

NUCLEAR REACTOR SAFETY: BEYOND DESIGN BASIS EVENTS

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SEVERE NUCLEAR ACCIDENTS

The Top Five

- Station Blackout
- Anticipated Transient Without Scram (ATWS)
- Reactor Vessel Rupture (Event V)
- Interface Loss of Coolant Accident
- Spent Fuel Pool Loss of Cooling

The Black Swan

- Multiple Reactor Accidents

LIKELIHOOD ESTIMATES

	<i>Before Fukushima</i>	<i>After Fukushima</i>
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The TOP FIVE

- Station Blackout	Extremely Unlikely	Occurred
- ATWS	Extremely Unlikely	?
- Reactor Vessel Rupture	Extremely Unlikely	?
- Interface LOCA	Extremely Unlikely	?
- Spent Fuel Pool Accident	Extremely Unlikely	Occurred

THE BLACK SWAN

- Multiple Core Melts	Absolutely Unlikely	Occurred
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INTERFACING LOCA PROBABILITY BY CONVENTIONAL WISDOM

- $10E-8$ to $10E-9$ Per Year
- Dictated by Check Valve and Motor-Operated-Valve Rupture Data
- Well Within Safety Goal Expectations
- Wide Acceptance Within Industry and Government

BROWNS FERRY-1 CORE SPRAY Sys 1

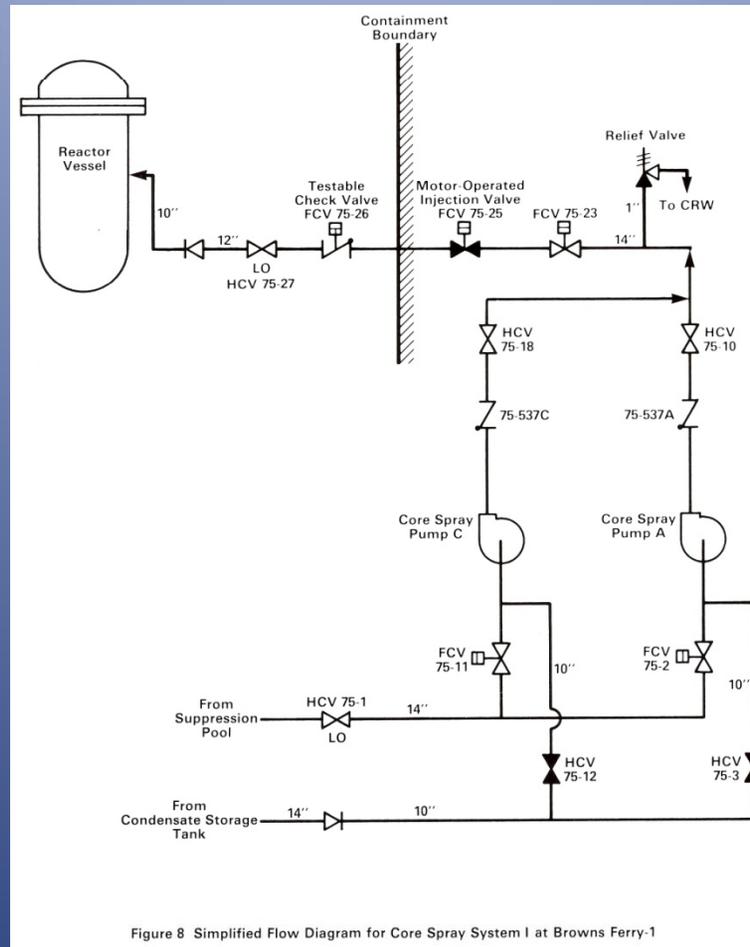
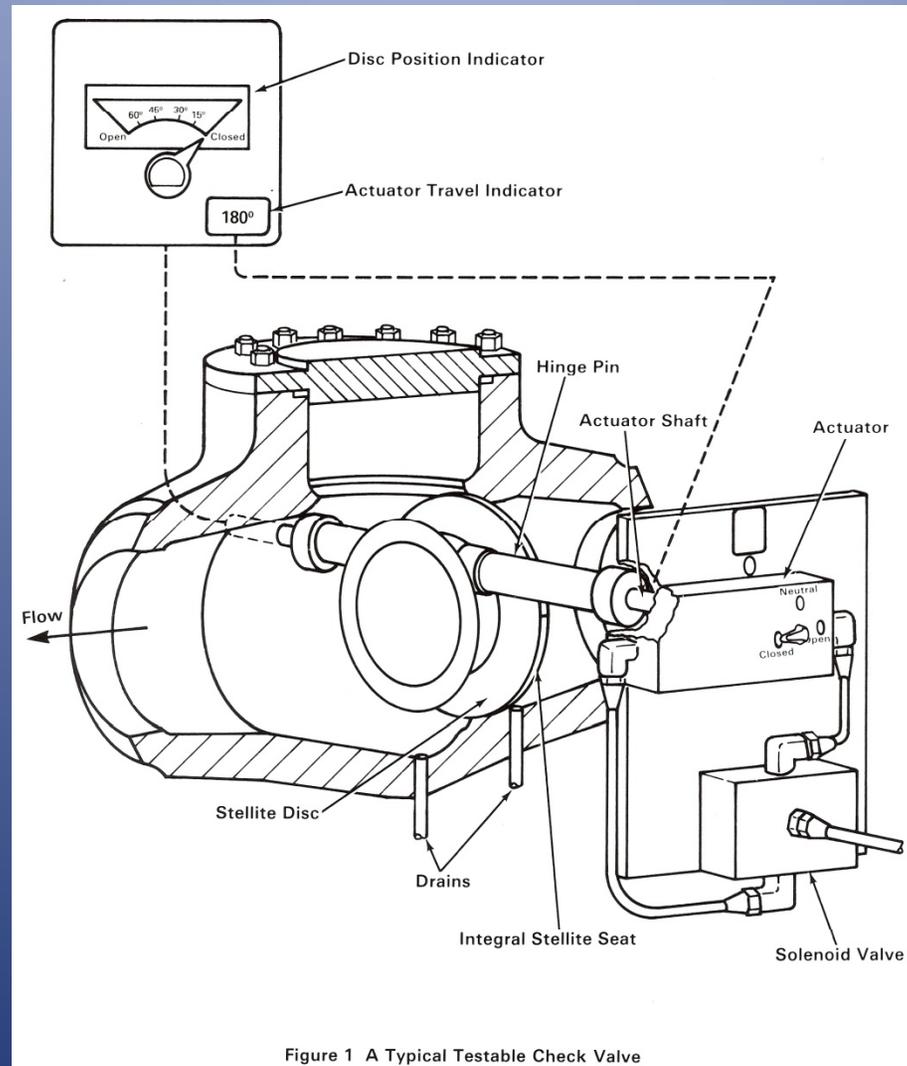


Figure 8 Simplified Flow Diagram for Core Spray System I at Browns Ferry-1

TESTABLE CHECK VALVE



BEYOND DESIGN BASIS EVENTS AFTER FUKUSHIMA

- Intense & Comprehensive Scrutiny
 - Numerous Participants:
NRC, DOE, IAEA, INPO, EPRI, NEI, CEC, and Licensees
 - Significant Effort with Tight Schedules
 - Many Actionable Measures
- Genuine Improvement in Nuclear Reactor Safety

BEYOND DESIGN BASIS EVENTS AFTER FUKUSHIMA: ANOTHER VIEW

- Acknowledgement: Current Design Bases May Not Be Adequate?
- Debate The Need For Additional Federal And State Oversight
 - Real Policy & Technical Considerations
 - Issues For CEC Consideration
 - 2008 CEC IEPR Recommendation on Spent Fuel Pool
 - Life-extension Licensing
 - Hosgri & Shoreline Fault Seismic Issues

2008 CEC RECOMMENDATION ON SPENT FUEL POOL

- CEC Recommended Reducing Spent Fuel Pool Density In The 2008 CEC Integrated Energy Policy Report
- Real Policy And Technical Issues
 - Absence Of Federal Waste Storage Facility
 - Dry Cask Storage Licensing Limits
 - Dry Cask Thermal Limits On 100% 5-year Old Fuels

EMERGENCY PLANNING ZONE

- Diablo Emergency Planning Zone (EPZ)
 - 18 Miles North
 - 22 Miles South
- Federal Rule: 10-Mile EPZ
- NRC's Recommendation For U.S. Citizens Near Fukushima

NUCLEAR SAFETY AFTER FUKUSHIMA: OBSERVATIONS

- **Future Safety Improvements**

- Current Extensive Federal Oversight Likely Be Expanded
- Increased Industry Vigilance Be Expected
- Inherent Difficulties
 - Sheer Size & Complexity
 - Idle Safety Systems, Large Capacity With Rapid Response
 - Human & System Interactions
 - Unforeseeable Events
- Unforgiving Technology After A Severe Accident

- **State Agencies Role**

- License Extension
- Spent Fuel Pool Issues
- Seismic Issues
- Once Through Cooling
- Emergency Planning Zone