NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION

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ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
McGuire Nuclear Station, Unit 2	05000370	1 OF 14

TITLE (4)
Unit 2 Refueling Water Storage Tank Level Instrumentation Inoperability During Cold Weather Conditions.

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER(S)
									N/A	05000
02	08	96	96	- 01	- 1	04	18	96		05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (Check one or more of the following) (11)			
POWER LEVEL (10)	100%	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
J.W. Pitesa	(704)	875-4788

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
E5	CFF	IXMITR	I204	YES							

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

Unit Status: February 8, 1996, Unit 2 - Mode 1 (Power Operation) at 100 percent power.

Event Description: On February 6, 1996, during performance of preventive maintenance, the Channel 2 Refueling Water Storage Tank (FWST) level transmitter was found frozen (inoperable) and the operability of the Channel 1 FWST level transmitter was in question. The ambient temperature in the Channel 2 and Channel 1 Refueling Water (FW) Level Transmitter Panels was immediately increased and testing was sequentially completed in a timely manner to avoid placing both channels in test simultaneously. On February 8, 1996, Engineering personnel concluded that the level transmitters were probably inoperable during extreme cold weather conditions prior to increasing the ambient temperature in the panels. The FWST Control Room annunciators and the auto swap over from the FWST to the Emergency Core Cooling System (ECCS) sump operate on a 2 out of 3 logic and; therefore, may not have functioned properly during those times.

Event Cause: The inoperability of the FWST Level Instrumentation is assigned a cause of Insufficient Monitoring of Equipment due to lack of a formal program to monitor proper operation of FW Level Transmitter Panel heaters/thermostats. The strip heaters were not maintaining the appropriate temperature.

Corrective Actions: The integrity and proper operation of the Unit 1 and Unit 2 FW Level Transmitter Panels will be verified during routine maintenance and periodically checked under a formal process.

EVALUATION:

Background

Level instrumentation for the Refueling Water Storage Tank (FWST) [EIIS:TK] consists of the following:

- One non-safety related wide range level loop (2FWLP5340) with indication on the Main Control Board [EIIS:MCBD] in the Control Room (CR) [EIIS:NA].

- One non-safety related upper narrow range level loop (2FWLP5341) with indication on the Main Control Board in the CR.

- Three safety related narrow range level loops (2FWLP5000, 2FWLP5010, and 2FWLP5020) designated as Channel [EIIS:CH] 4, Channel 1, and Channel 2, respectively. There is no loop designated as Channel 3.

  - These instruments supply three level indicators [EIIS:LI] on the Main Control Board, level alarms [EIIS:ALM] for annunciators [EIIS:ANN], and inputs for the Residual Heat Removal (ND) system [EIIS:BP] auto swap over from the FWST to the Emergency Core Cooling System (ECCS) sump.

  - There are individual computer alarms for each level channel; however, the FWST level control circuits require that a 2 of 3 logic be satisfied before annunciator alarms or automatic control functions occur.

  - Each safety related instrument is installed in a separate panel. The temperature of each panel is controlled by a strip heater [EIIS:HTR] and thermostat [EIIS:TH].

  - The range of the thermostat is 0 degrees F. to 100 degrees F. The thermostat is turned off when the thermostat is set at 0 degrees F.

- The portion of the impulse tubing [EIIS:TBG] located outside of the transmitter panel for each instrument is protected by two heat trace cables [EIIS:CBL]. These two cables are controlled by a local thermostat.

Description of Event

Unit 2 was in Mode 1 (Power Operation) at 100 percent power at the time of discovery.

- On February 5, 1996, at 0655, CR operators observed the non-safety related FWST wide range level instrument 2FWP-5340 drift high. The ambient air temperature at this time was approximately 6.3 degrees F.

- Instrument and Electrical (IAE) personnel investigated the problem and found the instruments were not working properly due to frozen impulse lines. IAE personnel raised the set point on the controller in the local heat trace panel for the back up heat trace. After discussion with Operations (OPS) personnel, a decision was made for OPS personnel to monitor the indicator overnight.

- The CR operators observed instrument 2FWP-5340 drift high again overnight. IAE personnel found that the strip heater inside the 2FWLT5340 transmitter panel [EIIS:PL] was being energized at approximately 30 degrees F. IAE personnel adjusted the thermostat for the strip heater and corrected the problem.

- On February 6, 1996, IAE personnel were to perform testing activities on the Channel 4 FWST level transmitter (2FWLT5000), the Channel 2 FWST level transmitter (2FWLT5020), and the Channel 1 FWST level transmitter (2FWLT5010) per procedure IP/0/A/3050/13B, RWST Class 1E Level Transmitter Operability Verification.

- In order to perform a test on the Channel 4 FWST Level Instrumentation, the channel was declared inoperable at 1240 per the test procedure. The FWST level transmitter was tested, responded properly, and the Channel 4 FWST Level Instrumentation was restored to operable status at 1304.

- Similarly, the Channel 2 FWST Level Instrumentation was declared inoperable at 1311 per the test procedure. The FWST level transmitter was tested, but did not respond properly, and was determined to be frozen (inoperable). The Channel 2 Refueling Water (FW) system [EIIS:DA] Level Transmitter Panel strip heater was not energized at this time. The ambient temperature in the panel was approximately 30 degrees F.

- IAE personnel notified the CR Senior Reactor Operator (CR SRO) that the Channel 2 FWST level transmitter was found frozen and the condition of the Channel 1 FWST level transmitter was not known at

this time. IAE personnel increased the ambient temperature in the Channel 2 FW Level Transmitter Panel by turning the strip heater thermostat up.

- In accordance with Technical Specification (TS) requirements, IAE personnel put the Channel 2 FWST Level Instrumentation in TRIP condition at 1350 per procedure IP/0/A/3090/14, Tripping Inoperable Protection Channels.

- The CR SRO notified the Operations Shift Manager (OSM) that the Channel 2 FWST level transmitter was inoperable and the condition of the Channel 1 FWST level transmitter was not known.

- The OSM asked IAE personnel if the Channel 1 FWST level transmitter was inoperable. IAE personnel indicated that they could not verify the Channel 1 FWST level transmitter operability without testing the channel first; however, they suspected the channel to be inoperable based on:

  - The FW Level Transmitter Panel strip heater was not energized at this time.

  - The ambient temperature in the panel was approximately 32 degrees F.

- At that point, the OSM wanted to test the Channel 1 FWST level transmitter, but had to consider the following:

  - Testing the Channel 1 FWST level transmitter with the Channel 2 FWST Level Instrumentation in TRIP condition would be placing 2 level channels in TRIP at the same time.

  - Having 2 level channels in TRIP condition at the same time would cause a non conservative action if a Safety Injection were to occur. This would cause the ND system to auto swap to a dry ECCS sump.

- The OSM asked IAE personnel how long it would take to return the Channel 2 FWST Level Instrumentation to service and thus be in a condition to test the Channel 1 FWST level transmitter. The OSM again asked IAE personnel if the Channel 1 FWST level transmitter was inoperable. IAE personnel indicated that it would not take long to

return the Channel 2 FWST Level Instrumentation to service, and they could not determine the Channel 1 FWST level transmitter operability without testing first.

- In the interest of ensuring operability of the Channel 1 FWST level transmitter, a decision was made by the OSM to have IAE personnel take the following actions:

  - Return the Channel 2 Level Instrumentation to service as soon as possible.

  - Immediately increase the ambient temperature in the Channel 1 FW Level Transmitter Panel by turning the strip heater thermostat on or up if not on.

  - Test the Channel 1 FWST transmitter as soon as the Channel 2 FWST transmitter test was completed.

- IAE personnel increased the ambient temperature in the Channel 1 FW Level Transmitter Panel by turning the strip heater thermostat up.

- The Channel 2 FWST level transmitter was retested and responded properly. The Channel 2 FWST Level Instrumentation was returned to NORMAL condition at 1614 and was restored to operable status at 1620.

- In order to perform a test on the Channel 1 FWST Level Instrumentation, the channel was declared inoperable at 1622 per the test procedure. The FWST level transmitter was tested, responded properly, and the Channel 1 Level Instrumentation was restored to operable status at 1635. The strip heater was on for approximately 1 hour before the operability test was performed.

- On February 7, 1996, IAE personnel verified proper operation of the Unit 1 FW Level Transmitter (1FWLT5000, 1FWLT5010, 1FWLT5020) Panel strip heaters.

- On February 8, 1996, Engineering personnel concluded that the Unit 2 Channel 1 FWST level transmitter was past inoperable during cold weather conditions and prior to increasing the panel strip heater thermostat setting.

- The required 1 hour notification to the NRC was made at 1105 in accordance with procedure RP/0/A/5700/10, NRC Immediate Notification Requirements.

- Engineering personnel have subsequently concluded that it is unknown if conditions existed within the panel which would have caused the Unit 2 Channel 1 FWST level transmitter instrument impulse line to freeze during cold weather conditions and prior to increasing the panel strip heater thermostat setting.

- The bases for considering the instrument conditions unknown include:

  - The ambient temperature inside the panel was approximately 32 degrees F.

  - The freezing point of the borated water inside the impulse lines is 30.6 degrees F.

  - IAE personnel stated that they only barely turned the thermostat to turn on the strip heater.

- Thus, the Channel 2 FWST Level Instrumentation was inoperable and due to the uncertainty associated with the Channel 1 FWST Level Instrument operability, the instrument is considered previously inoperable during cold weather conditions (< or = to approximately 30.6 degrees F.). The Unit 2 FWST CR annunciators and the auto swap over from the FWST to the ECCS sump operate on a 2 out of 3 logic and may not have functioned properly during those times.

Conclusion

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive material resulting from this event. This event is Nuclear Plant Reliability Data System (NPRDS) reportable due to the potential inoperability of the level transmitters and the effect of the inoperability in the accident scenario described above.

- The primary cause of the Channel 2 being past inoperable and Channel 1 FWST Level Instrumentation being potentially past inoperable was Insufficient Monitoring of Equipment due to lack of a formal program to monitor proper operation of the FW Level Transmitter Panel strip heater/thermostats.

- A method is in place for inspecting, cleaning, and performing an operational check of the FW system that is trace heated for freeze protection; however, the FWST Level Transmitter Panels were not included in the Cold Weather Preventive Maintenance (PM) program.

- IAE personnel indicated that the strip heater and thermostat in the Channel 1 and Channel 2 FW Level Transmitter Panels were working on February 6, 1996; however, the thermostats were set too low and the strip heaters were not maintaining appropriate temperature within the panels.

- Prior to adjusting the thermostats, the ambient temperature in the Channel 2 FW Level Transmitter Panel was approximately 30 degrees F. and the ambient temperature in the Channel 1 FW Level Transmitter Panel was approximately 32 degrees F. (the freezing point for the process liquid is 30.6 degrees F.). The strip heater in each panel energized when IAE personnel turned the thermostat setting up a small amount. Therefore, the thermostats were not turned off at this time.

- It cannot be determined when the thermostats had been set too low.

- The FW Level Transmitter Panels are located inside the FWST enclosure and are not easily accessible. Radiation Protection and Security personnel must be contacted to obtain entry to the FWST enclosure.

- Except for troubleshooting, the bolted covers of the FW Level Transmitter Panels are only opened to perform the 18 month calibration of the FWST level transmitters per procedure IP/0/A/3050/13, RWST Class 1E Level Transmitter Calibration. There are no steps in this procedure to verify the thermostat is properly set prior to replacing the cover on the FW Level Transmitter Panel.

- The 18 month calibration of the Channel 1 level transmitter was performed on November 13, 1995. The 18 month calibration of the Channel 2 level transmitter was performed on December 13, 1995.

- A search of the Operating Experience Program (OEP) and Problem Investigation Process (PIP) databases for the past 24 months revealed two other reportable events due to Insufficient Monitoring of Equipment. These events are documented in Licensee Event Reports (LER) 370/95-01 and 369/95-04. These events did not involve the same equipment, the same administrative controls, the same personnel

actions, or the same work groups. Therefore, this event is considered not recurring.

- Since 1984, there have been many Industry events where safety related instruments failed due to inadequate protection from cold weather conditions. Nearly all of these events could have been avoided by properly preparing for cold weather conditions. Measures were taken to prevent the FWST level transmitters from freezing; however, a method was not in place to ensure the proper operation of FW Level Transmitter Panel heaters/thermostats.

CORRECTIVE ACTION:

Immediate:

1. IAE personnel notified the CR SRO that the Channel 2 FWST level transmitter was inoperable and the condition of the Channel 1 FWST level transmitter was not known at the time but suspected to be inoperable.

2. IAE personnel placed the Channel 2 FWST Level Instrumentation in TRIP condition per procedure.

3. IAE personnel increased the ambient temperature in the Channel 2 FW Level Transmitter Panel by turning the strip heater thermostat up.

Subsequent:

1. To ensure the operability of all FWST level transmitters, the OSM directed the following:

   - IAE personnel increased the ambient temperature in the Channel 1 FW Level Transmitter Panel by turning the strip heater thermostat up.

   - The Channel 2 FWST level transmitter was retested and responded properly.

   - The Channel 1 FWST level transmitter was tested and responded properly.

2. IAE personnel verified proper operation of the Unit 1 FW Level Transmitter Panel strip heaters.

3. Management personnel established a task force, consisting of Engineering and Station personnel, to determine actions needed (short term and long term) to assure all equipment requiring cold weather protection is adequately protected.

Planned:

1. A step will be added to procedure IP/0/A/3050/13, RWST Class 1E Level Transmitter Calibration, to verify that the FW Level Transmitter Panel thermostats are set at 60 degrees F. or above.

2. A step will be added to procedure IP/0/A/3050/13B, RWST Class 1E Level Transmitter Operability Verification, to verify that the FW Level Transmitter Panel thermostats are set at 60 degrees F. or above whenever the covers of the FW Level Transmitter Panels are opened.

3. Steps will be added to the Cold Weather PM procedure to require inspection of the FW Level Transmitter Panels.

4. Engineering personnel will evaluate the adequacy of set point documentation and control of components in other non-safety related support systems.

SAFETY ANALYSIS:

The health and safety of the public and plant personnel were not affected as a result of this event.

- The event has been analyzed using the McGuire Nuclear Station (MNS) Individual Plant Examination (IPE)/Probabilistic Risk Assessment (PRA) models. The conditional core damage frequency due to this event is 8.7E-07 for an exposure time of 4 days. For comparison purposes, the nominal average core damage frequency for MNS is 7.4E-05 per reactor [EIIS:RCT] year.

- The safety related FWST level transmitters 2FWLT5000, 2FWLT5010, and 2FWLT5020 are used to provide narrow range (0 to 160 inches) FWST level indication, provide Control Room annunciators and computer [EIIS:CPU] alarms for low tank level conditions, and provide an automatic realignment of the ECCS sump to the ND pump [EIIS:P] suction.

- The automatic ECCS suction realignment is provided upon low FWST level, in conjunction with a Safety Injection (Ss) signal. The

alignment of the ECCS sump to the ND pump suction provides for long term core cooling using the ECCS in recirculation mode.

- The postulated events requiring the ECCS sump automatic swapover are the large break and small break Loss-Of-Coolant Accidents (LOCA) as defined in Final Safety Analysis Report (FSAR) Chapter 15.6.5, Loss-Of-Coolant Accidents, inadvertent opening of a Pressurizer [EIIS:PZR] Safety Valve (PSV) or Relief Valve [EIIS:RV] as defined in FSAR Chapter 15.6.1, Inadvertent Opening Of A Pressurizer Safety Or Relief Valve, and rod [EIIS:ROD] ejection accident as defined in FSAR Chapter 15.4.8, Spectrum Of Rod Cluster Control Assembly Ejection Accidents.

- Each of these events, described in the FSAR, are reduction in coolant inventory events, which result in depletion of the FWST. There are no particular differences in the stuck open PSV and rod ejection accidents (compared to the LOCA) relative to the failure of the FWST level transmitters.

- The FWST level transmitters are contained within separate sealed enclosures, located inside a concrete missile shield. The enclosures provide a thermal boundary between the outside air and the transmitter, and the heat capacity of the metal and water will tend to dampen temperature transients.

- The outside air temperature at the MNS during the winter period is typically above freezing, with occasional freezing overnight. The following climatology values for the MNS vicinity are depicted in FSAR Chapter 2.3, Meteorology, Appendix 2, Chapter 2 Tables and Figures, Table 2-9, McGuire Nuclear Station - Vicinity Climatology:

  - The January daily maximum/minimum temperature is 52.2 degrees F./32.3 degrees F., respectively.

  - The February daily maximum/minimum temperature is 54.9 degrees F./33.8 degrees F., respectively.

  - The December daily maximum/minimum temperature is 53.0 degrees F./33.0 degrees F., respectively.

- With this type of temperature pattern, the transmitters would not have been as likely to freeze, due to the heat capacity and insulation effects. Further, the water contained in the transmitters

contains 2175 to 2275 ppm Boric Acid, which has a freezing point of 30.6 degrees F. at 2200 ppm.

- Not withstanding the above, the failure of FWST level Channel 2, and presumed failure of level Channel 1 were identified on February 6, 1996. The investigation of the level transmitters was preceded by Control Room operators noticing the non-safety related FWST wide range instrument (2FWP-5340) drifting high.

- The non-safety wide range channel was found to be frozen. This was the first indication over the winter period where the wide range Control Room gage was noted to indicate erratically.

- The period immediately prior to discovery was unusually cold, with approximately 86 hours (February 2, 1996, to February 6, 1996) of sustained ambient temperatures below 32 degrees F. The lowest temperature over this freezing period was approximately 6 degrees F. on February 5, 1996.

- Prior to this period, the coldest recorded temperature during the winter of 1995/1996 was 16 degrees F. on January 8, 1996, when temperatures remained below freezing for approximately 48 hours.

- Since the non-safety related wide range transmitter was discovered frozen on February 5, 1996, based on indications which had been noted to behave erratically prior to this time, and since the weather pattern was extreme compared to the earlier periods, it is reasonable to assume the narrow range transmitters had not been frozen for significant periods prior to discovery.

- A total of 486 hours were recorded on the Operator Aid Computers (OAC) where intermittent freezing conditions existed between October 1, 1995, and February 6, 1996. Thus, 2 of the 3 safety related transmitters were possibly frozen for a period of up to 3 to 4 days prior to discovery, with the remote possibility of being frozen intermittently for up to an equivalent of 20 days during the winter period.

- The significance of the potential failure of two FWST level channels due to freezing conditions is that 2 of the 3 safety channels would fail high. The failure position is off scale high, similar to the normal Control Room indication. The third channel (2FWLT5000, Channel 3) was tested and verified operable on February 6, 1996.

- The operable third channel (Channel 4) provides a Control Room indication (0 to 160 inches) and provides an OAC alarm on low and low-low FWST level.

- For most credible LOCA scenarios (medium/small breaks), a reasonable time to evaluate the plant indications would exist. These indications would include ECCS sump level, ECCS pump flowrates, FWST narrow range level (Channel 4) and OAC alarms for FWST low and low-low level. These indications would provide the operators with a reasonable success path for manual swapover to the ECCS sump.

- The principle mechanism for entry in the ECCS sump recirculation mode for the small break LOCA is from procedure EP/2/A/5000/E-1, Loss of Reactor or Secondary Coolant, step 14.

  - This step and the procedure foldout page, which is continuously monitored by the operators, checks for the transfer to Cold Leg Recirculation criteria "FWST Level - less than 150 inches". The response not obtained sends the operator back to step 11.

  - Steps 11 through 13 verify Containment Hydrogen systems, Cold Leg Recirculation capability, and Reactor Coolant (NC) system [EIIS:AB] pressure. The operator then repeats step 14, check for transfer to Cold Leg Recirculation criteria.

  - Thus, FWST level would be repeatedly checked by the operators prior to the need to swap to the ECCS sump.

  - Upon determining the FWST level is less than 150 inches, based on the operable Channel 4 and other plant indications, and the Safety Injection (NI) system [EIIS:BQ] is not automatically aligned for Cold Leg Recirculation, the operators would be directed to procedure EP/2/A/5000/ES-1.3, Transfer to Cold Leg Recirculation, where steps for manual transfer would be followed.

  - Thus for small breaks, the emergency procedures and Control Room alarms and indications remained adequate for a successful manual swapover to the ECCS sump.

- In the unlikely event of a large break LOCA, timely operator diagnosis can not always be assured. However, simulator exercises, detailed below, indicate appropriate operator response.
  - In the large break LOCA case, the NC system would depressurize rapidly, and the ND pumps would begin injection immediately.
  - In the event that the operators missed the transfer to Cold Leg Recirculation, and the ECCS pumps lost suction on low FWST level, the Chemical and Volume Control (NV) [EIIS:CB], NI, Containment Spray (NS) [EIIS:BE], and ND pumps would begin cavitating. This would likely result in the failure of the high (NV) and intermediate (NI) head pumps due to the tight clearances in the multistage pumps. However, the single stage ND and NS pumps would be more likely to survive a brief period of cavitation.
  - Annunciators for low flow to the Cold Leg would alert the operators to the loss of ND suction. In this case, the ECCS sump level would be high, due to ice melt and the entire volume of the FWST being transferred, and the alignment of the ECCS to sump to recirculation would be expedited to restore suction.
  - Since the ND and NS suction temperature and ECCS sump temperature would be considerably less than saturation, the restart of the pumps upon swapover to the ECCS sump is considered a likely recovery step.
  - Further, since the core had been reflooded from the complete injection phase of the accident, adequate time for this recovery is likely.
- McGuire Operations Training personnel conducted 4 simulator exercises/tests that simulate conditions similar to the event.
  - The exercises were unannounced and the operators were not informed of the scenario ahead of the exercise.
  - Three of the exercises were conducted with 2 of the 3 safety related narrow range FWST level transmitters failed and a 4 inch to 6 inch LOCA in the NC system.

- The fourth exercise included 2 of the 3 safety related FWST level transmitters failed, the wide range detector failed, and the non-safety related narrow range detector failed. The LOCA consisted of a double ended NC pipe break.

- In each exercise, the operators were able to recognize the failures and swap to sump recirculation prior to pump cavitation.

- There have been no events at MNS challenging the Unit 2 ECCS auto swap from FWST to ECCS sump feature.