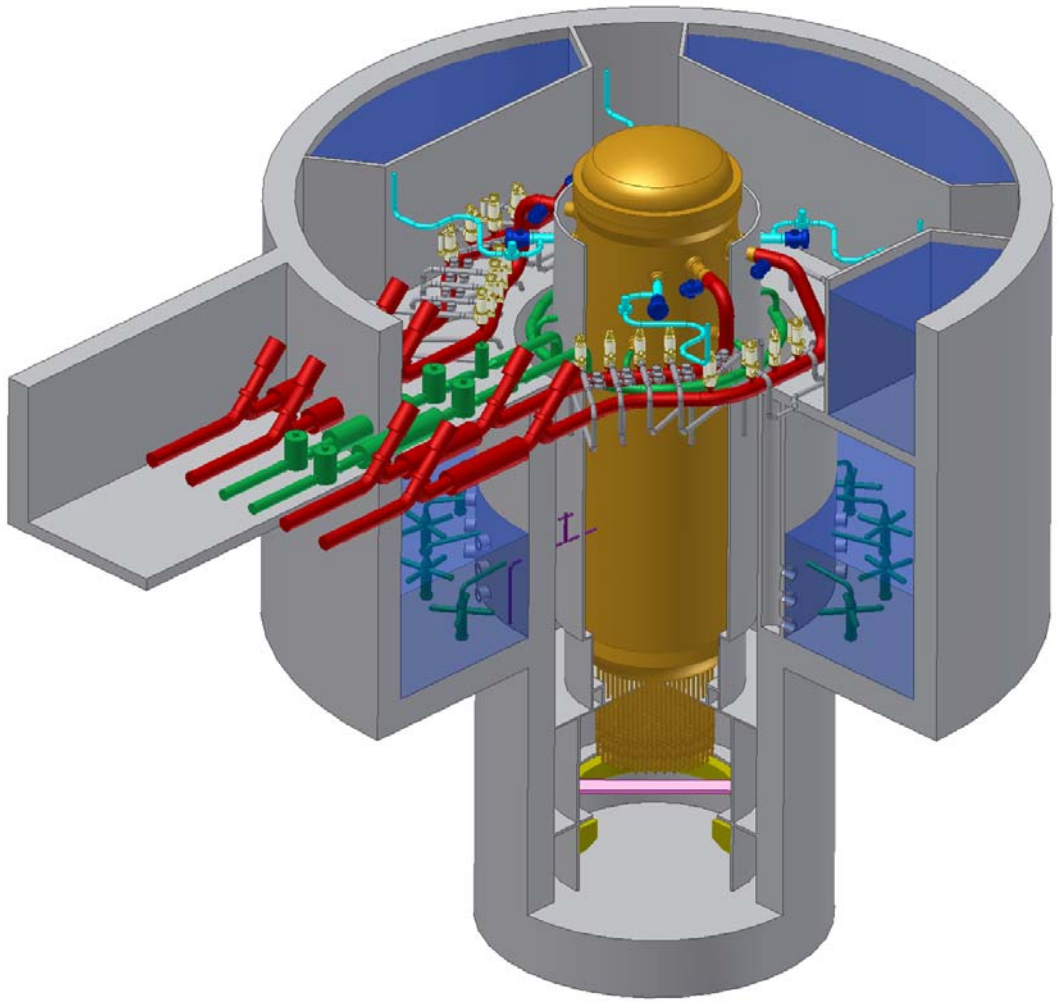
Probabilistic Risk Assessment

Update and Information Exchange



Presented By:
Rick Wachowiak
General Electric
November 29, 2006

imagination at work

GE Presentation Agenda

RAI Status
PRA Rev 2 Scope
PRA Revision Timeline
Affect of Major Design Changes
Common Cause Model
Data for Equipment With Long Test Intervals
Initiating Event RTNSS Analysis
Discussion of Thermal-Hydraulic Uncertainty

Status of Chapter 19 RAI Responses

73 RAIs Remain to Be Answered

18 Are Actively Being Worked

> Severe accidents

> Information already contained in rev 1

9 Can Have Partial Answers Relatively Soon

29 Would Be Most Efficiently Answered in Rev 2

15 Are Seismic Follow-Up Questions

2 We Do Not See the Relevance for DCD Review

Proposal for Moving Forward

Reduce Emphasis on RAIs for Revision 1

Concentrate Our Efforts on Revision 2

This Will Help Focus Both NRC and GE Resources

Scope of PRA Revision 2 – Base Model

Isolation Condenser Additional Water Volume

I&C Architecture and Requirements

Additional Design Detail for BOP Systems

Revise Common Cause Model (MGL Method)

Move Model Detail to Event Trees

Eliminate Sequence Specific Logic Flags

Add Model Detail for 24 – 72 Hour Sequences

Reconcile Component Names With DCD

Include Shutdown and Class II Sequences in LRF

Other Design Details as Information Becomes Available

Scope of PRA Revision 2 - Other

Basic Event Naming Convention May Change

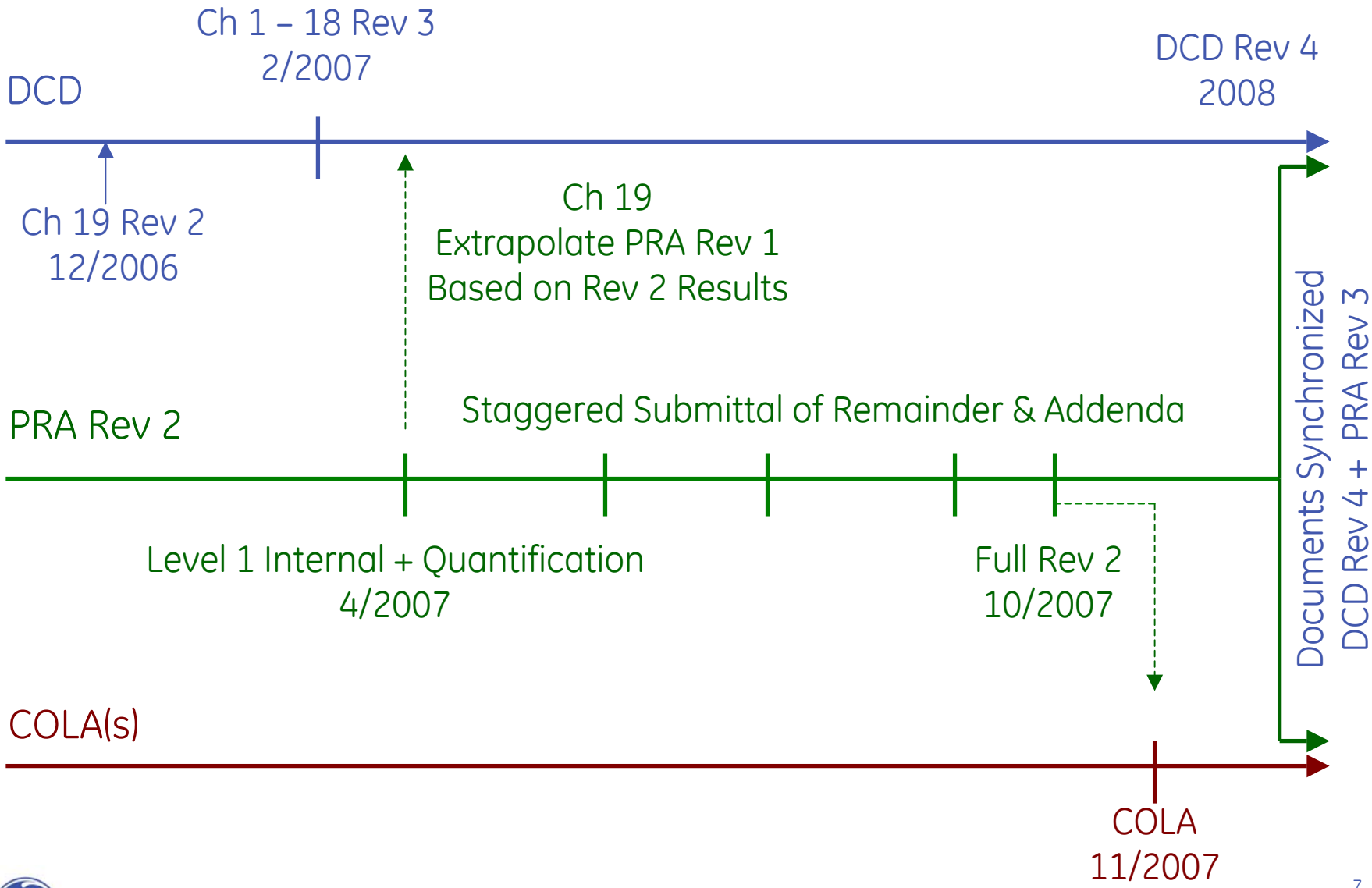
> Required to implement URD database

> Eliminates patch in rev 1 model

Gate Names in Rev 1 Did Not Match Our Convention

Considering Direct Connection of CET to Level 1

Certification PRA Timeline



ICS Design Change

Add Volume to ICS Condensate Return Lines

> 9 m^3 per IC

Allows Optimization of the Level 1 ECCS Signals

CRD Not Needed to Prevent Depressurization in Loss of Feedwater Events

Top 90% of Cutsets in Rev 1 Involve Loss of Feedwater + Loss of CRD

ICS Design Change – Additional Figures

ICS P&ID	Figure 5.1-3 Rev 1
	Figure 5.1-3 Rev 2
LOFW Water Level	Figure 15.2-16c Rev 1
	Figure 15.2-16c Rev 2
TGEN Event Tree	Figure A.3-1 Rev 1
TFDW Event Tree	Figure A.3-3 Rev 1

Digital Control and Instrumentation System Architecture

GE Has Chosen DCIS Architecture

Determined Diversity & Defense-In-Depth Requirements

Implementation of Safety-Related DCIS is Double Failure Proof

> Allows maintenance of 1 division without AOT

> OOS Time Controlled By TRM + Maintenance Rule

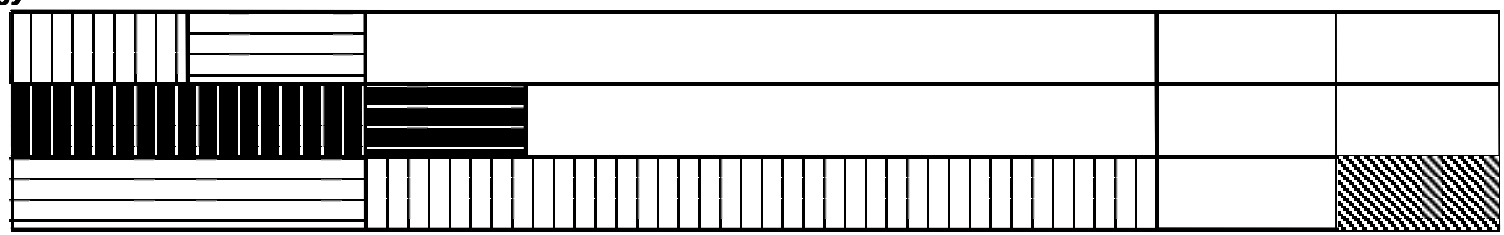
Diversity & Defense-In-Depth Strategy

Safety	Safety-Related		Nonsafety-Related				
Category	E - DCIS		NE - DCIS				
System Families	RPS NMS	ECCS ESF	DPS	NUCLEAR CONTROL SYSTEMS	Balance of any NE-DCIS Systems	PCS	Severe Accident
Architecture	NUMAC Derived	Redundant	Triple Redundant	Triple Redundant	Dual Redundant	Workstations **	PLCs
Systems	RPS LD&IS (MSIV) NMS ATWS/SLCS*	ICS SRV/DPV GDCS LD&IS (Non-MSIV)	RPS ECCS Backup	FWC, PAS (Automation) SB&PC, T/G Control	PIP A, PIP B Balance Of Plant (Power Generation)	HMI, Alarms, SPDF, Historian, 3D-Monicore	Deluge System

Diversity Strategy

*Non-Microprocessor based

** Dual redundant as necessary



Check NEDO-33251 for Latest Version of this Figure

Robust DCIS Implementation

Double Failure Proof (N-2)

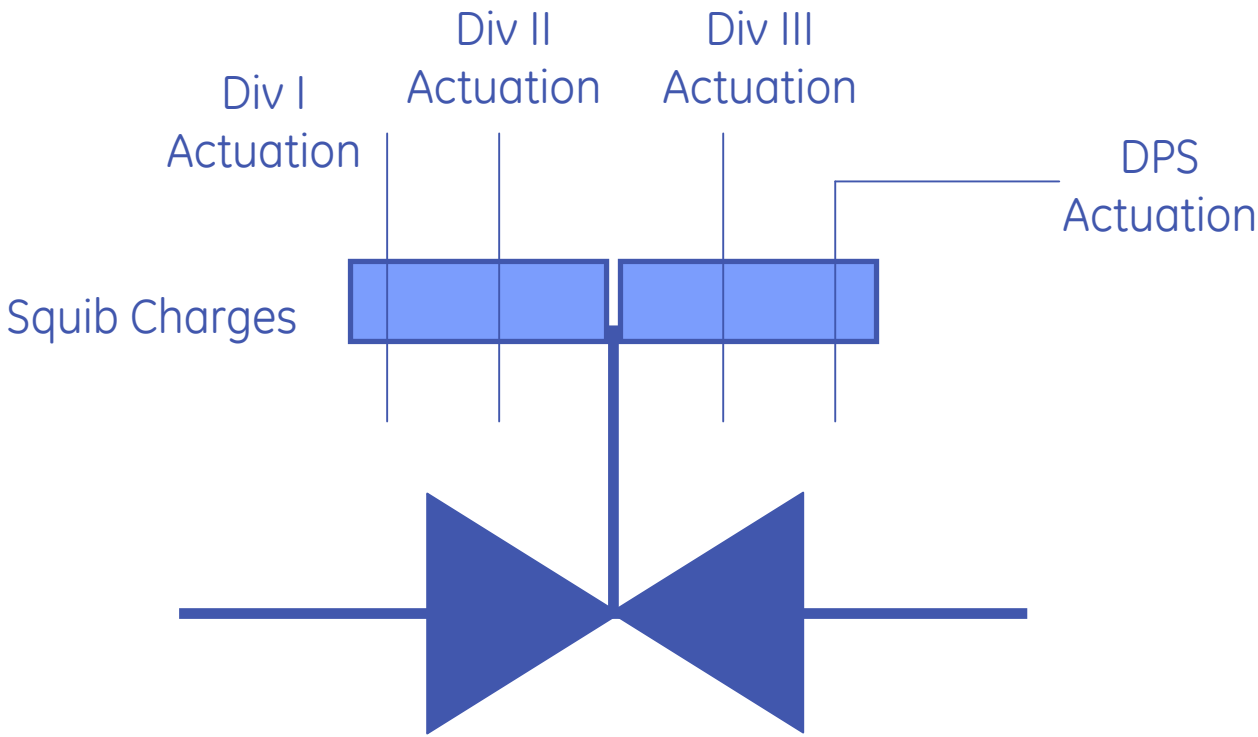
Allows Single Failure Protection with One Division Out of Service

Enables Online Battery Testing

At Least 3 Safety Related Divisions Plus DPS Activates Safety Related Valves

Common Cause is the Only Way to Fail ECCS

Squib Valve Example for N-2



Div I OOS
Div II Fails

Div III + 4 Provides 2 of 4 Signal
Div III Provides Actuation

Valve Actuation is Successful

DCIS Block Diagram

See Additional Handout

Common Cause Model

PRA Rev 1 Used Alpha Factor Method

This Causes Difficulty With:

- Uncertainty Analysis
- Some Sensitivity Analyses

Revision 2 Will Use Multiple Greek Letter Method

Data Sources Under Review

Demand Failure Rates for Equipment with Long Test Intervals

Most Demand Data is Associated with Equipment Tested Quarterly

Some ESBWR Equipment Tested at Much Longer Intervals

Three Methods Proposed, Two Were Used

Demand Failure Rate - continued

Three Cases

1. Test Interval 6 Months or Less
   - Directly Use Generic Failure Probability
2. Test Interval 6 Months – 1 Year
   - Use 95th Percentile of Generic Failure Prob
   - No Components in this Category
3. Test Interval Greater than 1 Year
   - Convert Demand Failure to Rate (Quarterly Test)
   - Calculate Unavailability Based on Rate, Test Interval, and No Repair

RTNSS Based on Initiating Events

Three Conditions Must Be Satisfied

- Does non-safety system failure cause initiator?
- Is that initiator risk significant?
  - Contributes approximately 10% to CDF
- Can availability controls reduce initiator frequency?

Initiating Event Evaluation

See NEDO-33201 Rev 1 Chapter 20