EA-03-057

NMC

Point Beach Nuclear Plant

Regulatory Conference Concerning Auxiliary Feedwater Orifice Issue

June 6, 2003

Agenda

Purpose/Objective	Mano Nazar
Overview	Fred Cayia
Root Cause Analyses	Fred Cayia
Significance Determination	Mark Reddemann
Closing Remarks	Mano Nazar

Purpose

- Provide Overview of Auxiliary Feedwater System Orifice Issue
- Discuss Root Cause Evaluation of the AFW Orifice Issue
- Present Methodology and Conclusion of the NMC/Point Beach Significance Determination Process for AFW Orifice Issue

Objective

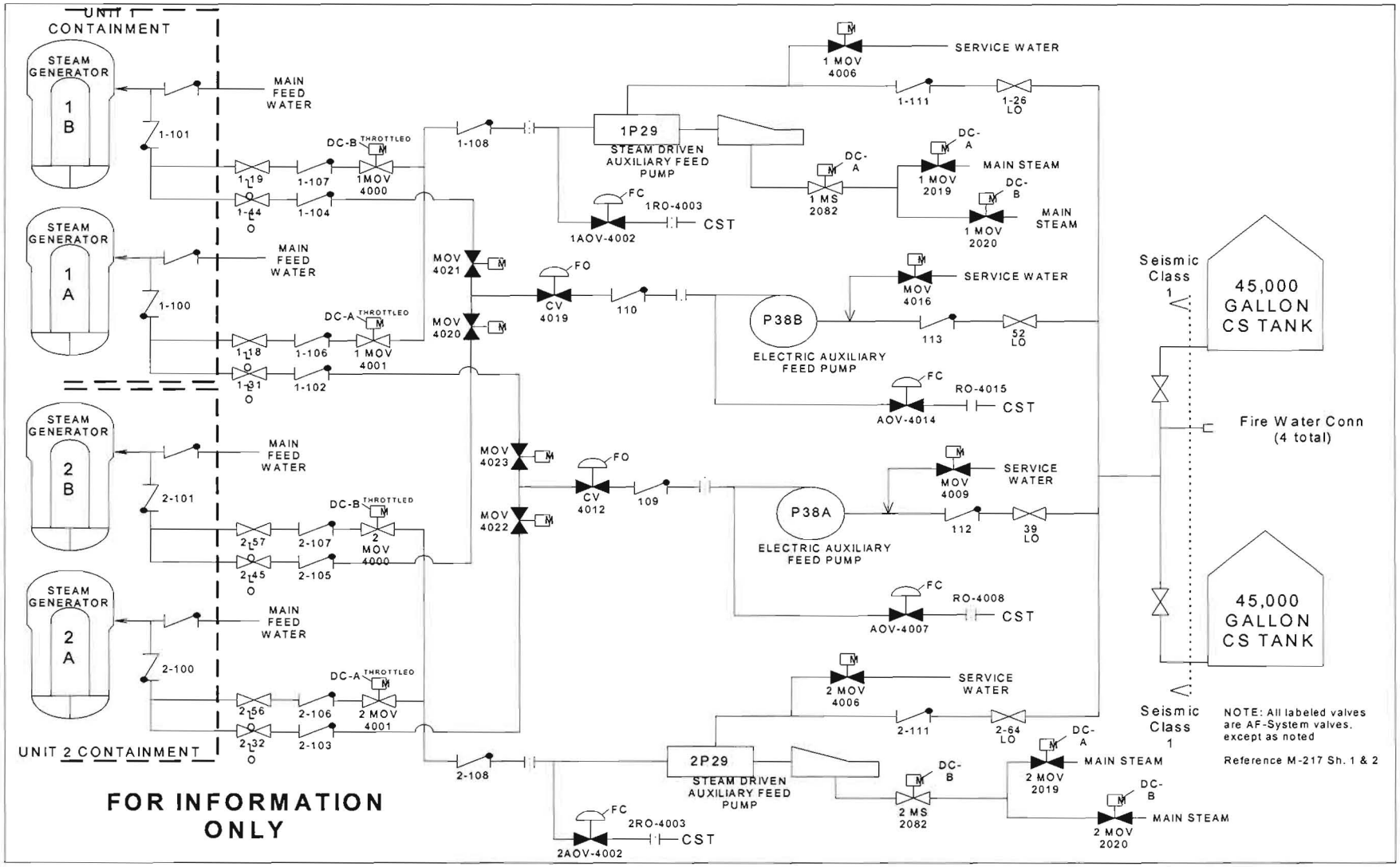
- Present New Information and Considerations Concerning Issue Significance

- Provide NMC's Position on the Characterization of the Apparent Violation of 10 CFR 50, Appendix B, Criterion III "Design Control"

Overview

Overview

Auxiliary Feedwater System



Overview
Timeline of AFW System Improvements

Oct 1970
U1 Licensed

March 1973
U2 Licensed

March 1979
TMI
Accident

Feb. 1981
GL 81-14 issued
(AFW seismic
qualifications)

May 1982
NRC SER,
NUREG-0737
Item II.E.1.2.
NRC accepts
"safety grade"
status of AFW
auto initiation

Aug 1984
Added AFW
discharge
MOV controls
(TMI
response)

Sept 1986
Added SR EQ level
transmitters for CST
(TMI response)

1991
Added recirc flow
instruments and
larger recirc lines and
orifices to increase
recirc flow to 70 &
100 GPM

April 1993
Installed air line
to allow IST
testing of AFW
recirculation
valves

July 1997
Missile
protected
portions of
AFW suction
piping

July 1997
Added AFW
discharge valve
backup nitrogen
supply; installed
cable separation
modifications

Jan 2002
NRC
inspection of
Modifications
/50.59

Feb. 2002
Added
backup
N2/air to
all AFW
recirc
valves

Sept 2002
AFW
recirculation
designated
safety
function

1970 | 1980 | 1985 | 1990 | 1995 | 2000

Note: At time of licensing,
AFW was not safety related

July 1981
Added AFW supply
line flow indication
(TMI response)

Nov 1983
Added AFW
inoperable alarm
(TMI response)

1985
Added low suction
pressure trip
(TMI response-
seismic/ tornado)

June 1988
Point Beach response
to IEB 88-04
(review of AFW
minimum flow)
identifies need for
greater recirculation
flow capability

Nov 1995
Added SW flush
connection at AFW
pump suctions

Feb 1998
Upgraded
AFW low
suction
pressure trip

March 1999
Modification to
assure control
wire separation
for AFW system

March 2003
Proper
(larger)
orifices
installed on
all AFW
recirc lines

Overview
Recirculation Line Orifice

Discussion:

- Orifice Modification Developed in 2000 to Reduce Recirculation Line Cavitation
- Recirculation Line Orifices- Modification History

	Unit 1	Unit 2
Motor Driven AFW Pumps (MDAFP) Modification issued	June 2000	June 2000
MDAFP Modification Installed	March 2001	November 2000
Turbine Driven Auxiliary Feedwater Pump (TDAFP) Modification Issued	March 2002	December 2001
TDAFP Modification Installed	October 2002	May 2002

Overview
Recirculation Line Orifice

Description:

Potential for Fouling of Recirculation Line Coincident with Procedurally-Directed Operator Action to Secure AFW Forward Flow.

- Identified by NMC Following System Testing of the Motor Driven AFW Pump
- Orifice Plugging Could Occur When AFW Pumps Were Aligned to Service Water Resulting in Potential Common Mode Failure
- Prompt Corrective Actions
  - All Four AFW Pumps Declared Out-of-Service Due to Potential Recirculation Orifice Common Mode Failure
  - Compensatory Actions Established to Direct Operators to Secure AFW Pumps in the Event Minimum Recirculation Flow Cannot be Maintained

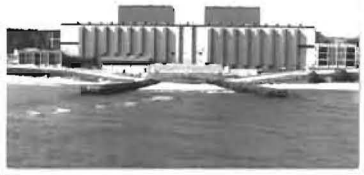
Root Cause Analyses

Root Cause Analyses AFW Recirculation Orifice

- Root Cause-Orifice Issue (RCE000191)
  - Failure to Properly Evaluate the Potential for Orifice Plugging Within the Design Process
- Contributing Causes
  - Use of Unverified Information and the Omission of Key Design Information in the Safety Evaluation for the Orifice Modification

Root Cause Analyses AFW Recirculation Orifice

- Corrective Actions- Complete
  - Increased Engineering Management Involvement in Approval and Oversight of Modifications
  - Implemented Periodic Review of Engineering Products by a Quality Review Team
  - Presented Lessons Learned to Engineering Personnel Stressing the Use of the Design Process
  - Revised Training Materials to Accurately Reflect AFW Recirculation Line Design Functions
  - Orifice Redesigned, Tested and Installed on all Four Pumps in March 2003



Root Cause Analyses
AFW Air Operated Valve Finding

Missed Opportunity (RCE 01-069)

- The Root Cause Problem Statement Focused on Emergency Operating Procedure (EOP) Limitations Related to a Loss of Instrument air event.
- The Root Cause Problem Statement should have Focused on the Potential Loss of Recirculation Flow.
- The Extent of Condition Evaluation would then have Investigated Conditions in Addition to a Failed Closed AFW AOV recirculation valve.
- Examples of Possible Loss of Recirculation Failures would have Included:
  - Orifice Plugging
  - Electrical/ Control System Failures
  - Indication Failures

Root Cause Analyses Comprehensive AFW Evaluation

- Root Cause-Comprehensive AFW Evaluation (RCE000202)
  - Failure to Consider the Integration of AFW System Design and Accident Progression (RC-1)
  - Less than Adequate Knowledge of the Safety Significance of the AFW Recirculation Line in Protecting the Pumps (RC-2)
- Contributing Causes
  - Lack of Problem and Issue Ownership (CC-1)
    - Corrective Action Program Weaknesses
  - Less than Adequate Engineering / Operations Interface (CC-2)
  - Less than Adequate Management of the Inter-Relationship of Documents (CC-3)

Root Cause Analyses Comprehensive AFW Evaluation

- Prompt Corrective Actions- Complete
  - Placed Modifications Developed using "Old Process" on Installation Hold Pending Accident Progression Review
  - Implemented Multi-Discipline Review of Proposed Modifications by Management Team
- Interim Corrective Actions- Complete
  - Implemented New Fleet Modification Process
  - Implemented Design Review Board
  - Assigned Issue Managers for Significant Station Issues
  - Conducted Detailed Review of AFW Design and Licensing Bases (RC-2)
  - Implemented the Corrective Action Program Improvements

Root Cause Analyses Comprehensive AFW Evaluation

Additional Corrective Actions:

- Enhance Understanding of System Design and Accident Progression (RC-1)
  - Upgrade Modification Process and EOP/AOP change process
  - Develop and conduct training for Engineering and Operations
- Resolve Remaining Issues from AFW Design and Licensing Bases (RC-2)
- Develop and Conduct Training on AFW Design Bases (RC-2)
- Strengthen the Role of Engineering in the Development/Revision of Operations Procedures (CC-2)
- Upgrade Electronic Document Management System (CC-3)
- Continue Implementation of Corrective Action Program Improvements

Significance Determination

Significance Determination Historical Timeline

Key:
Recirculation Line Orifice
Recirculation Line AOV

2000

June 2000
A & B MD AFW pumps' anti-cavitation orifice modifications issued

Nov 2000
B MD AFW pump anti-cavitation orifice installed

2001

March 2001
A MD AFW pump anti-cavitation orifice installed

Nov 2001
•Identification of recirc line AOV issue.

• Procedures modified to monitor recirc AOV position and low instrument air header pressure alarm to ensure minimum AFW flow

Dec 2001
U 2 TD AFW pump anti-cavitation orifice modification issued

2002

March 2002
U 1 TD AFW pump anti-cavitation orifice modification issued

May 2002
U 2 TD AFW pump anti-cavitation orifice installed

May/June 2002
Installed safety related backup N2/air to all AFW recirc AOVs

Sept 2002
AFW recirc AOV open-function designated safety related

Oct 2002
•U 1 TD AFW pump anti-cavitation orifice installed

• Potential for orifice plugging identified while testing A MD AFW pump a few weeks later

• Procedures modified to rely on forward flow to ensure min flow

2003

March 2003
Replacement (larger) orifices installed on all AFW recirc lines

Significance Determination Events Affected by Orifices

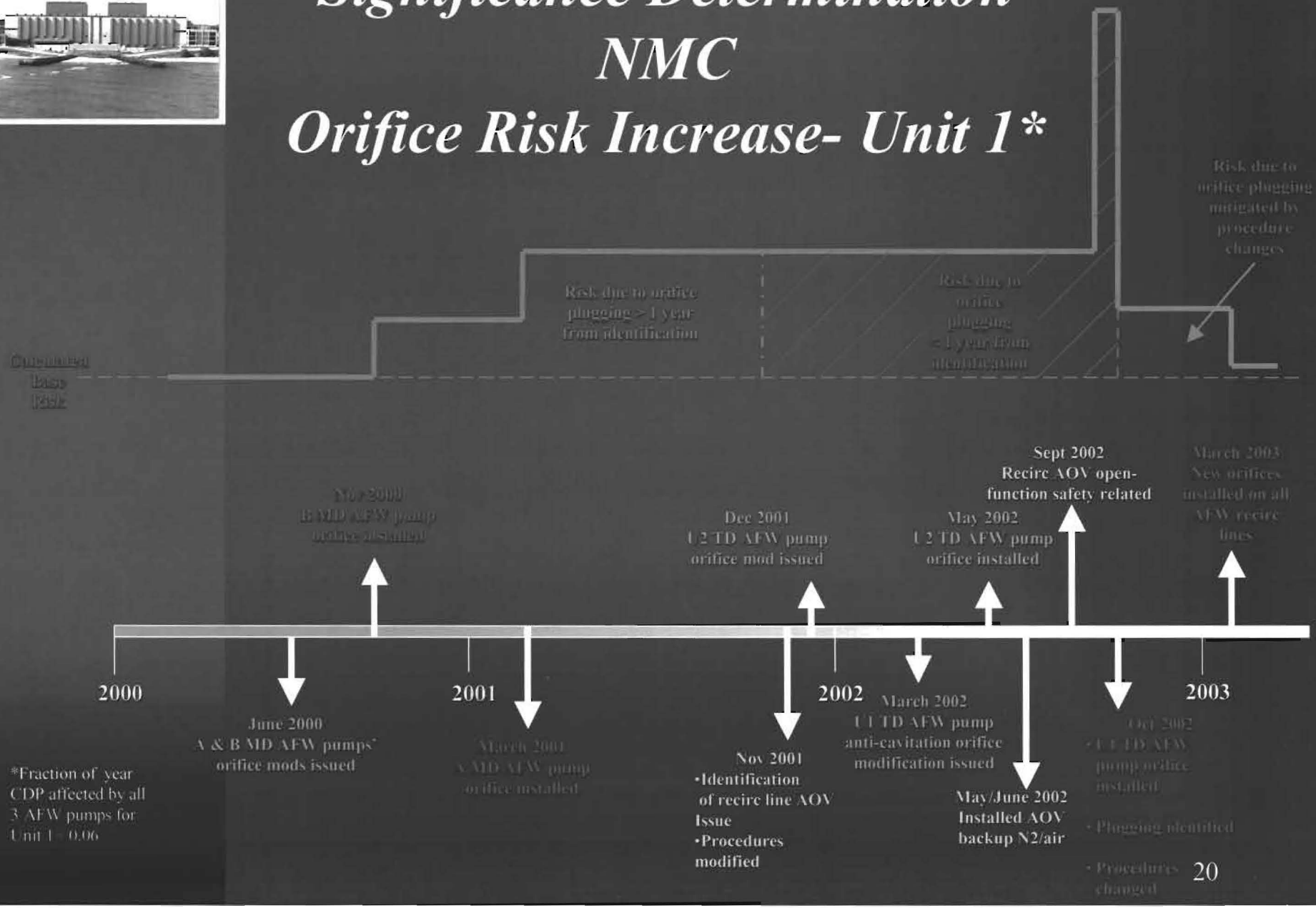
Dual Unit Events

- Loss of Offsite Power
- Loss of Service Water
- Loss of Instrument Air (Minor)
- Loss of DC Bus D02

Single Unit

- Transient (Minor)
- Transient without Heat Sink
- Steam / Feed Line Break (Minor)
- Loss of Component Cooling Water (Minor)

Significance Determination
NMC
Orifice Risk Increase- Unit 1*



Significance Determination NMC Orifice Risk Increase- Unit 2**

Risk due to orifice plugging mitigated by procedure changes

Risk due to orifice plugging < 1 year from identification

Risk due to orifice plugging > 1 year from identification

Sept 2002
Recirc AOV open-function safety related

March 2003
New orifices installed on all AFW recirc lines

Nov 2000
B MD AFW pump orifice installed

Dec 2001
U2 TD AFW pump orifice mod issued

May 2002
U2 TD AFW pump orifice installed

2000

2001

2002

2003

June 2000
A & B MD AFW pumps' orifice mods issued

March 2001
A MD AFW pump orifice installed

Nov 2001
•Identification of recirc line AOV Issue
•Procedures modified

March 2002
U1 TD AFW pump anti-cavitation orifice modification issued

May/June 2002
Installed AOV backup N2/air

Oct 2002
• U1 TD AFW pump orifice installed
• Plugging identified
• Procedures changed

**Fraction of year CDP affected by all 3 AFW pumps for Unit 2= 0.472

Significance Determination- Event Timelines

Events	Time to CST Low-Low Level	With Water Treatment System Clearwell	Time to Initiate Feed & Bleed (If Required)	Notes
Dual Unit Events				
•Loss of Offsite Power, Loss of Instrument Air, Loss of DC Bus D02, Loss of Service Water	1.6 Hrs	System Not Available	4.8 Hrs	
Single Unit Events				
•Transients without Heat Sink	Not Required	Not Required	Not Required	Normal CST Makeup Available
•Transient without Heat Sink and No Water Treatment	2.1 Hrs	System Not Available	5.5 Hrs	
•Small LOCA	5.1 Hrs (0.5" Break Only)	Not Required	Not Applicable	Three break sizes, with and without safety injection. Only smallest break reaches CST Low-Low Level
•Steam Generator Tube Rupture	3 Hrs	9.7 Hrs	Not Applicable	
•Main Steam Line Break (Inside Containment)	3.3 Hrs	12 Hrs	15 Hrs	
•Main Steam Line Break (Outside Containment)	1.6 Hrs	Not Required	Not Required	RHR conditions reached on CST inventory at ~2.2 hrs- prior to reaching SG level requiring feed & bleed.

Significance Determination Differences for Plugged Orifice

- AFW Swap-Over Occurs Hours After Reactor Trip
  - Decay Heat Lower
    - Charging Successful for Feed and Bleed
    - Shutdown Cooling Credited
    - Steam Generator Depressurization and Service Water /Fire Water Addition Possible
  - Emergency Response Facilities Staffed
  - More Time for Troubleshooting and Recovery

Significance Determination NRC

- Preliminary Evaluation of Risk Increase Based on Phase 2 Analysis
- Assumed AFW Failure Probability of 1.0
- No Credit for:
  - Initial Cooling by AFW
  - Charging Feed and Bleed
  - Transition to Shutdown Cooling
  - Service / Fire Water Addition

Significance Determination NMC

- Internal Events Evaluated Probabilistic Risk Assessment
  - MAAP (Modular Accident Analysis Program) used to Demonstrate Success and Determine Timeline of Recovery Actions
  - Human Reliability Analysis for Credited Recovery Actions
- Seismic Events Evaluated using Seismic PRA
- Fire Event Analysis in Progress

Significance Determination NMC Risk Mitigating Factors Incorporated

- Water Treatment System
  - Makeup to Condensate Storage Tank
  - Clearwell Tank Makeup to CST
  - Recovery Following Restoration of Off-Site Power
- Service/Fire Water through Disabled AFW Pump
- Charging for Feed and Bleed

Significance Determination NMC Risk Mitigating Factors Incorporated (cont'd)

- Changes to HEPs for Feed and Bleed
- Recovery of SI/ RHR Valves Left in Incorrect Position
- Operators Starting/Stopping AFW Pumps to Avoid Failure of 2nd and/or 3rd Pump

Significance Determination NMC Risk Mitigating Factors Not Incorporated

- Available 14,000 Gallons of Water Left in Each CST at Low Low Level
- Increase Charging to Maximum While in Loss of Heat Sink Procedure
- Likely AFW Pump Survival Time Following Swap-Over to Service Water
  - Valve Leakage
  - Packing Leakage
- Alignment of N_2 to Pressurizer PORVs Following Loss of IA

Significance Determination Largest Contributors to Risk

Largest Contributors

Recovery Credited

Initiator	Water Treatment	Service / Fire Water	Charging Feed & Bleed	Shutdown Cooling
Loss of Offsite Power- Dual and Single Unit	x	x	x	x
Transient w/o Heat Sink	x	x		x
Loss of DC Bus 2		x	x	x
Loss of SW		x		

Significance Determination Sensitivity Analysis

Factor	Contribution to CDP Reduction (%)
Water Treatment System Impacts	91
Service Water/Fire Water through AFW Pump	48
Feed and Bleed HEP Change	48
Charging for Feed and Bleed	19
SI / RHR Valve Recovery HEP	10
Start / Stop AFWPs	5

Significance Determination Results

Internal Events

- Increase in Internal Events Core Damage Probability
  - Unit 1: High White
  - Unit 2: Mid Yellow

Significance Determination Results

External Events- Seismic

- Fragility Analysis Performed
- Charging, CST, and Service Water Addition Credited Following Safe Shutdown Earthquake
- Increase in Seismic Initiated Core Damage Probability
  - Unit 1: Green
  - Unit 2: Green

Significance Determination Results

Increase in Internal Event and Seismic Initiated Core Damage Probability

- Unit 1: High White
- Unit 2: Mid Yellow

Significance Determination Results

External Events- Fire

- Fire PRA Model Not Developed
- Development is in Progress
- Method Includes:
  - Fire Initiation Frequency
  - Detection Probability
  - Automatic and Manual Suppression Probability
  - Identification of Cables and Determination of Equipment Affected
  - Credit for Mitigating Factors
  - Consequences of Unsuppressed Fires
- Completion Targeted in August

Summary

- Installation of Inappropriate Orifice Design was Risk Significant
- NMC Significance Determination Preliminary Results (Internal and Seismic)
  - Unit 1: High White
  - Unit 2: Mid Yellow
  - Final Results, Including Fire, Targeted in August 2003
- Further AFW System Modifications
  - Electrical Modifications in Progress
  - Margin Recover Study
- Engineering Excellence Plan

Closing Remarks

- AFW Orifice Issue Self-Identified and Resolved in Timely Manner.
- AFW System Today is more Reliable.
- NMC Understands the Importance of the AFW Orifice Issue.
- NMC Significance Determination Preliminary Results (Internal and Seismic)
  - Unit 1: High White
  - Unit 2: Mid Yellow
- SDP for Fire Events Remains a Work in Progress.
- NMC Concurs with the Characterization of the Apparent Violation of 10 CFR 50 Appendix B.