

# AREVA Enrichment Services

## Eagle Rock Enrichment Facility

AES Approach for Developing IROFS Boundary  
Definition Documents (BDD)

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## Meeting Objectives

- ▶ Discuss the AES IROFS boundary definition process
- ▶ Provide an overview of the initial boundary definition document (BDD)
  - ◆ BIN 1 – Hardware Only IROFS
  - ◆ IROFS51 – Process Building Seismic Design
  - ◆ Initial package related to SBM
- ▶ Obtain NRC feedback

# Boundary Definition Document



## Appendix A from ISAS is used in AES Procedure PM-ENG-03-019

- ◆ Integrates key input providers – Engineering Companies, AES Engineering & AES Safety
- ◆ Added Human Factors related requirements to be addressed as part of the final BDD Packages
- ◆ References to Specific Implementing procedures or technical documents supporting BDD Package development, control and retention
- ◆ BDD are documented in a formal AES Boundary Package Document

## Table of Contents

1. IROFS Safety Function Identification
2. IROFS Attributes
  - ◆ Safety functions (a – r)
  - ◆ Support functions (s – z)
  - ◆ Human factor attributes
3. Management Measures/Reliability

**Responses (and justification for the responses) to items 1, 2, and 3 above are documented in the Boundary Package Document.**



## **Initial BDD: IROFSS1** **Process Building Seismic Design (SBM)**

- ▶ **Building or structure-related IROFS are QA Level 2 (QAPD Section 2.1)**
- ▶ **IROFSS1 falls into BIN 1 - Hardware Only IROFS Boundary Definition**
  - ◆ Since performance of the safety function is dependent entirely on the design and construction of the building structures, this IROFS is classified as a BIN 1 Hardware only IROFS (No operator actions are needed to satisfy the intended safety function of the IROFS)
- ▶ **IROFS Safety Function Identification**
  - ◆ Design feature of buildings containing UF6 process systems for seismic to ensure UF6 process systems integrity
  - ◆ This is implemented by designing the building structures to withstand the effects of seismic events consistent with the assumptions in the bases for the consequence calculations

## IROFS Attributes



- ▶ **As each IROFS attribute is considered, the following general guidance is applied by the preparer and reviewers of a typical BDD, as appropriate.**
  - ◆ How does the attribute support the safety function defined for the IROFS?
  - ◆ Which specific components are required for the attribute to support the safety function?
  - ◆ For each component (or sub-component as appropriate):
    - How does the component support the safety function?
    - Which properties or characteristics of the component are required to provide this support?
    - What is required to establish design values for these properties or characteristics that assure acceptable performance?
    - What is required to assure that these properties or characteristics are within acceptable design value ranges?
  - ◆ What specific actions or operations are required for the attribute to support the safety function? (Not applicable to Bin 1 IROFS, but included here for completeness and discussion.)
- ▶ **For each action/operation:**
  - ◆ How does the action/operation support the safety function?
  - ◆ Which characteristics of the action/operation are required to provide this function?
  - ◆ What is required to establish design values for these characteristics that assure acceptable performance?
  - ◆ What is required to assure that these characteristics meet the design values?

# Attributes Determined Not Applicable

## ▶ Safety Functions

- ◆ Separation from other redundant or diverse IROFS
- ◆ b. Redundancy/Diversity/Independence
- ◆ c. Electrical Separation (Isolation)
- ◆ e. Leak-tightness
- ◆ f. Piping and (Pressure) Vessel Pressure Integrity
- ◆ g. Software Validation Verification (V&V)
- ◆ h. Setpoints
- ◆ i. IROFS Reset Capability
- ◆ j. Equipment Qualification
- ◆ l. Normal Electrical Power Supply Voltage and Frequency Variations (including power surges)
- ◆ m. Electromagnetic Interference (EMI) / Radio-Frequency Interface (RFI)
- ◆ n. Fire Protections
- ◆ o. Lightning Protection
- ◆ p. Internal Flooding

## ▶ Support Functions

- ◆ s. Instrumentation
- ◆ t. Controls
- ◆ u. Heat Tracing
- ◆ v. Instrument/Control Air System
- ◆ w. Cooling System(s) (Air and/or Water)
- ◆ x. Lubrication System(s)
- ◆ y. Seal System(s)
- ◆ z. Electrical Power (Normal/Emergency) System(s)

**Attributes determined to be not applicable are justified in the responses included in the BDD.**

## Applicable Safety Function Attributes

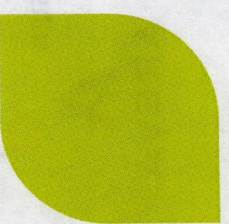
### ▶ (d) Fail-Safe or Highly Reliable [For IROFSS1 - Design is highly reliable] -

*If the IROFS is designed to be highly reliable, then identify the methods and components used to achieve high reliability*

- ◆ Building design is sufficiently reliable to meet 10CFR70.61 performance criteria.
- ◆ The building and its seismic qualification is based on design, material, inspection, and construction commensurate with the codes and standards used
- ◆ The design basis earthquake (DBE) for the buildings has been selected as the 10,000-yr (1.0E-4 mean annual probability) earthquake
- ◆ This DBE for the buildings is used in the detailed design process to demonstrate compliance with the overall ISA performance requirements
- ◆ This has been accomplished by confirmatory seismic performance calculations for the seismic building IROFS
- ◆ The calculations demonstrate that the structural performance for this DBE has a likelihood of unacceptable performance of less than approximately 1.0E-5 per year
- ◆ The difference between the mean annual probabilities for design (1.0E-4) and performance (1.0E-5) is achieved through conservatism in the design (factors of safety), elasticity in the structures, and conservatism in the evaluation of the design
- ◆ This constitutes a “highly unlikely” event likelihood of exceeding the seismic capacity of the building
- ◆ The applicable calculations (by revision) are identified and listed in the BDD. (Once AES Design Report issued, applicable revisions of BDD will be identified therein.)

# Applicable Safety Function Attributes

Continued



▶ (k) **Seismic Qualification** - IROFS components whose safety function is required during or after a design basis seismic event shall be seismically qualified. Identify any additional components necessary to achieve qualification

## ◆ Seismic Qualification Specific Safety Function

- All main structural building members and connections for the SBM and connections for SSCs located in the vicinity of IROFS will maintain their structural integrity during and after the DBE seismic event

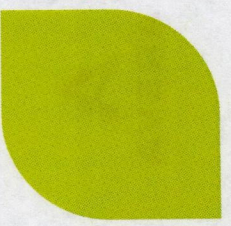
## ◆ Boundary Physical Components

- Rock base surface and foundation concrete backfill for IROFS buildings
  - Building superstructures – all main load-carrying building components and connections that are part of the building's structural analysis/design
    - Structural steel members, connections and anchor bolts
    - Reinforced concrete building components
  - Main load carrying members and connections for SSCs located in the vicinity of IROFS
- ◆ The final Critical Attributes are listed based on Quality Level Classification Forms (QCFs) generated in accordance with PM-ENG-03-022



# Applicable Safety Function Attributes

Continued



## ▶ (k) Seismic Qualification (cont.)

- ◆ Seismic Qualification of Rock Base Surfaces for IROFS Buildings
  - Safety Function Contribution – A solid rock base surface will ensure that the geotechnical rock dynamic properties used in the earthquake foundation analysis/design are maintained
  - Critical Attributes:
    - A. The post-excavated rock surfaces shall be clean of loose rock
    - B. The QA Level 2 Controls are rock surface inspections by a geotechnical or geological engineer
- ◆ Seismic Qualification of Concrete Fill Backfill for IROFS Buildings
  - Safety Function Contribution – The strength and dynamic properties of the concrete backfill will be equivalent to the rock base
  - Critical Attributes:
    - A. The shear wave velocity
    - B. The compressive strength of the concrete backfill
    - C. QA Level 2 Controls are concrete cylinder break strength tests
- ◆ Other elements treated in a similar manner (e.g., building superstructure elements – steel members, connections, anchor bolts and reinforced concrete building components)
- ◆ Critical attributes are incorporated into the technical specifications that are used for procurement and construction

## Applicable Safety Function Attributes

Continued

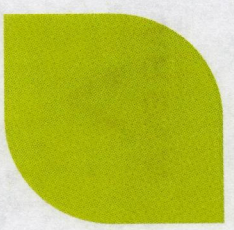
- ▶ (q) **Load Drop/Impact** - *IROFS shall be designed such that load drops/impacts do not adversely impact IROFS safety function. Identify design features provided to preclude adverse impact*
  - ◆ All structural elements of the building are part of the IROFS51 boundary
  - ◆ Internal building architectural and mechanical and electrical equipment loads supported from these elements have been evaluated to not result in a load drop or impact state that would negatively impact this IROFS in the event of the design basis earthquake
  - ◆ This is accomplished through the design criteria for the EREF Structures, Systems, and Components

# Applicable Safety Function Attributes

Continued

- ▶ (r) Non-QA Level Component Interactions with QA Level Components - *IROFS shall be designed such that interactions between non-QA Level components and QA Level components do not adversely impact IROFS safety function. Identify design features provided to preclude adverse impact*
- ◆ Non-QA Level (Non QA Level Components are QA Level 3 or FP Components as defined in the QAPD) components are outside the IROFS51 boundary. Failure of these components during the design basis earthquake is addressed under Section 2.q of the BDD for load drop/impact. There are no other non-QA Level components which interact with IROFS51 that could negatively impact the IROFS safety function
- ◆ Adjacent buildings are adequately separated and/or designed such that there is no adverse interaction between the buildings

## Human Factor Attribute(s)




### ▶ **Applicable:**

- ◆ **a. Operating Experience Review (OER) - AES Procedure PM-ENG-03-010, EREF**  
*Lessons Learned Program* is used to identify and implement lessons learned from the following into building IROFSS1 :

- Other AREVA facilities (e.g., GB11, REC11)
- Vendor experience (e.g., ETC, URS)
- Industry experience
- MOX
- NRC

### ▶ **Not Applicable**

- ◆ **b. Functional Requirements Analysis (FRA)**
- ◆ **c. Function Allocation (FA)**
- ◆ **d. Human System Interface Design (HSI)**



# Management Measures & Reliability

## ► **Applicable:**

- ◆ **a. Configuration Management**
  - AES Procedure PM-ENG-02-001, *Configuration Management Program* addresses the implementation of Configuration Management for IROFS, and any items that may affect the function of IROFS. The configured elements (i.e., drawings, specifications, calculations etc.) of IROFSS1 are defined in this boundary package
- ◆ **c. Training and Qualifications**
  - There are no unique training or qualification requirements associated with the “operation” of this IROFS. The IROFS safety function (seismic qualification of the building) is based on design, material, inspection, and construction commensurate with the codes and standards used
  - Personnel involved in the design, construction, testing, and inspection of this IROFS are trained and qualified as required by these applicable codes, standards, and quality assurance programs of the organizations responsible for the work
- ◆ **d. Procedures**
  - Activities to design, construct, test, and inspect the building features required to achieve seismic qualification of the SBM are performed to written procedures as required by applicable codes, standards, and quality assurance programs, where applicable
- ◆ **e. Audits and Assessments**
  - Audits and assessments will be performed as required by the QAPD to ensure that IROFSS1 performs as required

# Management Measures & Reliability

Continued



## ▶ Applicable (cont.):

### ◆ f. Incident Investigations

- The CAP for incidents associated with IROFSS1 are performed in accordance with the QAPD. AES Procedure QA-16-03-001, *Corrective Action Program* – *WEBCAP* and equivalent sub tier vendor procedures, are used to address incidents

### ◆ g. Record Management

- Record management as required by the QAPD, are performed and controlled by contract with sub tier vendors to assure that the QAPD requirements are met. AES Procedure QA-17-03-001, *Quality Assurance Records* and sub tier vendor equivalent procedures, are used for project record management

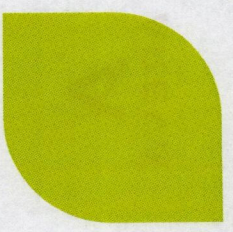
## ▶ Not Applicable:

### ◆ b. Maintenance

- 1. Planned Maintenance/Preventive Maintenance
- 2. Functional Testing (Preoperational and Operational) / inspection
- 3. Calibration
- 4. Response Time Testing

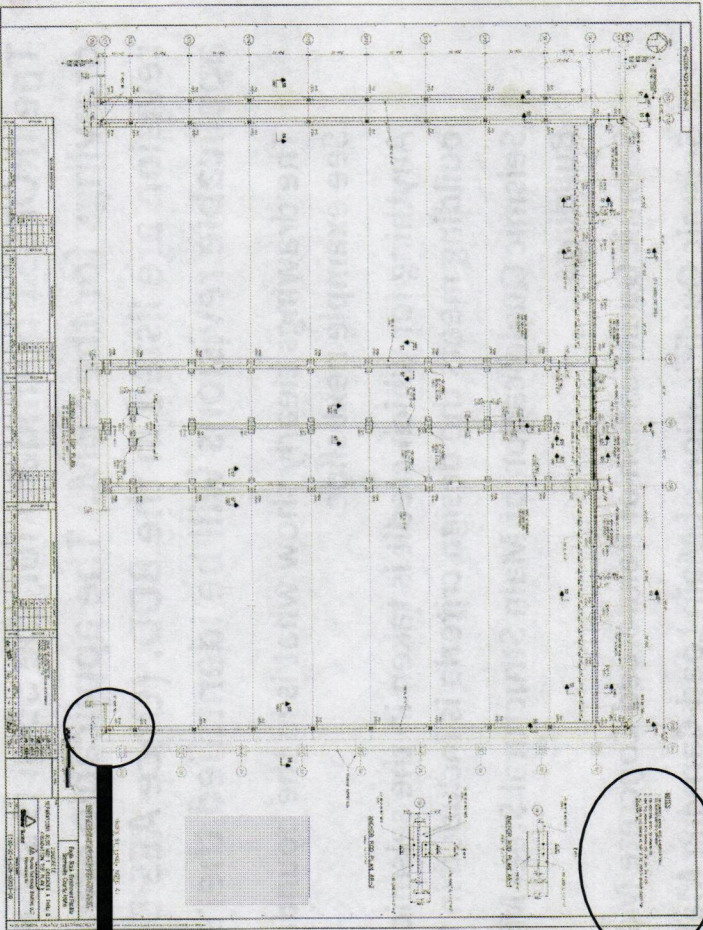
### ◆ h. Other Quality Assurance Elements

## Documentation of IROFS Boundary



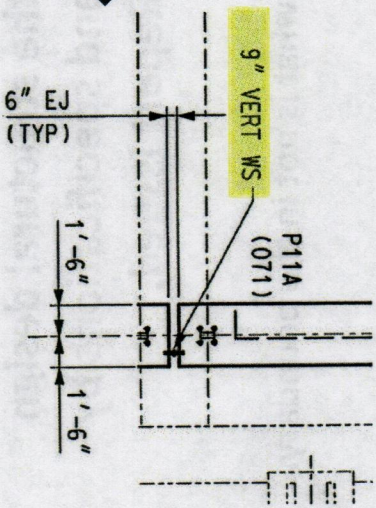
- ▶ The IROFS51 boundary for the SBM is shown on the structural design drawings for the SBM. The applicable drawings and specifications by revision are listed in the BDD. (Once AES Design Report issued, applicable revisions will be identified therein.)
  - ◆ The drawings clearly show what is in the boundary and what is not in the boundary. See example next slide
  - ◆ Anything for which credit is taken in the seismic analysis to demonstrate that the building meets the design criteria is included in the boundary.
  - ◆ Seismic Qualification of Main Structural Steel Members and Connections for IROFS Buildings
  - ◆ Seismic Qualification of Reinforced Concrete Members for IROFS Buildings
  - ◆ Seismic Qualification of Main Load-Carrying Members and Connections for SSCs Located in the Vicinity of IROFS

# IROFSS1 Boundary on Structural Concrete Drawing



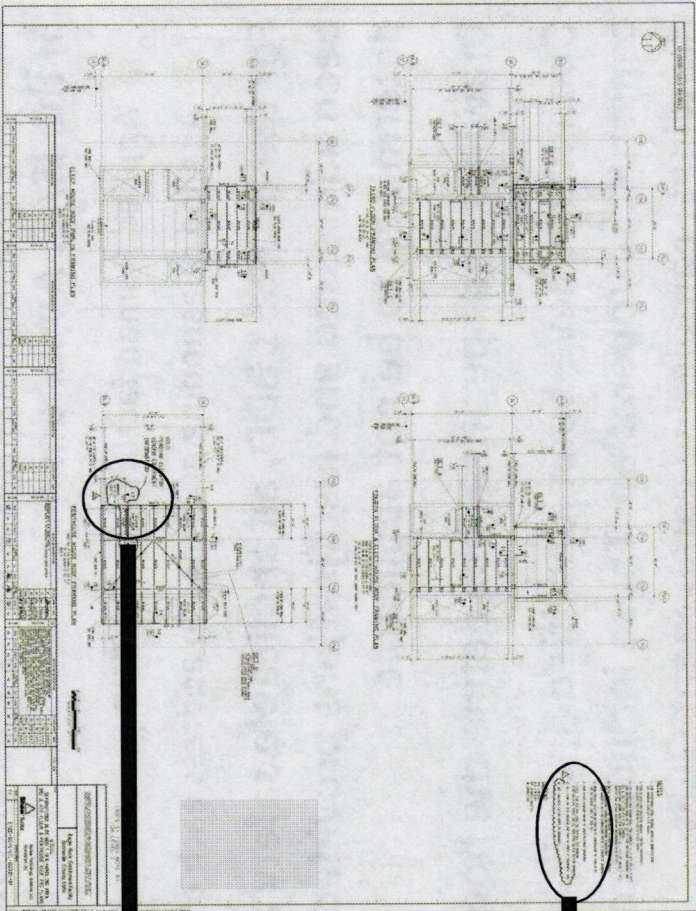
## NOTES

1. FOR CONCRETE GENERAL NOTES & ABBREVIATIONS, SEE DRAWING E00-00-5-CN-00001.
2. FOR ADDITIONAL NOTES, SEE DRAWING 001.
3. WORK THIS DRAWING WITH DRAWING 003, 004, 005, 004 & 035.
4. ALL ITEMS ON THIS DRAWING ARE PART OF THE IROFSS1 BOUNDARY EXCEPT FOR MATERIALS (MS1).





# IROFSS1 Boundary on Structural Steel Drawing

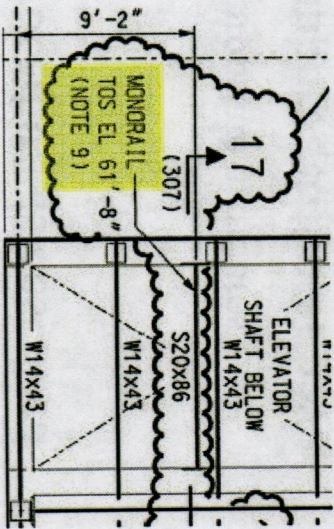


NOTE: ALL STEEL FABRICATED PER THE IROFSS1 BOUNDARY. SEE IROFSS1 BOUNDARY FOR DETAILS.

OK

1. STEEL FIRE RAILINGS SHALL BE DETAIL PER UNIFORM EDITION 00-5-S-STL-00001 AND AS INDICATED ON THE DESIGN DRAWINGS.  
 8. ALL ITEMS ON THIS DRAWING ARE PART OF IROFSS1 BOUNDARY. UNCL.  
 9. NOT INCLUDED IN THE IROFSS1 BOUNDARY.

## LEGEND



## Conclusion



- ▶ AES has implemented the boundary definition procedure as described in the ISAS, Appendix A
  - ◆ Applied Human factors into the BDD process
  - ◆ Applied questioning guidance to address each of the appropriate attributes
- ▶ For the IROFSS1 BDD, all applicable safety and support attributes have been addressed and justifications provided for those attributes determined to be not applicable
- ▶ Drawings and specifications define the boundary
- ▶ Open Items have been identified and will be closed prior to construction/operation These include completing calculations and drawings; completing component QCFs

**The IROFSS1 Boundary Definitions Package is a living document**