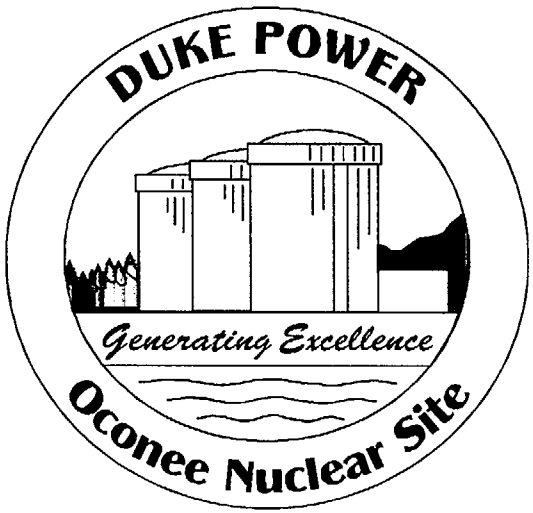
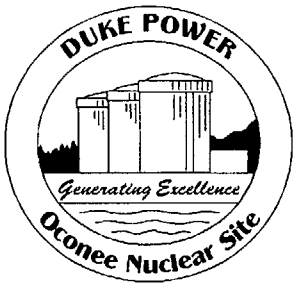
Oconee Nuclear Station



Predecisional Enforcement Conference
Emergency Feedwater Licensing Issues
April 25, 2000

Enclosure 3



Agenda

- System Overview
- Single Failure Analysis Overview
- Risk Significance
- Apparent Violations
- Regulatory Perspective
- Closing Remarks

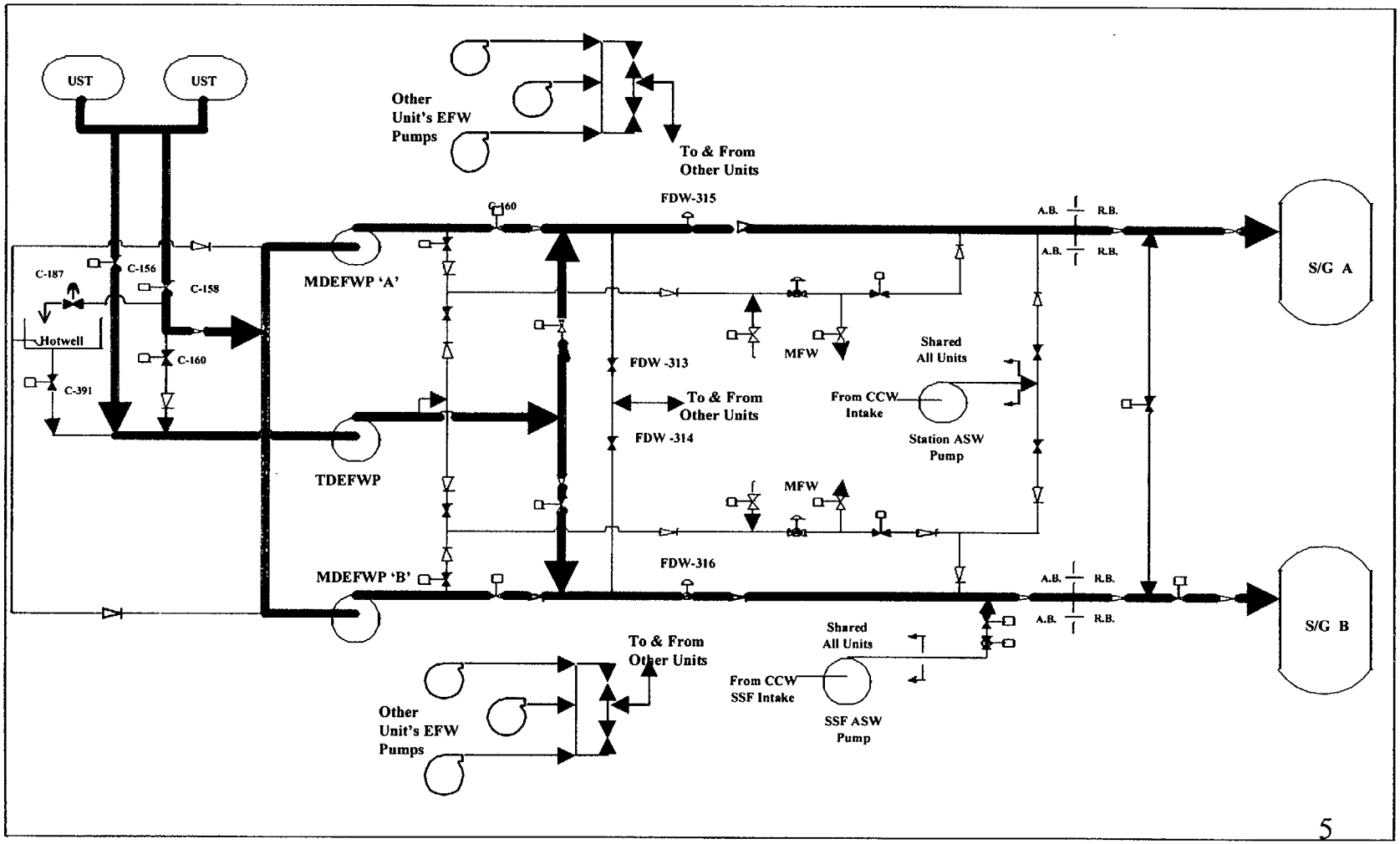
Overview Of Oconee Feedwater Systems

- Main Feedwater (MFW)
  - Two turbine driven MFW pumps per unit
  - Three motor driven hotwell pumps per unit
  - Three motor driven condensate booster pumps per unit
- Emergency Feedwater (EFW)
  - Two motor driven pumps and one turbine driven pump per unit
- EFW from other units (cross-connect)
- Standby Shutdown Facility Auxiliary Service Water (SSF ASW)
  - One motor driven pump capable of feeding all three units
- Station Auxiliary Service Water
  - One motor driven pump capable of feeding all three units

Emergency Feedwater

- Two motor driven pumps and one turbine driven pump per unit
- Safety-related, non load shed power for motor driven EFW pumps
- Turbine driven EFW pump is independent of AC power
- Auto-start on:
  - Low MFW pump hydraulic control oil pressure
  - Low steam generator level (motor driven pumps)
  - AMSAC
- Upper Surge Tank (UST) is initial suction source

Post-TMI EFW System



Evolution of EFW System

Time Frame	Change	Impact
1973	One TDEFWP per unit	Original Design
1973-1974	Added EFW cross-connects Rerouted EFW piping through Turbine Building basement	Resolved HELB vulnerability Allowed EFW to be fed from alternate unit
1979-1980	Added two motor driven pumps per unit	Improved redundancy and diversity of design
1979-1980	Implemented auto-actuation circuitry and safety-grade control system	Improved automatic response of system
1984	SSF operational	Improvement in overall reliability of SG heat removal function
1986	Lowered elevation of suction source from hotwell for motor driven EFW pumps	Improved NPSH and increased available hotwell inventory for motor driven EFW pumps
1989	GL 81-14 seismic modifications for seismic boundary valves	Improves seismic design/boundaries for EFW System
1990	Added AMSAC	Added diverse actuation circuitry for motor driven EFW pumps
1991-1992	Further improved hotwell suction source for motor driven EFW pumps	Improved NPSH and increased available hotwell inventory for motor driven EFW pumps
1991-1992	Added SG dryout protection	Added diverse actuation circuitry for motor driven EFW pumps
1993	Auxiliary Instrument Air modification	Increased reliability of several key air operated valves
1994	C-187 auto-closure on low UST level	Reduces vulnerability associated with hotwell emergency makeup line
1994-1996	MSLB mod	Improves runout protection for turbine driven EFW pump

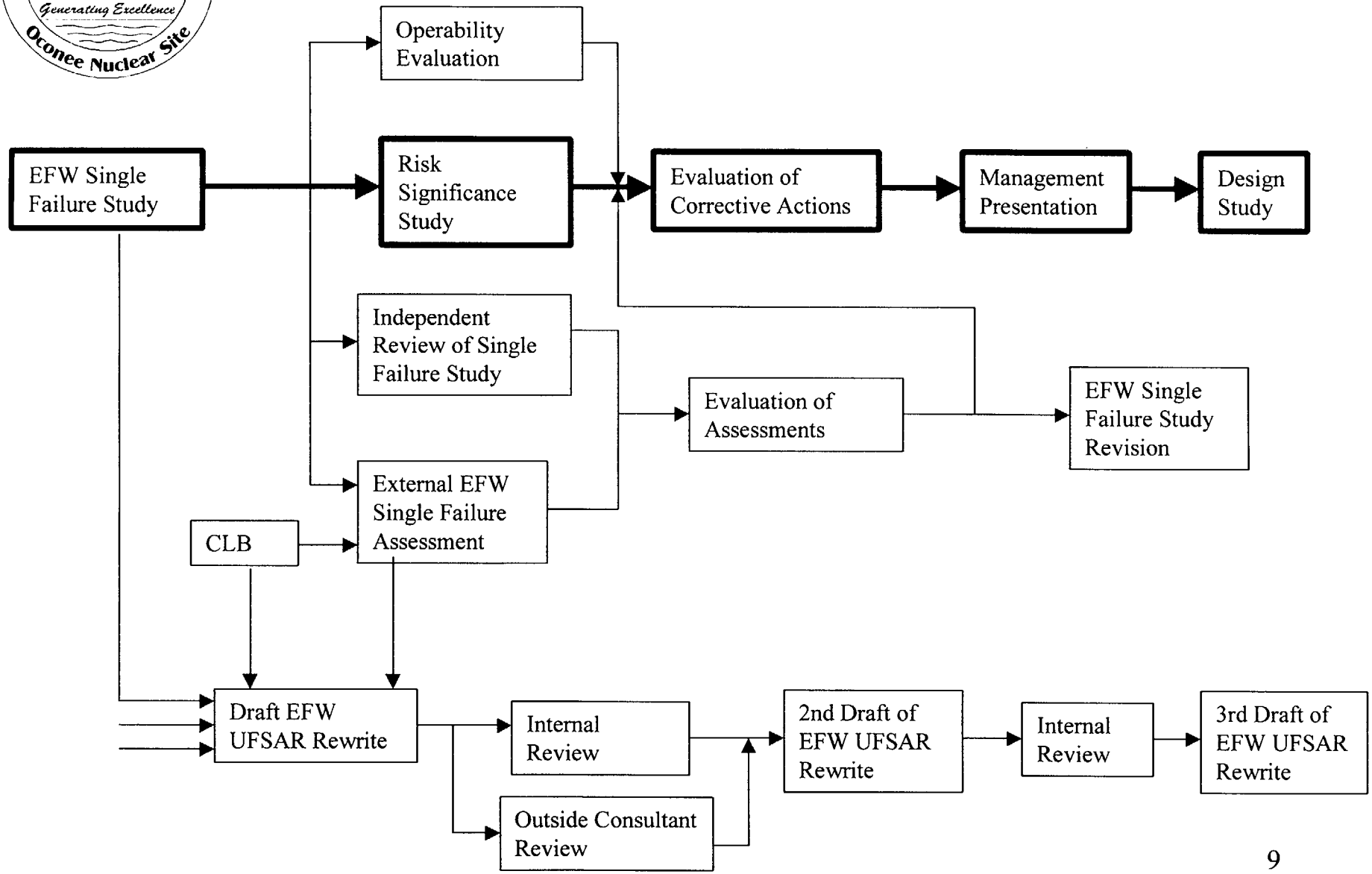
Overall Perspective on Secondary Heat Removal

- Secondary heat removal capability is currently safe & reliable
  - Feedwater can be delivered during full range of scenarios
  - Adequate controls in place to ensure capability
  - EFW reliability comparable to other plants
  - Diversity in systems that support secondary side decay heat removal makes SG cooling function very reliable

EFW Single Failure Analysis

- Developed comprehensive understanding of EFW limitations
- Limited to EFW proper on Unit specific bases
  - Biased away from licensing bases debate
- Results used for input into design study & UFSAR rewrite

Oconee EFW Activities



Results of EFW Single Failure Analysis

- 37 issues identified by study
- Adequate feedwater can be delivered in all scenarios
- Results inspected & reported in NRC Inspection Report 99-08
  - Concluded effort was comprehensive and thorough

Results of EFW Single Failure Analysis

- Resolutions presently being evaluated:
  - Modify Plant:
    - Common mode failure of EFW control valves
    - Loss of UST inventory
  - Clarify Licensing Bases:
    - Reliance on non-safety MFW startup flowpath
    - Loss of hotwell inventory

Risk Evaluation of EFW Single Failure Issues

- Most failures contribute to cut sets with CDF less than 1E-8 (including C-187)
- Aggregate effect of all issues is an increase in CDF of approximately 4E-7
- Approximately half of 4E-7 CDF increase is already included in base ONS CDF
- Potential modifications to mitigate single failures would not significantly lower estimated CDF for Oconee

Specific Vulnerabilities Discussed in IR 99-13

- Failure of Common Air Supply to EFW Control Valves
  - Issues 10 - 14
- Failure Open of a Turbine Bypass Valve
  - Issues 25 & 26
- Failure to Break Condenser Vacuum
  - Issue 21

Failure of Common Air Supply to EFW Control Valves

- Failure could impact both EFW control valves
- Secondary side cooling can be provided by:
  - MFW startup flow path
  - SSF ASW
- Postulated failures contribute approximately 4E-8 to the Oconee CDF
- Modifications will be implemented to eliminate this single failure

Failure Open of a Turbine Bypass Valve

- Failure could impact hotwell inventory due to elevated temperature
- Potential long-term inventory sources:
  - Makeup to UST
  - EFW Cross connect
  - SSF ASW
  - Station ASW
- Postulated failures contribute approximately 5E-8 to Oconee CDF
- Clarification included with UFSAR revision

Failure to Break Condenser Vacuum

- Precludes hotwell as suction source
- Potential long-term sources:
  - Makeup to UST
  - EFW Cross connect
  - SSF ASW
  - Station ASW
- Postulated failure contributes approximately 8E-8 to Oconee CDF
- Clarification included with UFSAR revision

APPARENT VIOLATIONS OVERVIEW

Apparent Violation #	Issue	Duke Perspective	Resolution
1	Past EFW Design Not Functional for a Main Feedwater Pipe Break (C-187)	UFSAR Licensing Bases Description Did Not Adequately Reflect Historical Basis of EFW Design	Resolved via Modification NSM 2911 Implemented in 1993-1994
2	Inadequate Corrective Action & Reporting of Item #1 Above (C-187)	Cause Same as Apparent Violation #1	Resolved via Modification NSM 2911 Implemented in 1993-1994 and LER 99-01
3	Insufficient Water Source for EFW System	Adequate Inventory is Available & Compliant With Current Licensing Basis	Clarification To Be Included With UFSAR Revision
4	EFW System Single Failure Vulnerability (C-187)	Cause Same as Apparent Violation #1	UST Modification Under Development
5	Inadequate EFW Seismic Boundary (C-187)	Valve C-187 Meets Seismic Boundary Valve Requirements	Issue Corrected via 1993 Modification. Clarification To Be Included With UFSAR Revision.
6	Inadequate Safety Evaluation for Modification to Auto-close Valve C-187	Cause Same as Apparent Violation #1	UST Modification Under Development
7	Inadequate Safety Evaluation for UFSAR Change that Reduced EFW System Design Criteria (C-187)	Cause Same as Apparent Violation #1	Resolved, UFSAR Change Withdrawn

Apparent Violations 1,2,4,6 & 7

- Duke actions in accordance with a reasonable, consistent interpretation of licensing bases (discussed on 2/8/99)
- Duke understands the NRC interpretation provided in 2/24/99 letter, and acknowledges that historical actions were not commensurate with that interpretation

UFSAR Wording Example

- From NRC 8/25/81 SER:
  - *"By letter dated April 3, 1981, the licensee responded that in order to provide emergency feedwater flow to the intact steam generator and isolate the ruptured steam generator the operator must take manual action. The system is designed so that a single active failure of any of the emergency feedwater pumps or valves will not prevent the operator from directing sufficient flow to the intact steam generator." "We find the response to this request acceptable."*

UFSAR Wording Example

- From Duke 4/3/81 submittal:
  - "*In the event of a postulated break in the main steam or main feed system, coupled with a single active failure of either one of the three emergency feedwater pumps, sufficient flow will occur to provide adequate core cooling. Similarly, if the active failure occurs with the flow control valve (FDW-316), emergency feedwater flow can be aligned through the main feedwater startup control valves to either the main or auxiliary nozzles.*"

Apparent Violations 1,2,4,6 & 7

- Underlying cause the same; UFSAR licensing bases description did not adequately reflect historical bases of EFW design
  - Documentation commensurate with vintage
  - Allows wide range of reasonable interpretations
- UFSAR rewrite will clarify licensing bases

Effect of Valve C-187 on EFW Reliability

- Makes essentially no contribution to the base case Oconee CDF
- Makes essentially no contribution to the Oconee CDF with an arbitrary increase in the failure probability by a factor of 10

Completed Duke Actions

- All issues entered into Corrective Action Program
- All issues assessed for impact on operability
- Licensee Event Report 99-01 issued 3/26/99
- Completed Single-Failure Analysis
- Completed Risk Evaluation
- Completed Independent Assessments

Ongoing Duke Actions

- Revise EFW UFSAR chapter
  - Uses Regulatory Guide 1.70 (Standard format & content of UFSAR) as template
- Design study to evaluate modification options

Hotwell Inventory (Apparent Violation #3)

- Apparent Violation:
  - *Modification in 1979 to install motor-driven EFW pumps failed to implement the design bases that the EFW system could perform its safety-related function in the event of a secondary pipe break (not considering a coincident single failure) as described in UFSAR Section 10.4.7.1. Following a secondary pipe break, the hotwell water could be lost out the break, resulting in insufficient EFW system water sources to cool down the RCS*

Hotwell Inventory - Duke Perspective

- Diverse design features assure adequate inventory following a secondary side pipe break
- Risk significance of EFW inventory has been thoroughly evaluated
  - FWLB is assumed to fail hotwell, resulting in CDF of 5E-8
- Changes to the facility not justified from a CDF perspective

Hotwell Inventory

- UFSAR 10.4.7.3 reflects use of diverse sources, including the SSF, to maintain feedwater inventory following reactor shutdown
- Technical Specifications & UFSAR reflect original design bases to cool down following loss of main feedwater transient (not main feedline break).

Hotwell Inventory

- Subject of NRC letter (dtd 11/14/80), question 16 was "Long Term Source of AFW Supply"
- Duke 4/3/81 response to question 16 credited use of Standby Shutdown Facility
  - "*The Standby Shutdown Facility Auxiliary Service Water System is seismically qualified and is capable of providing sufficient secondary side cooling for over 3-1/2 days.*"

Hotwell Inventory

- Duke 4/3/81 response also reflected EFW design bases to cool down following loss of main feedwater
  - "*the requirements for EFW system performance are determined by the heat removal demand for the loss of main feedwater transient, and the successful cooldown of the RCS to decay heat removal mode.*"
- NRC accepted Duke response to NUREG-0737, Item II.E.1.1 in closure letters dated 8/25/81 and 4/8/82

Hotwell Inventory Conclusions

- Issue is not safety significant
  - Adequate inventory is available
- Both the current UFSAR & Improved Technical Specification reflect use of Standby Shutdown Facility
- NUREG-0737, Item II.E.1.1, did not require additional inventory
- Duke does not agree with Apparent Violation #3

Seismic Boundary Valve (Apparent Violation #5)

- IR 99-13 states that 1989 modification failed to establish an adequate seismic boundary
- Duke agrees that 1989 modification did not establish adequate seismic boundary
- PIR 89-0111 was written to address this deficiency
- Resolved in 1993 by adding circuitry to automatically isolate C-187 on low UST level

Seismic Boundary Valve

- IR 99-13 states that the seismic design deficiency remains in effect
- UFSAR Section 3.7.3.9 states "Failure in the non-seismic portion of the system cannot cause Loss of function to the safety system in that automatic or remote-manual valves are used for valves normally open during reactor operation."
- Valve C-187 meets the design requirements in that it is an automatic valve
  - Closes on low UST level

Overall Violation Conclusions

- Feedwater can be successfully delivered
- Issues arise from insufficient licensing documentation during the post-TMI era
  - Not a result of poor design control or 50.59 program
- Duke has taken comprehensive actions to resolve

Duke Position on Apparent Violations

Apparent Violation #	Issue	Duke Position	Duke Perspective
1	Past EFW Design Not Functional for a Main Feedwater Pipe Break (C-187)	Duke Does Not Agree With Apparent Violation #1	• Resolved in 1993 • Not Safety Significant nor Willful
2	Inadequate Corrective Action & Reporting of Item #1 Above (C-187)	Duke Does Not Agree With Apparent Violation #2	• Resolved in 1993 • Reported via LER 99-01 • Not Safety Significant nor Willful
3	1979 Modification Failed to Implement NUREG-0737 Requirements Involving EFW Inventory	Duke Does Not Agree With Apparent Violation #3	• Issue Outside Mod Scope • Inventory Issue Not a NUREG-0737 Requirement • Not Safety Significant nor Willful
4	1993 Modification Failed to Correct EFW System Single Failure Vulnerability (C-187)	Duke Does Not Agree With Apparent Violation #4	• Issue Outside Mod Scope • Not Safety Significant nor Willful • Comprehensive Actions Taken
5	1989 Modification Did Not Establish Adequate EFW Seismic Boundary (C-187)	Duke Does Not Contest That a Historical Violation Occurred	• Issue Duke Identified • Resolved in 1993, Presently in Compliance • Not Safety Significant nor Willful
6	Inadequate Safety Evaluation for 1993 Modification to Auto-close Valve C-187	Duke Does Not Agree With Apparent Violation #6	• Issue Outside Mod Scope • Not Safety Significant nor Willful • Comprehensive Actions Taken
7	Inadequate Safety Evaluation for UFSAR Change that Reduced EFW System Design Criteria (C-187)	Duke Does Not Agree With Apparent Violation #7	• Safety Evaluation IAW Reasonable Interpretation • UFSAR Change Withdrawn • Not Safety Significant nor Willful

Oconee Design Bases Initiatives

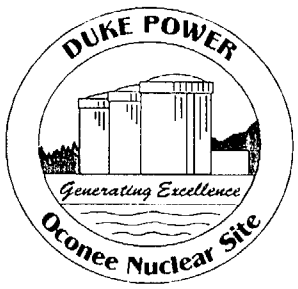
- EFW effort part of larger initiative
- Systematic approach to improve the design bases
  - Oversight provided by Oconee Design Review Board
- Upgrade of calculations continues
- Focus on reducing operator burden and increasing design margin
- Continued review of key safety systems
  - SSF SITA scheduled this summer

Regulatory Perspective

- Oconee continues a strong focus on improving the design and licensing basis
- Safety significance has been thoroughly evaluated and does not appear to meet criteria for escalated enforcement
  - No actual safety consequences
  - Potential safety consequences minimal

Regulatory Perspective

- Duke has taken prompt and comprehensive corrective actions to address issues
  - Comprehensive single-failure analysis
  - Evaluation of risk significance
  - Independent Assessments
- Escalated enforcement not necessary to assure improvement of the design and licensing bases of Oconee



Closing Remarks