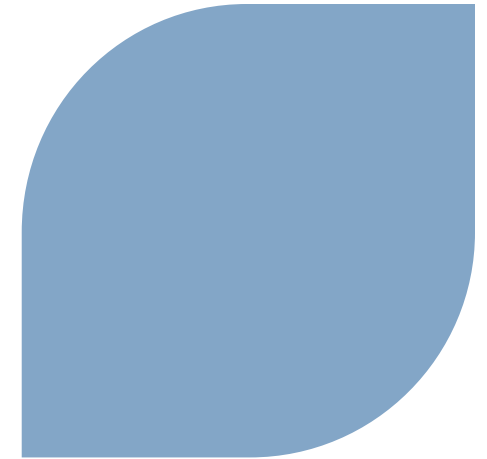
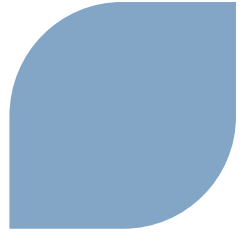


# U.S. EPR I&C Design Plans

AREVA/NRC Meeting  
Rockville, MD  
December 18, 2014

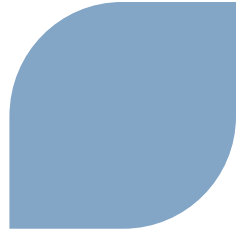


# Agenda



- ▶ **Introductions**
- ▶ **Meeting Objectives**
- ▶ **Status of U.S. EPR I&C Activities**
- ▶ **Review of Current Open Issues**
- ▶ **Plan to Address RAI 555 Question 07.01-53**
- ▶ **Analysis Approach and Method (Proprietary)**
- ▶ **Next Steps**
- ▶ **Meeting Summary**

# Meeting Objectives

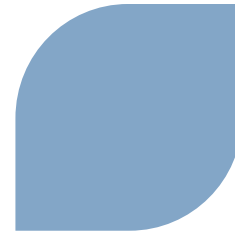


- ▶ **Provide an update on I&C activities for the U.S. EPR DC project**
- ▶ **Present proposed approach to resolve plant level impact of non-safety related control system failures to obtain NRC feedback and concurrence**
- ▶ **Align on Chapter 7 open issues associated with July 2 letter and plans for closure**

## Status of U.S. EPR I&C Activities

- ▶ **AREVA / NRC interaction on U.S. EPR I&C design has been deferred since August 2013**
- ▶ **Sept. 30, 2014 closure plan letter identifies remaining Chapter 7 activities**
  - ◆ **SPND failures (RAI 505 Q07.01-33 and ANP-10287P) – resolved during Nov. 4-6, 2014 audit**
  - ◆ **RAI 555 Q07.01-53**
  - ◆ **RAI 608 Q07.01-56 through 07.01-63**
  - ◆ **RAI 609 Q07.01-64 through 07.01-83**
  - ◆ **RAI 611 Q07.01-84**

# Overview of Current Open Issues



## ▶ Today's meeting

- ◆ Discuss design and analysis approach to address points in RAI 555, Question 07.01-53 and July 2, 2013 letter

## ▶ Future meetings

- ◆ Open Technical Points in Chapter 7 RAI 555, Question 07.01-53 and July 2, 2013 letter closure plan
- ◆ Remaining RAIs identified in Chapter 7 closure plan
- ◆ I&C design interfaces with other FSAR chapters

*AREVA seeks regular, transparent dialogue on open issues*

## Plan to Address Question 07.01-53

- ▶ AREVA has reviewed the NRC position on the last AREVA response to RAI 555, Question 07.01-53 and the July 2, 2013 letter and will supersede the previous response.
- ▶ The revised response will address the results of analyses, including any new defense-in-depth features which demonstrate that the U.S. EPR is adequately protected from the effects of common cause failures and spurious actuations of non-safety related I&C systems.

*Analysis conclusions will be provided to support the safety case*

## RAI 555 Question 07.01-53

- ▶ **“The staff requests the applicant provide additional information on how the U.S. EPR Design takes into account and bounds the effects of potential failure(s) of the Process Automation System (PAS) and Process Information and Control Systems (PICS) on safety-related components and systems.”**
- ▶ **“Demonstrate how the plant would be adequately protected from each PAS failure, including software and hardware failures that could prevent or delay the safety function in multiple safety divisions.”**
- ▶ **“Are the safety functions and their corresponding response times in FSAR Table 15.0-8 sufficient to protect the plant if a PICS/PAS failure occurs, and is the PS capable of mitigating a Design Basis Event (DBE) concurrent with a PICS/PAS failure?”**

*AREVA agrees these points need to be comprehensively addressed*

## Points from July 2<sup>nd</sup> Letter

- ▶ Means are to be taken outside the software affected by the SWCCF to either prevent or mitigate the SWCCF. Means within the software affected by the SWCCF are not to be credited for prevention or mitigation.
- ▶ The staff position calls for preventive and mitigative means for SWCCF outside the affected software both from a practical approach and to support an adequate level of defense-in-depth.
- ▶ DI&C-ISG-04 states that if spurious actuations are possible as a result of the design basis condition, then the safety analyses must envelope those spurious actuations.

*ISG Points on malfunctions and spurious actuations will be addressed*

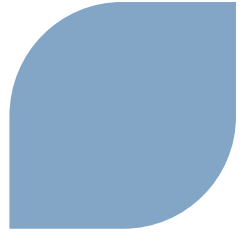


## Points from July 2<sup>nd</sup> Letter

- ▶ The NRC staff expects AREVA NP to evaluate the complete design to ensure coherence across all areas of the I&C design
- ▶ Provide a plan to address the NRC staff's issues in those areas of the design where AREVA NP has not yet submitted final responses to the NRC staff's RAIs
- ▶ The impact upon safety-related systems caused by failures in non-safety-related I&C systems must be bounded by the safety analysis or prevented/mitigated by design features that do not rely upon the affected non-safety-related I&C system
- ▶ The comprehensive review should also address spurious actuation of other I&C systems, such as the protection system and diverse actuation system

*A comprehensive review has identified a number of items that have been added to the I&C closure plan*

# Start of Proprietary Information



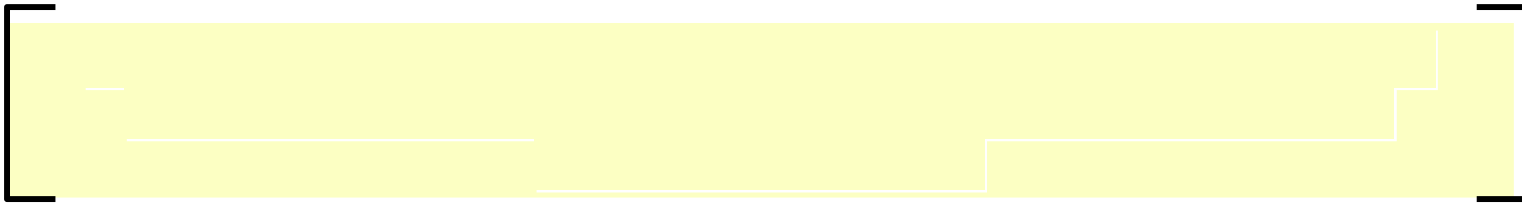
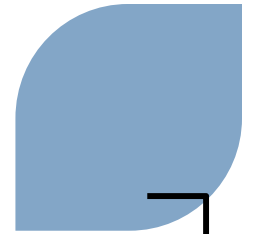
▶ **Closed meeting will begin with next slide**

# Closure Plan

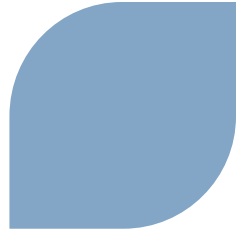
- ▶ AREVA has been developing a closure plan that addresses open items required to resolve RAI 555, Question 07.01-53 and the July 2, 2013 letter technical points

*Details about this method will be provided later in the presentation*

# Closure Plan



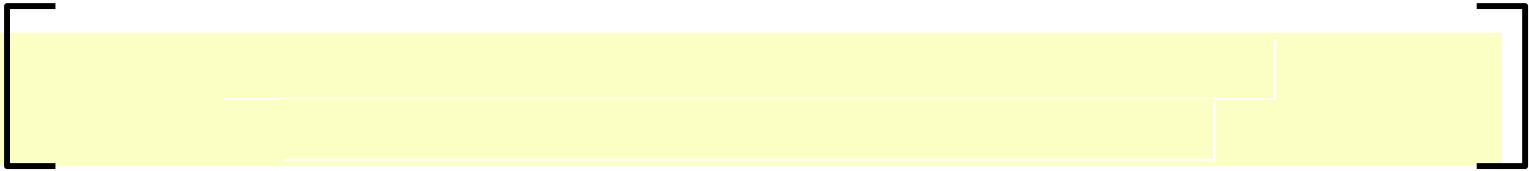
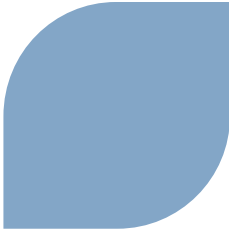
# Closure Plan



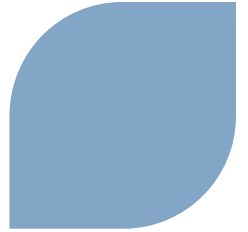
- ▶ Preventive or mitigative changes may be needed to resolve CCFs that cannot otherwise be addressed by analysis.
- ▶ Today's meeting will focus on the methodology used by the Plant Coping Analysis to address the effects of CCF of non-safety I&C systems
- ▶ Future meetings will elaborate more on other aspects of the closure plan

*The details of the analysis approach will be discussed next*

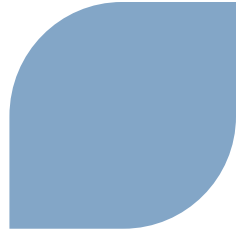
# Objective of Plant Coping Analysis



# Plant Coping Analysis Key Inputs/Assumptions

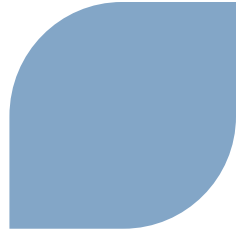


# Plant Coping Analysis Key Inputs/Assumptions

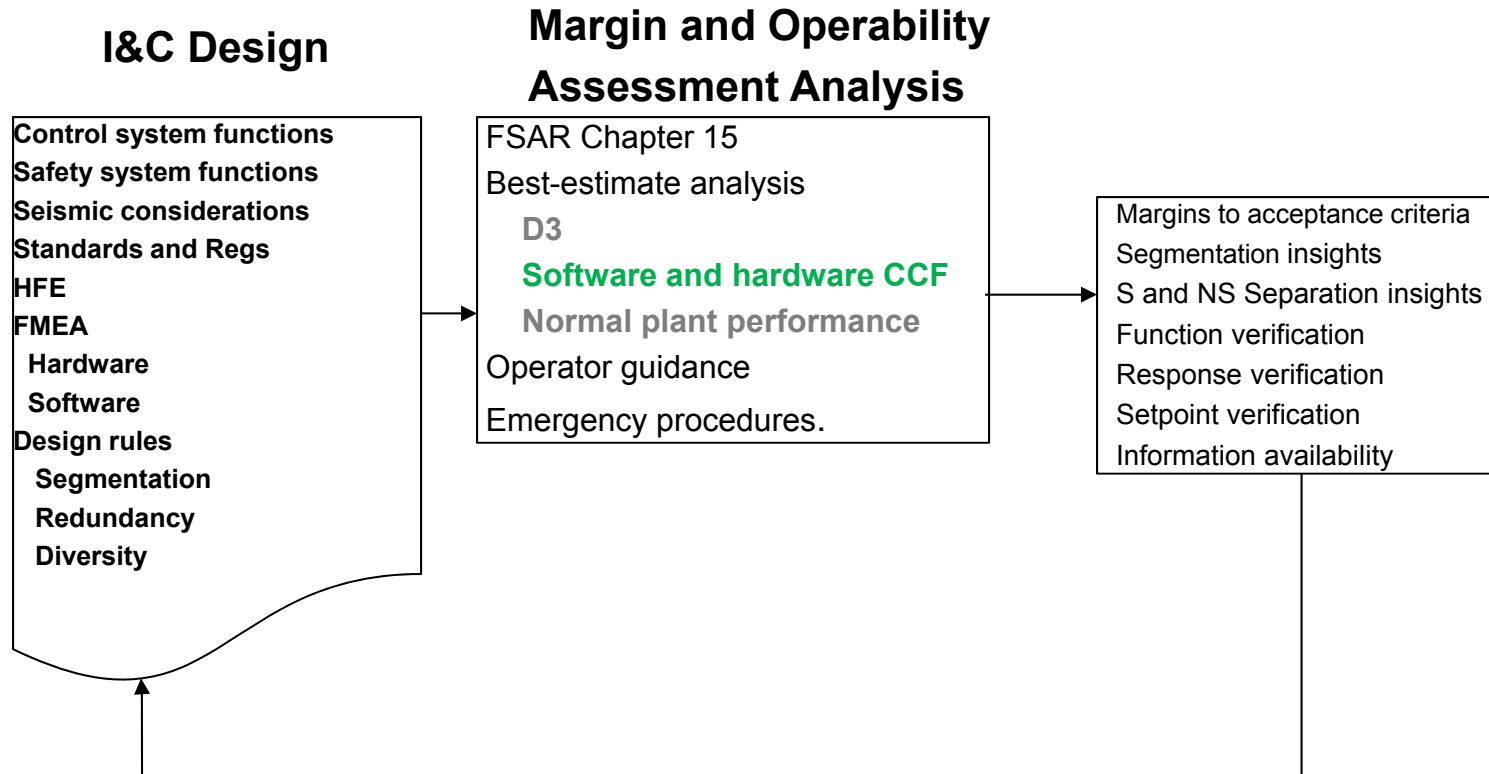
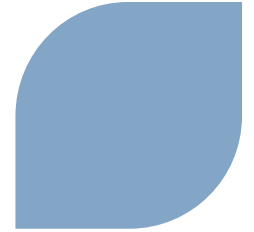




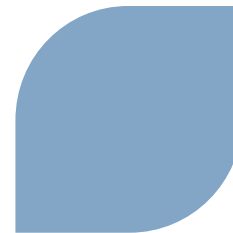
# Plant Coping Analysis Key Inputs/Assumptions



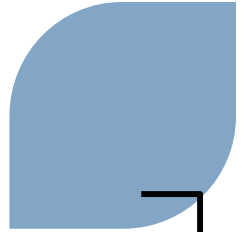
# Analysis as Part of Design Process



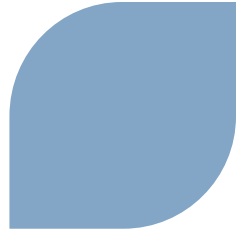
# System Analysis Logic



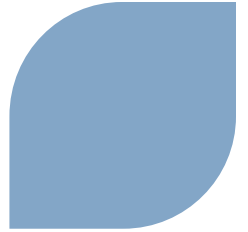
# Quick Overview



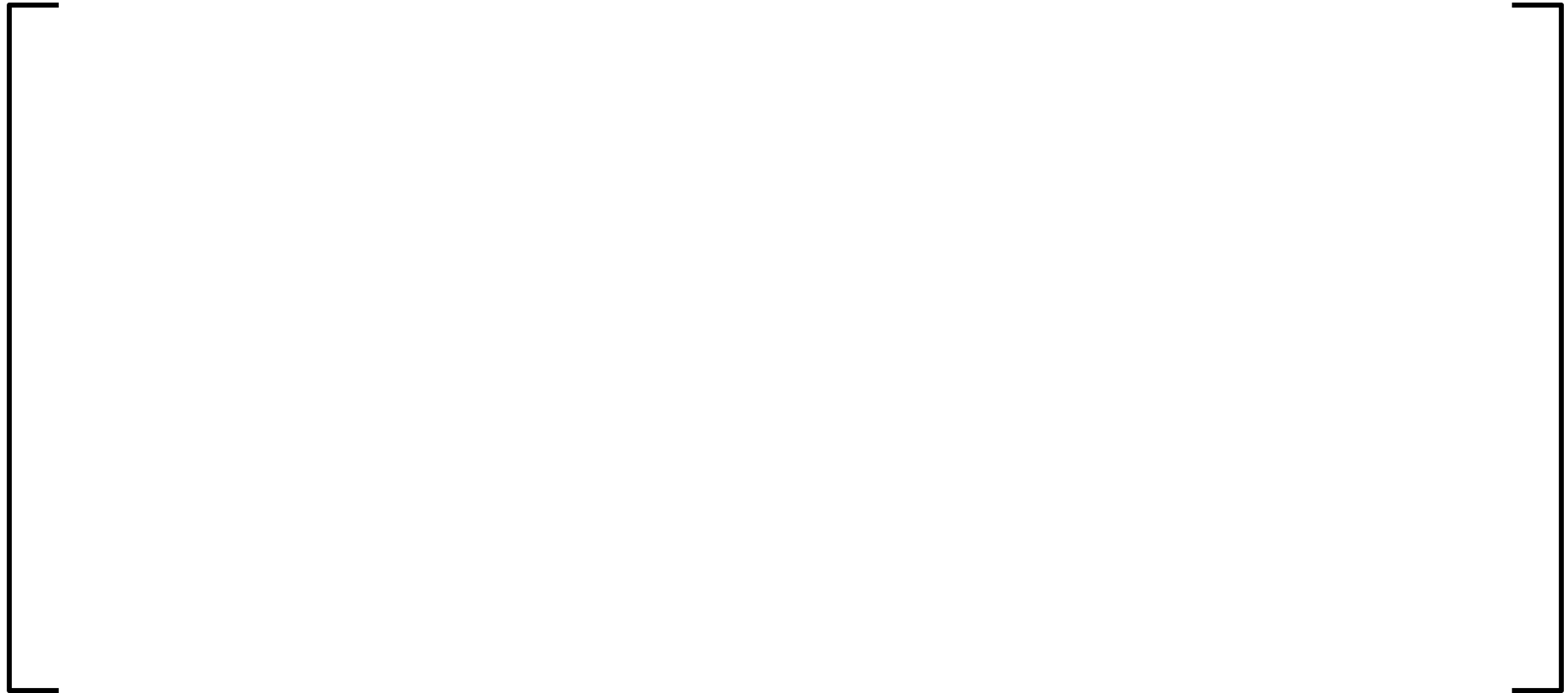
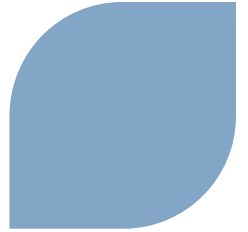
# System Analysis of CCF



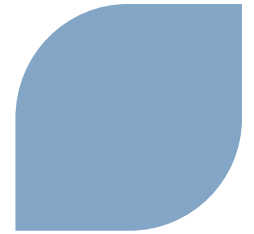
# System Analysis of CCF



# General Approach

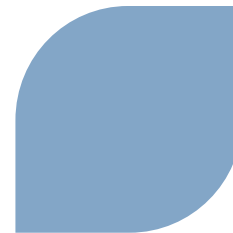


# Methodology

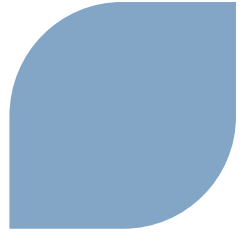




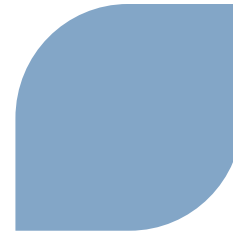
# Methodology



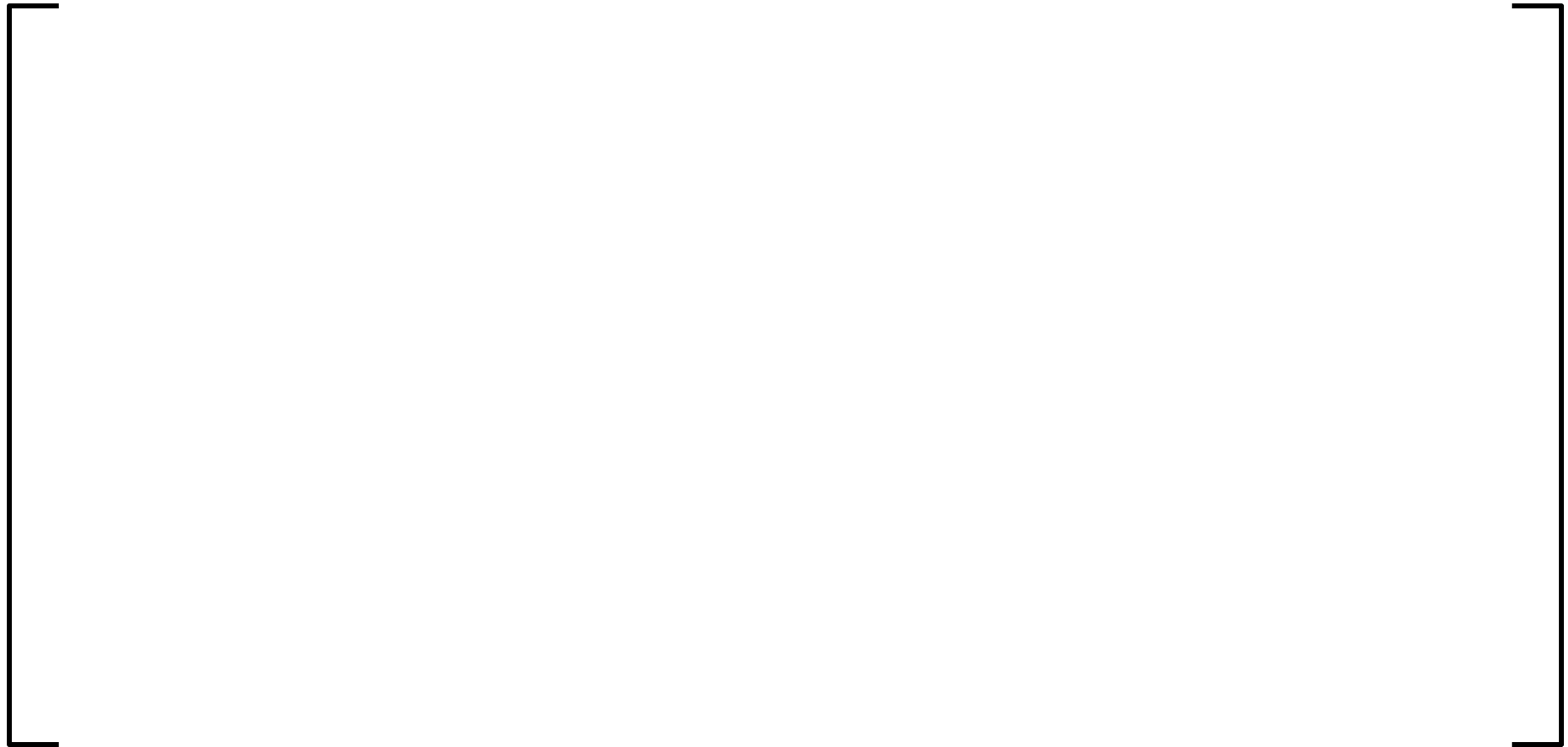
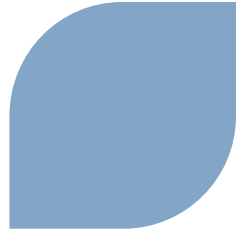
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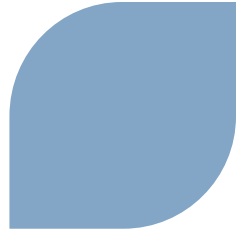
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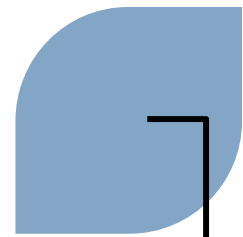


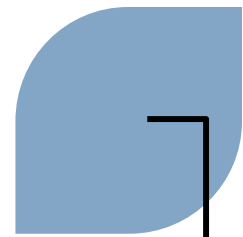
# Issues To Be Solved

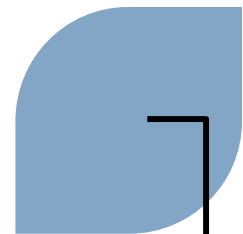


# Evaluation Approach







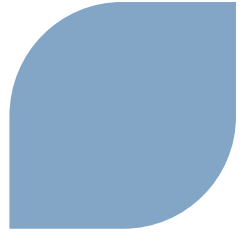




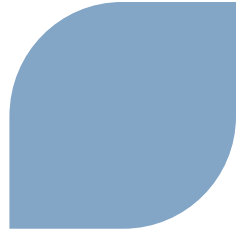
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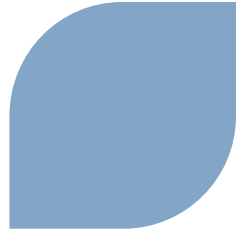
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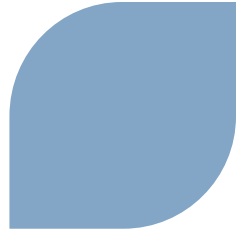
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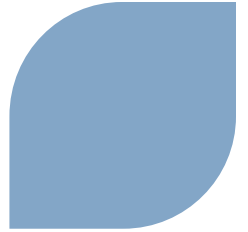
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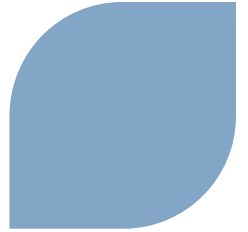
# Demonstration of Method



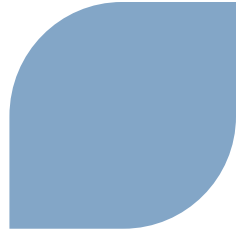
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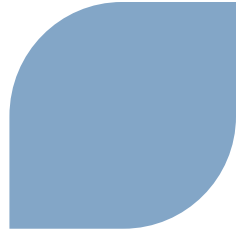


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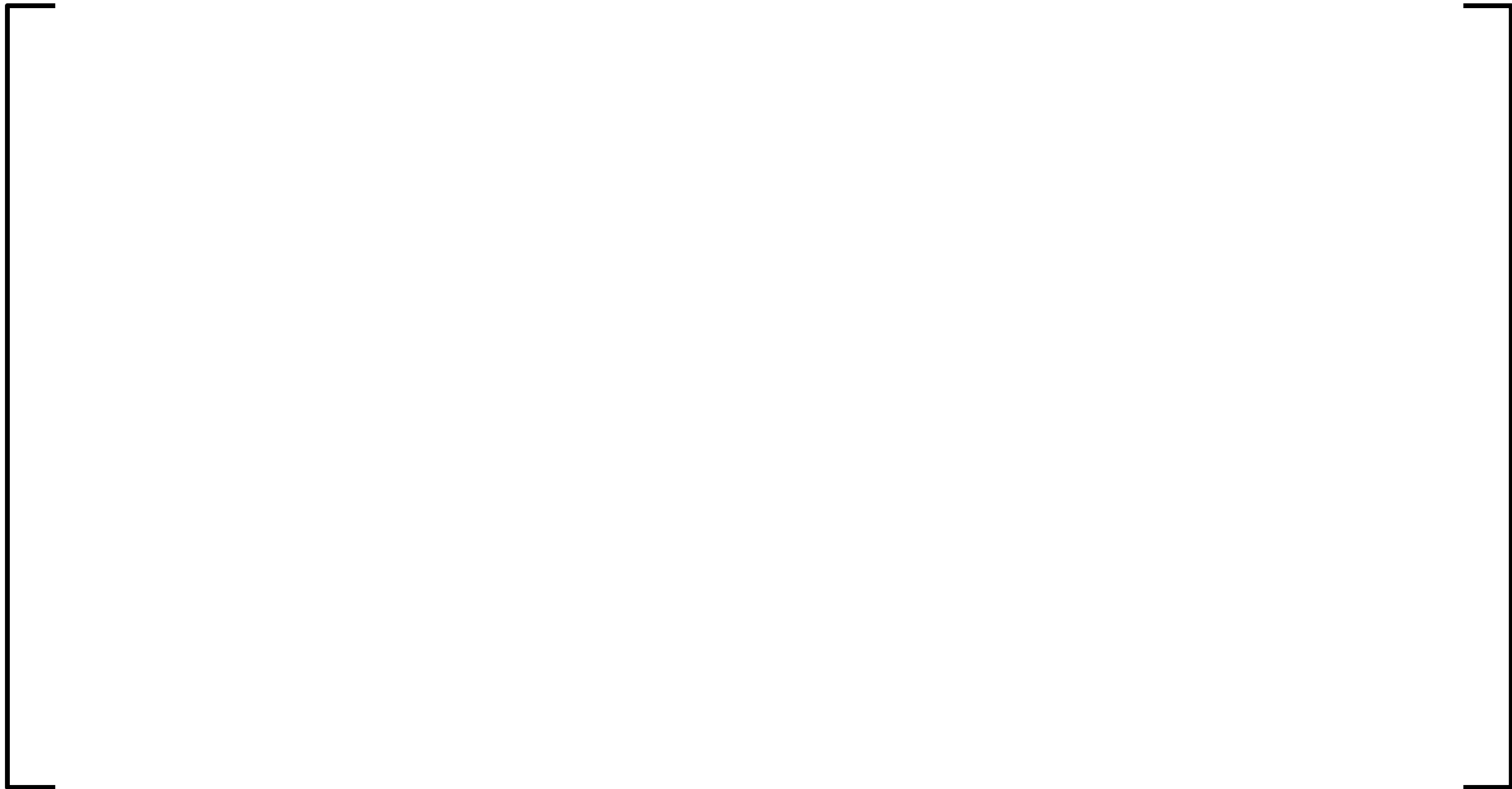
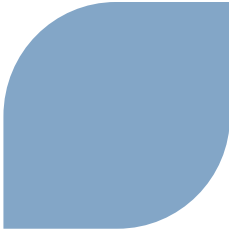




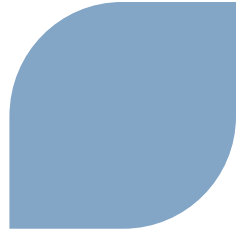
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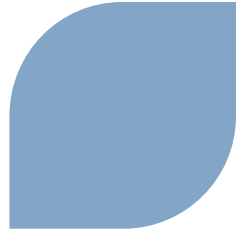
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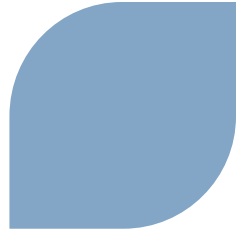
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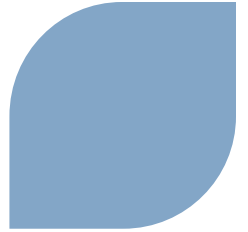
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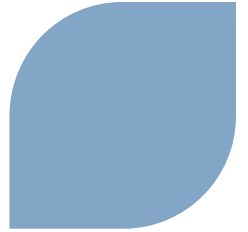
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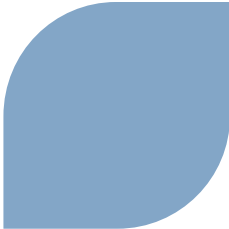
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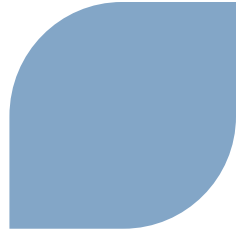


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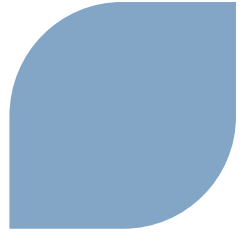




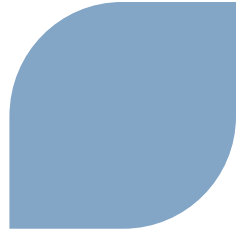
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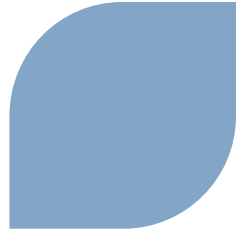
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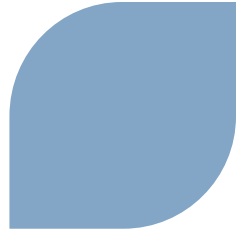
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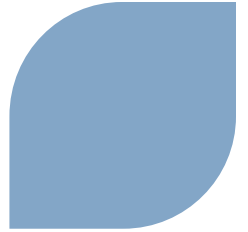


# Demonstration Results

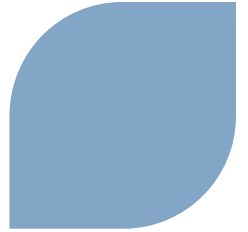


*Peak RCS pressure well below acceptance criterion*

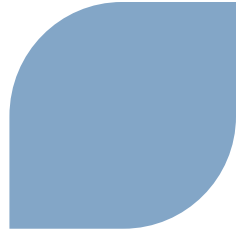
# Discussion of Preliminary Results



# Discussion of Preliminary Results

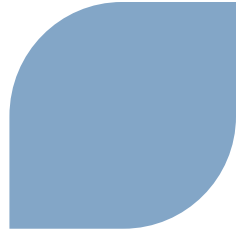


# Discussion of Preliminary Results

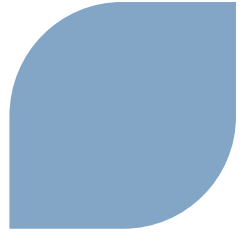




# Analysis Summary



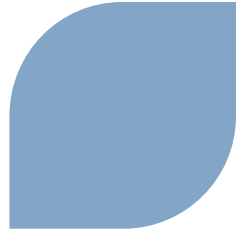
# Analysis Summary



## Next Steps

- ▶ **Elaborate on the Closure Plan to address RAI 555 Question 07.01-53 and July 2<sup>nd</sup> letter technical points**
  - ◆ Next meeting targeted for January/February 2015
- ▶ **Complete analyses and determine any preventive or mitigative changes needed to address CCFs and spurious actions that cannot otherwise be addressed by analysis**
- ▶ **Submit revised response to RAI 555 Question 07.01-53**

## NRC Feedback



▶ **Closure plan for RAI 555 Q07.01-53 and July 2<sup>nd</sup> letter**

▶ **Coping analysis**



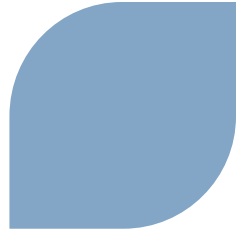
▶ **Complimentary analyses**



▶ **Approach to future preventive or mitigative changes that may be needed to resolve CCFs**

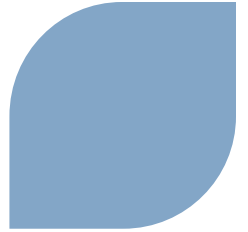
▶ **Other**

## Meeting Summary



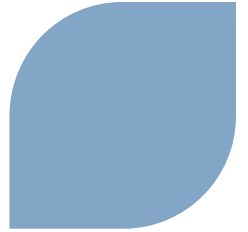
- ▶ **AREVA is progressing toward resolution of remaining Chapter 7 open issues with a priority on resolution of RAI 555 Q07.01-53.**
- ▶ **AREVA looks forward to regular, transparent dialogue on the remaining issues.**
- ▶ **AREVA has presented a design and analytical approach that is responsive to NRC concerns regarding non-safety related control system failures.**
- ▶ **Future meetings will elaborate on additional aspects of the closure plan.**

# Acronyms/Nomenclature



- ▶ **AOO** Anticipated operational occurrence
- ▶ **BOL** Beginning of life
- ▶ **CCF** Common cause failure
- ▶ **DAS** Diverse actuation system
- ▶ **DBE** Design basis event
- ▶ **D3** Diversity and defense-in-depth
- ▶ **DC** Design certification
- ▶ **EOL** End of life
- ▶ **FMEA** Failure modes and effects analysis
- ▶ **HFE** Human factors engineering
- ▶ **MSIV** Main steam isolation valves

# Acronyms/Nomenclature



- ▶ **MSRT**      **Main steam relief train**
- ▶ **PAS**      **Process automation system**
- ▶ **PDS**      **Primary depressurization system**
- ▶ **PICS**      **Process information and control system**
- ▶ **PIRT**      **Phenomena identification and ranking table**
- ▶ **PS**      **Protection system**
- ▶ **PSRV**      **Pressurizer safety relief valves**
- ▶ **SAS**      **Safety automation system**
- ▶ **SLS**      **Standard least squares**
- ▶ **SPND**      **Self-powered neutron detector**
- ▶ **SWCCF**      **Software common cause failure**