door Opening Protected

# Lower VBS Equipment Room Door Protection for Postulated Automobile (El. 117'-6")

Security-Related Information, Withhold Under 10 CFR 2.390d



SRI

- Wall 11
- First Bay
- Tornado Missile Barrier
- Potential Car Path
- Wall 11 Door



1. Sphere and Shell Stopped by Wall 11 door
2. Car stopped by First Bay & Tornado Missile Barriers
3. No direct Line of Sight from Wall 1.2 First Bay Door
4. No credit taken for intervening equipment or Wall 1.2 First Bay Door
5. Lower VBS Equipment Room Door Opening Protected

# Upper VBS Equipment Room & MSIV Room Door Protection for Postulated Automobile (El. 135'-3")

Security-Related Information, Withhold Under 10 CFR 2.390d



- Wall 11
- First Bay
- Tornado Missile Barrier
- Potential Car Path
- Wall 11 Door



1. Sphere and Shell Stopped by Wall 11 doors
2. Car stopped by First Bay & Tornado Missile Barriers
3. No direct line of sight from Wall I.2 First Bay Door through Wall 11 door opening
4. Car paths from roof are stopped by First Bay roof & floor at El 148'-10"
5. No credit taken for intervening equipment or Wall I.2 First Bay Door
6. Missiles from First Bay roof Upper VBS Equipment & MSIV Room Door Openings Protected



# Evaluation of Two Auxiliary Building Wall 11 Vents



# Protection from the Sphere and Artillery Shell for the 2 Wall 11 Vents (Looking South)

Security-Related Information, Withhold Under 10 CFR 2.390d



Must credit the First Bay to protect  
the vents from the sphere, shell,  
and car

# MSIV Subcompartment Vents

a,c



# MSIV Room Pressure Relief Vent / Flooding Drain (El. 117'-6")

Security-Related Information, Withhold Under 10 CFR 2.390d

SRI

- Wall 11
- First Bay
- Tornado Missile Barrier
- Potential Sphere or Shell Path
- Potential Sphere, Shell, or Car Path
- Tornado Missile Barrier  
(detailed design to be finalized)
- Wall 11 Door

1. All missiles stopped by First Bay concrete structure
  - Car stopped by tornado missile barriers
  - No credit taken for missile barriers in First Bay Walls for the sphere or shell
2. No direct line of sight through Wall 11 vent opening
3. No Credit taken for intervening equipment or Wall 1.2 First Bay Door
4. MSIV Room Vent / Drain Openings Protected

# Wall 11 Penetrations & Openings in First Bay Roof

## Penetrations

- Wall 11 contains piping and electrical penetrations
- Each penetration has been evaluated
- Tornado missile protection is provided by a combination of the following:
  - Robust Pipe Sleeve
  - No line of sight through penetration
  - Pipe analyzed for high energy pipe break
  - No safe shutdown essential equipment in the line of sight for missiles passing through penetration



All Wall 11 penetrations and openings protected

# Summary: Evaluation of Auxiliary Building Wall 11 Openings

	Sphere Stopped by:	Shell Stopped by:	Car Stopped by:
Wall 11 Concrete Structure	<ul style="list-style-type: none"> <li>Wall 11 Reinforced Concrete</li> <li>Wall 11 Door</li> </ul>	<ul style="list-style-type: none"> <li>Wall 11 Reinforced Concrete</li> </ul>	<ul style="list-style-type: none"> <li>First Bay Concrete,</li> <li>Missile Barriers,</li> <li>No LOS Through Opening</li> </ul>
Valve/Piping Room Door			
Lower VBS Eq. Rm Door			
Upper VBS Eq. Rm Door			
MSIV Room A Door			
MSIV Room B Door			
MSIV Room A Vent	<ul style="list-style-type: none"> <li>First Bay Concrete,</li> <li>Missile Barriers,</li> <li>No LOS Through Opening</li> </ul>	<ul style="list-style-type: none"> <li>First Bay Concrete,</li> <li>Missile Barriers,</li> <li>No LOS Through Opening</li> </ul>	<ul style="list-style-type: none"> <li>First Bay Concrete,</li> <li>Missile Barriers,</li> <li>No LOS Through Opening</li> </ul>
MSIV Room B Vent			

# Tornado Missile Evaluation Conservatism

- No credit for intervening equipment in the First Bay
- No credit for intervening equipment and structures in the Turbine Building general area
- Tornado Missile is assumed to impact an opening normal to the surface

# Turbine Building First Bay Design





# Turbine Building First Bay Design

- Located between the nuclear island and the turbine building
- Provides separation between the nuclear island and general portion of the Turbine Building
- Precludes structural failure during a safe shutdown earthquake or interaction with the Aux Building
- Building designed and constructed to seismic category II requirements
- Reinforced concrete walls and roof
- Designed and analyzed for the SSE using the same methods and design allowables used for seismic Category I structures:
  - ACI-349 for concrete features
  - AISC-N690 for steel features
- Designed to Category I tornado loading

# Turbine Building First Bay Design

- Constructed to ACI 318
  - ACI 318 is the general specification used for the design of reinforced concrete buildings in the United States and it provides the basis for the majority of the design information presented in ACI 349
  - ACI 318 also provides the commentary for ACI 349
  - ACI 318 does not require certified material test reports to provide documentation of traceability of materials and has less stringent requirements with respect to record keeping and inspection and testing of construction work
- Credited as a key feature for the protection of the auxiliary building from the impact of large commercial aircraft (UFSAR 19F.4.2)
- Designed for an SSE and is designed to be capable of stopping all design basis tornado missiles defined in UFSAR Section 3.5.1.4

# Turbine Building First Bay



Turbine Building First Bay viewed from  
Valve/Piping Room Door in Wall 11  
looking north toward wall 11.2

# First Bay Missile Barrier

- Detailed design to be finalized
  - Designed per AISC N690
  - Meets UFSAR Section 3.5.3 requirements
  - Equipment Class D

a,c

# Wall I Missile Protection



# Wall I Tornado Missile Protection

## Security-Related Information, Withhold Under 10 CFR 2.390d

SRI

AP1000 RAI COL03.05.01.04-1 Revision 2 response states that the Annex Building provides protection for openings in the external wall of the Nuclear Island.

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.**

In process of evaluating the tornado missile paths for Wall I based on finalized Annex Building layout.



**Missile protection may be performed by the Annex Building for Wall I**

# Applicable Current Licensing Basis Requirements



# Licensing Basis – Tornado Missile Protection

The licensing basis indicates:

1. Openings through nuclear island walls are evaluated on a case-by-case basis to provide confidence that a missile passing through the opening would not prevent safe shutdown
  - UFSAR Subsection 3.5.2
2. First Bay is a C-II Structure
  - Table 3.2.2
3. Seismic Category II SSCs are designed and analyzed to the pertinent portions of Appendix B and perform no safety function
  - UFSAR Subsection 3.2.1.1.2 & RAI OI-SRP3.2.1-EMB2-03
4. Missile protection is performed by safety-related Class C equipment but may be performed by SCII structure
  - UFSAR Section 3.2.1.1.1, 3.2.2.5, & RAI COL03.05.01.04-1
5. SCII buildings are designed and analyzed to requirements of ACI 349 and AISC N690 and are constructed to requirements of ACI 318
  - UFSAR Subsection 3.2.1.1.2 & 3.3.2.3
6. Spatial separation may be used to demonstrate protection from missile hazards when it is shown that the range and trajectory of the generated missile is less than the distance to or is directed away from the potential target (i.e. Line-of-sight)
  - UFSAR Subsection 3.5



The tornado missile protection description for openings in the Auxiliary Building is not concisely described in the licensing basis



# Proposed Resolution



# Proposed Resolution

- NRC approval will be requested to credit the Turbine Building First Bay for protecting openings in the North Auxiliary Building Wall (Wall 11)
  - Approach is consistent with the tornado missile protection for Wall I
- The tornado missile protection approach is as follows:
  - The Auxiliary Building concrete structure is capable of stopping all design basis missiles
  - Openings in the Auxiliary Building are protected by
    - Crediting an existing adjacent nonsafety seismic category II structure on a limited case-by-case basis
    - Evaluating tornado missiles in the direct line-of-sight of the Auxiliary Building opening
    - Installing tornado missile barriers on a limited case-by-case basis
- The proposed licensing basis markups are under development and will be included in the LAR-30 pre-submittal discussion

# Supporting Technical Documentation, LAR Schedule & Construction Activities



# Tornado Missile Supporting Technical Documentation

a, c



# Schedule & Construction Activities

a,c



# Questions

