

Calvert Cliffs PRA

January 22, 2000

Agenda

- Management Overview

Tom Pritchett

Manager

Nuclear Engineering Department

- Calvert Cliffs PRA Update

Bruce Mrowca

Principal Engineer

Reliability Engineering Unit

- Cost-beneficial Design
Improvements

Bruce Mrowca

- Plant Changes &
Closing Remarks

Tom Pritchett

Vision

Consistent with our site vision to generate electricity safely, efficiently, and reliably, we plan to improve CCNPP CDF.

Objective

- We plan to achieve and maintain a CCNPP CDF of $\leq 1 \times 10^{-4}$
- We plan to accomplish this through a combination of:
 - Plant modifications
 - Procedure changes
 - PRA model improvements

What have we done?

- PRA Model Improvements
- Plant improvements



PRA Update

Bruce Mrowca



PRA Update - Presented in April 2000

- Scheduled to be issued by 3rd quarter 2000
- Expect to see some additional CDF reduction - changes include:
 - improved plant trip performance
 - updated failure and unavailability data
 - refined switchgear room heat-up rate calculation
 - new SRW heat exchangers
 - improved flood analysis
- 20% estimated CDF reduction $\Rightarrow 1.7 \times 10^{-4}$
- Believe update will yield Internal Events $< 1 \times 10^{-4}$

PRA Update - Internal Event Status

■ CCPRA Update - Internal Events Unit 1

- Completed in November 2000.
- Documentation of results is still in progress
- Unit 1 CDF (Internal Events) = $4E-5$

■ CCPRA Update - Internal Events Unit 2

- Completed in November 2000
- Addresses only the EDGs configuration
- Unit 2 CDF (Internal Events) = $4E-5$

PRA Update - External Event Status

■ Fire

- Unit 1 update nearing completion
- CDF approximately $4E-5$ -- down from $6E-5$
- Update for Unit 1 & 2 targeted for completion: May 2001

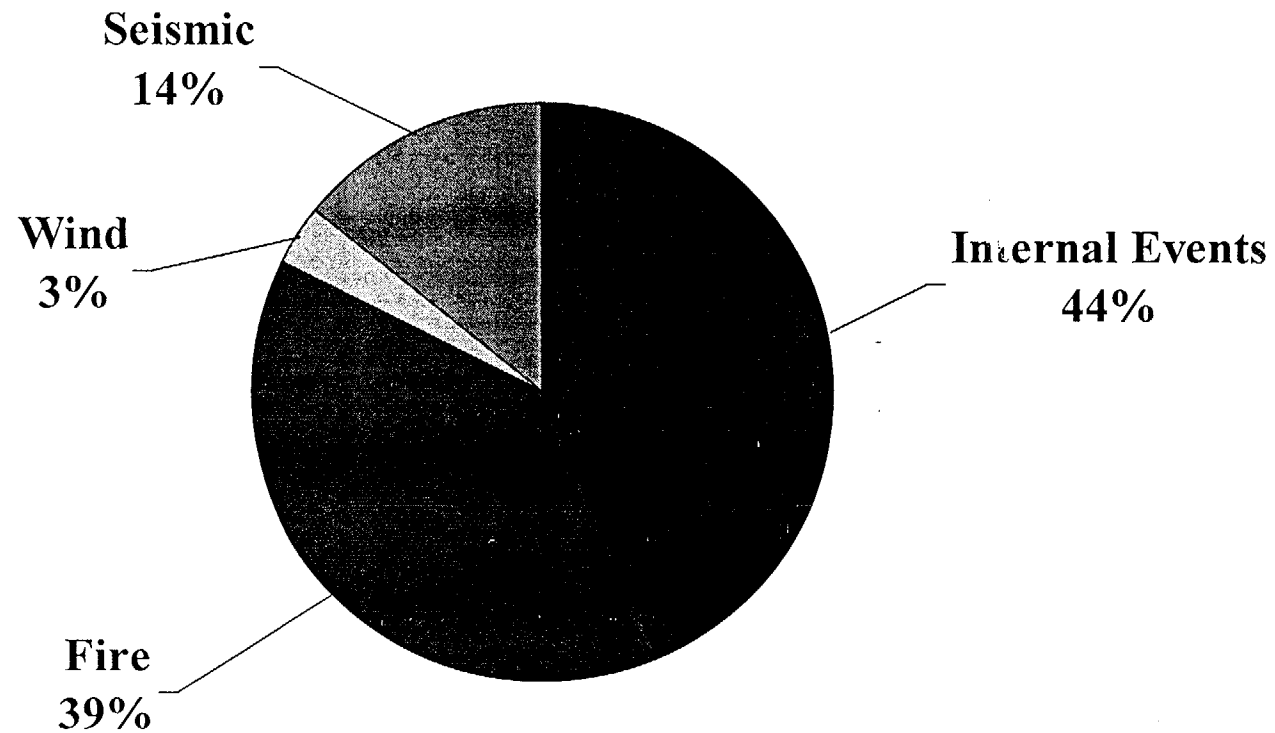
■ Wind

- Update for Unit 1 & 2 targeted for completion: May 2001

■ Seismic

- Update for Unit 1 & 2 targeted for completion: May 2001

Unit 1 CDF = 9×10^{-5} /year



PRA Update - Internal Events Changes

- Unit 1 Internal Events (w/o Flood) CDF decreased (52%) from $1.2\text{E-}4$ to $3.8\text{E-}5$
- Updated Initiating Event Frequencies
 - approximately 50% of internal events reductions
 - significant improvement in plant performance
 - significant improvement in prior distributions (based on NUREG/CR-5750, “Rates of Initiating Events at U.S Nuclear Power Plants”)
 - Most notable gains: loss of 125 VDC and LOCA initiating events

PRA Update - Internal Events Changes

■ Updated Failure and Unavailability Data

- updated risk significant data (data collected by Maintenance Rule Program)
- reliability data: 1992 to 1997 availability data: 1995 to 1998
- data was generally favorable - aggregate impact is unknown

■ Improved PTS Data

- Lowered the likelihood of a PTS event
- Participating in NRC PTS effort

■ Improved modeling of induced SGTR

- Calculations show a dramatic reduction on induced SGTR when PORV is open

PRA Update - Internal Events Changes

- More Human Action Recoveries
 - Detailed sequence analysis identified additional recoveries
 - Sensitivity analysis performed to identify inappropriate recoveries
- Added new SRW Heat Exchangers
 - Lower unavailability due to parallel heat exchangers
- Removed the HPSI and LPSI dependency on ECCS Room Air Coolers
- Improved success criteria of SWGR ventilation
 - Critical temperature not reached during LOOP
 - Recovery times increased from < 1 hr to 9 hrs (16 hrs Unit 2) for most 480VAC buses. 4KV Buses are unaffected.

PRA Update - Internal Events Changes

- Improved modeling of Spurious Safety System Actuation
 - Now tracking order of 120 VAC panel failures. This eliminates some scenarios.
- Improved LOOP Modeling
 - Added two additional bins (5 bins to 7 bins). This eliminates conservatism associated with long duration LOOPS

PRA Update - Flood Model Changes

- Unit 1 Flood CDF decreased (89%) from $1.4\text{E-}5$ to $1.6\text{E-}6$
- First Flood Model Update since IPE (1993)
- Based on new Internal Events model
- Updated flood frequencies and included maintenance-induced floods
 - Number of Initiating Events increased from 47 to 68
- Additional walk-downs, detailed flood height calculations and new recoveries

PRA Update - Fire Model Changes

- Unit 1 Fire CDF decreased (42%) from 6.2E-5 to 3.6E-5
- Based on new internal events model
- Model changes are being finalized
- Significant upgrade of turbine building and battery room fire models
- Updated fire modeling to reflect the issues identified with the EPRI Fire Implementation Guideline
- Improved cable failure to PRA function analysis



Potentially Cost-beneficial Design Improvements

Bruce Mrowca



Potential Plant Improvements

- Re-evaluated some previously reported cost beneficial improvements
- Evaluated one additional improvement
- Used Updated Internal Event PRA (Revision 0) and April 1999 External Events PRA (Revision A)
 - Total CDF: $1.3\text{E-}4$
- Use a more realistic evaluation based on our Unit 1 PRA

Potential Improvement 1

Change ESFAS, AFAS & PORV actuation logic to 3 of 4

- **Net Benefit** (176K) 35 years
- **Benefit Bases** Set PORV related top events associated with spurious safety system operation to success. Set AFAS block human actions to success. Set aligning inverter to back-up bus to success.
- **Cost** 598K per Unit
- **Cost Bases** Based on CCNPP cost estimate for 3 of 4 logic. Requires 10 new logic modules per unit

Potential Improvement 1

Change ESFAS, AFAS & PORV actuation logic to 3 of 4

■ Conclusion

- Not cost beneficial
- Changing logic to 3 of 4 is not the best solution

Potential Improvement 2

Change PORV actuation logic

- **Net Benefit** 203K 35 years
- **Benefit Bases** Estimate that 60% of Improvement 1's benefit is achieved.
- **Cost** 50K per Unit
- **Cost Bases** Based on preliminary CCNPP cost estimate.

Potential Improvement 2

Change PORV actuation logic

■ Conclusion

- Cost beneficial
- Entered into CCNPP Corrective Action Program

Potential Improvement 3

Replace batteries with more reliable model

- **Net Benefit** (144K) 35 years
- **Benefit Bases** Short-term battery PRA top events set to 90% success and DC Initiating Events were adjusted
- **Cost** >>375K per Unit
- **Cost Bases** Based on the 1997 cost of replacing batteries like-for-like. Does not include design and structural modification cost.

Potential Improvement 3

Replace batteries with more reliable model

■ Conclusion

- Not cost beneficial. No action planned.
- Recently replaced batteries with what is believed to be the best available option
- Not aware of any feasible options
- Estimate is low for installing new technology
- Estimate reflects 1997 pricing

Potential Improvement 4

Add accumulator for AFW block valves

- **Net Benefit** (184K) 35 years
- **Benefit Bases** Set Unit 2 AFW instrument air to Unit 1 top events to success
- **Cost** 268K per Unit
- **Cost Bases** Based on CCNPP cost estimate for installing 9 non-safety-related 4 ft³ accumulators
- **Conclusion** Not cost beneficial. No action planned.

Improvement 5

Automate Demineralized Water make-up to CST 12

- **Net Benefit** (9K) 35 years
- **Benefit Bases** Set long-term AFW make-up to success. SRW and CCW make-up to adjusted as if DM is always available.
- **Cost** 376K per Unit
- **Cost Bases** Based on CCNPP cost estimate to install 230V/25A diesel generator, fuel tank and controls
- **Conclusion** Not cost beneficial. No action planned. Estimate reflects 1998 pricing.



Plant Changes

Tom Pritchett



Planned Plant Changes

Change	ECD	CDF Reduction
1. Addition of condenser pit sprinklers	2001/2002	3%
2. Addition of watertight door	2003	3%
3. Analysis of ECCS pump cooler dependency	NA	implemented
4. Change PORV actuation logic	2002/2003	7%

Estimate an additional 10% CDF reduction $\Rightarrow 8 \times 10^{-5}$

Note: An analysis of the integrated impact of all the changes has not been performed.