



DUKE POWER

July 29, 1991

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 2  
Docket No. 50-370  
Licensee Event Report 370/91-04

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 370/91-04 concerning the Auxiliary Feedwater System Turbine Driven Pump being inoperable due to the erroneous calibration of the Suction Pressure Switches. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

*T. L. McCornell*

T. L. McCornell

ADJ/cbl

Attachment

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# LICENSEE EVENT REPORT (LER)

FACILITY NAME(1) McGuire Nuclear Station, Unit 2										DOCKET NUMBER(2) 05000 370		PAGE(3) 1 OF 10	
TITLE(4) The Auxiliary Feedwater System Turbine Driven Pump Was Past Inoperable Due To Erroneous Calibration Of Suction Pressure Switches Due To A Management And A Design Deficiency													
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 NAMES			DOCKET NUMBER(S)	
04	22	91	91	04	0	07	29	91				05000	
OPERATING MODE(9)		1		THIS REPORT IS SUBMITTED PURSUANT TO REQUIREMENTS OF 10CFR (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)			
				20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)					
				20.405(a)(1)(iv)		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)(ix)					
LICENSEE CONTACT FOR THIS LER(12)													
NAME Alan R. Sipe, Chairman, McGuire Safety Review Group								TELEPHONE NUMBER					
								AREA CODE 704		875-4183			
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT(13)													
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC			
SUPPLEMENTAL REPORT EXPECTED(14)										EXPECTED SUBMISSION DATE(15)	MONTH	DAY	YEAR
X YES (If yes, complete EXPECTED SUBMISSION DATE)											9	30	91
NO													
ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)													
<p>On April 22, 1991 at approximately 2021, while Unit 2 was in Mode 1 (Power Operation) at 100 percent power, the Auxiliary Feedwater (CA) Turbine Driven (TD) Pump was declared inoperable due to erroneous calibration of CA TD Pump suction pressure switches 2CAPS5380, 5381, and 5390. These pressure switches monitor CA TD Pump suction pressure and automatically open assured water source isolation valves 2CA-162C (TD CA Pump Suction Header from Nuclear Service Water Supply Isolation), 2RN-162B (Engineered Safety Function CA Assured Supply From B Train Nuclear Service Water System), and 2CA-116B (Engineered Safety Function TD CA Pump Suction From TD Feedwater Consensate Storage Tank), when CA TD Pump suction pressure falls below 2 psig for more than 2-3 seconds. It was subsequently determined that the CA TD Pump had been technically inoperable since initial startup because the assured suction source isolation valves would not have automatically opened as required. The associated pressure switches were subsequently calibrated under work request 601014IAE. The CA TD Pump was returned to operable status on April 22, 1991 at 2332. This event is assigned causes of Management Deficiency and Design Deficiency.</p>													

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**EVALUATION:**

**Background**

The Auxiliary Feedwater (CA) [EIIS:BA] system is nuclear safety related and assures feedwater will be supplied to the Steam Generators (S/Gs) [EIIS:SG] for decay heat removal if the Condensate [EIIS:KA] system and Feedwater [EIIS:SJ] system are not available because of a loss of power or other malfunctions. The CA system is provided with two motor [EIIS:MO] driven pumps [EIIS:P], one turbine driven (TD) [EIIS:TRB] pump and associated piping, valves [EIIS:V] and controls. Each motor driven CA pump can supply two S/Gs. However, by means of crossover valves one motor driven CA pump can supply all four S/Gs. The TD CA pump supplies water to all four S/Gs and may be used during normal startup and shutdown as well as emergencies. This system is designed to handle single equipment failures.

There are four sources from which the CA pumps can be supplied. In order of preference and quality, they are:

<u>Source</u>	<u>Supply Valves</u>
1. CA Condensate Storage Tank [EIIS:TK]	2CA-6
2. Upper Surge Tank	2CA-4 and 2CS-18
3. Condenser Hotwell	2CA-2 and 2CM-265
4. Nuclear Service Water (RN) [EIIS:BI] system	2CA-15A, 2RN-69A, 2CA-18B and 2RN-162b

Pressure switches [EIIS:PDS] 2CAPS5380, 5381 and 5390 (TD CA Pump Suction Pressure) were manufactured by the United Electric Company and designated as model number J302-552. They are used to monitor the pressure on the TD CA pump suction header and generate signals to automatically open isolation valves 2CA-162C (TD CA Pump Suction Header From RN System Supply Isolation), 2RN-162B (Engineered Safety Function CA Assured Supply From B Train RN System), and 2CA-116B (Engineered Safety Function TD CA Pump Suction From TD Feedwater Pump Condensate Storage Tank), on low suction pressure. The McGuire Instrument and Control (I&C) List specifies that these pressure switches shall be calibrated to actuate at 2 psig decreasing referenced to within +/- 6 inches of the centerline of the pipe at the suction flow element [EIIS:FE]. The low suction pressure signal(s) must be present for at least 2-3 seconds before the valve(s) will start to open. This action provides an assured suction supply from the RN system essential header.

Valve 2CA-162C is automatically controlled by pressure switch 2CAPS5380. Pressure switch 2CAPS5380 is located 85 inches below the suction flow element in the CA TD Pump header. The presence of this 85 inch water leg, which exerts a pressure of 3.07 psig, requires that the pressure switch be calibrated to actuate at a decreasing pressure of 5.07 psig.

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Valve 2RN-162B is automatically controlled by pressure switch 2CAPS5381 and pressure switch 2CAPS5012. Pressure switch 2CAPS5012 (Motor Driven CA Pump 2B Suction Pressure) is associated with Motor Driven CA Pump 2B. Either pressure switch will open valve 2RN-162B on low suction pressure for the respective pump. Pressure switch 2CAPS5381 is located 85 inches below the flow element in the CA TD Pump header. The presence of this 85 inch water leg, which exerts a pressure of 3.07 psig, requires that the pressure switch be calibrated to actuate at a decreasing pressure of 5.07 psig.

Valve 2CA-116B is automatically controlled by pressure switch 2CAPS5390. Pressure switch 2CAPS5390 is located 107 inches below the flow element in the CA TD Pump header. The presence of this 107 inch water leg, which exerts a pressure of 3.86 psig, requires that the pressure switch be calibrated to actuate at a decreasing pressure of 5.86 psig.

The tap location for pressure switches 2CAPS5380 and 2CAPS5381 is located approximately 33 inches below the centerline of the TD CA Pump suction piping (see page 10 of 10) flow element. The tap location for pressure switch 2CAPS5390 is located approximately 69 inches below the center line of the TD CA Pump suction piping at the flow element.

Technical Specification (TS) 3.7.1.2 requires at least three independent CA pumps and associated flow paths be operable in Modes 1 (Power Operation), Mode 2 (Startup), and Mode 3 (Hot Standby). The action statement specifies that if one CA pump is inoperable, it must be returned to operable status within 72 hours, or the Unit shall be in at least Mode 3 within the next six hours and in Mode 4 (Hot Shutdown) within the following six hours. The action statement also specifies that with two CA pumps inoperable, the Unit shall be in at least Mode 3 within six hours and in Mode 4 (Hot Shutdown) within the following six hours.

When the TD CA Pump is declared inoperable, it also makes the Standby Shutdown Facility inoperable per the Selected Licensee Commitments (SLC) Manual section 16.9-7.

EVENT DESCRIPTION

On April 18, 1991, an Operations (OPS) staff engineer was performing a review of CA pump suction sources. He was doing research to evaluate manual operation of CA pump suction valves to answer an outstanding item (McGuire Action Directory (MAD) item 1-90-01-16D: Evaluation of manual operation of CA suction valves) on emergency procedures that had previously been identified by an NRC inspection team. While in the Unit 2 CA Pump Room, the OPS staff engineer noticed that pressure switches 2CAPS5380, 5381, and 5390 had taps at a different location than the associated flow element on the TD CA pump suction piping. He suspected that it would be easy for a technician to make a mistake on compensating for the water leg when calibrating the pressure switches. He subsequently asked some Instrument and Electrical (IAE) technicians to explain how a pressure switch is calibrated. The IAE technicians explained a

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standard calibration procedure and showed a typical water leg data sheet to the OPS engineer. The OPS engineer then obtained the water leg data sheets for the pressure switches associated with the CA pump suction. He noticed that each pressure switch associated with the same pump had different tap locations on the water leg data sheets. This did not seem quite right to the OPS engineer. He believed that every pressure switch associated with the same pump should use the same tap location to calculate the water leg data value. The different values on the sheets made him suspect that the pressure switches may have been miscalibrated. Subsequently, he wrote a memorandum on the results of his investigation and requested the on duty Shift Manager to have IAE personnel follow up by determining if the CA suction pressure switches were properly calibrated. The Shift Manager then contacted a Maintenance Engineering Services - Instrument and Electrical (MES-IAE) engineering supervisor and asked him to determine if the CA suction pressure switches had been miscalibrated. The MES Engineer responsible for the CA system was not available that day. Therefore, the MES-IAE engineering supervisor then asked other IAE personnel to investigate the situation. IAE personnel investigating the problem had limited knowledge of water leg calculations. During their investigation, a note was discovered on the I&C list. The note associated with the subject pressure switches specified "set 2 psig decreasing, opens (associated) valve on low suction pressure, calibrated within +/- 6 inches centerline pipe elevation at flow element". Also, the associated water leg data sheets had conflicting information concerning data for calculating water legs. IAE personnel were confused by this. They were not sure whether the instrument tap location or the flow element location had been factored into the water leg reference during the last pressure switch calibration. Other knowledgeable personnel were not available for consultation at the time. Therefore, IAE personnel that performed the investigation were not sure whether the OPS engineer's concerns were valid or not. This was discussed with the Shift Manager and OPS Management personnel. It was subsequently decided by management personnel that the investigation could wait until the MES engineer responsible for the CA system or other knowledgeable personnel were available. Therefore, the MES-IAE engineering supervisor placed the memo written by the OPS engineer on the MES engineer's desk and temporarily suspended the investigation.

On April 22, 1991 the MES engineer responsible for the CA system returned to work and he started an investigation to determine if the CA suction pressure switches had been miscalibrated. Early that morning, the OPS engineer contacted the CA system MES engineer to ensure that he was aware of his concern and was investigating the problem. The MES and OPS engineer continued researching the problem. At approximately 0900, they went to the CA Pump Room and started measuring water legs of all CA pump suction (both units) pressure switches. It took most of the day to collect the field data required for analysis. By 1600, all pressure switches other than 2CAPS5380, 5381, and 5390 were determined to have been calibrated correctly. At 1611, the MES CA system engineer informed OPS Control Room [E11S:NA] personnel that subject CA pump suction pressure switches were probably inoperable and that IAE personnel were in the process of making an operability evaluation. At 1630, the MES

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engineer determined that a problem did exist with the CA pump suction pressure switch calibration. At approximately 1700, he subsequently telephoned Design Engineering (DE) personnel and requested them to perform an operability determination of the CA pumps. At 1830, he generated a priority "E" (emergency) work request 601014IAE to recalibrate pressure switches 2CAPS5380, 5381, and 5390. Recalibration activities on pressure switches 2CAPS5380, 5381, and 5390 as directed by work request 601014IAE were then initiated. During the next hour and 45 minutes several teleconferences were held between MES personnel and DE personnel concerning the operability of the CA system. At approximately 2015, DE personnel confirmed that they could not state qualitatively that the CA TD pump would operate properly if required. The MES engineer then notified OPS Control Room personnel that pressure switches 2CAPS5380, 5381, and 5390 were inoperable due to erroneous calibration. At 2021, OPS Control Room personnel declared the TD CA pump inoperable and made an appropriate entry in the Technical Specification Action Item Log (TSAIL). At the time, Motor Driven CA Pump 2A was also inoperable. Therefore, a load reduction was initiated per TS 3.7.1.2 and immediate notification was made to the NRC. By 2255, pressure switches 2CAPS5380, 5381, and 5390 were calibrated to the correct set points. Subsequently, at 2332, the TD CA pump was declared operable and the load reduction was secured. OPS Control Room personnel then commenced Unit 2 load increase activities. By April 23, 1991, at 0107, the load increase was secured with Unit 2 at 100% power. On April 26, 1991, Problem Investigation Report (PIR) 2-M91-0077 was written to initiate a past operability evaluation of the TD CA pump. On May 7, 1991, Design Engineering personnel received PIR 2-M91-0077 which requested a past operability determination. DE personnel performed an operability determination and on April 28, 1991, while Unit 2 was operating in Mode 1, at 100 % power, it was determined that the TD CA Pump had been past inoperable from April 1983 (initial Unit startup) through April 22, 1991.

## CONCLUSION

This event is assigned a cause of Management Deficiency resulting from inadequate knowledge on the part of IAE technicians concerning water leg calculations. This inadequacy is the result of management direction, incomplete training, and incomplete information on the water leg data sheets.

The I&C list specifies that the three pressure switches are to be calibrated to close contacts at 2 psig decreasing with the reference point being the centerline of the CA TD Pump suction piping at the flow element. Most plant instrumentation taps come off the pipe at the associated flow element location. However, the taps for pressure switches 2MCAPS5380 and 5381 are located approximately 33 inches below the centerline and the tap for pressure switch 2MCAPS5390 exits at approximately 69 inches below the centerline. The as found setpoint was measured at 3.99 psig for pressure switches 2MCAPS5380 and 5390, and 1.89 psig for pressure switch 2MCAPS5381. However, the required setpoint was 5.10 psig for pressure switches 2MCAPS5380 and 5381, and 5.90 psig for pressure switch 2MCAPS5390. IAE and MES personnel

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believe the discrepancy was due to incorrect calibration and not to instrument drift. The discrepancy between the required and the as found pressure setpoints was approximately equal to the difference between the tap location and the reference location water leg pressure. Therefore, it appears that the physical tap location was used by IAE personnel in calculating the water legs for these three switches instead of the given reference location.

A review of past work requests indicated that this error has been repeated numerous times since 1984. IAE technicians have stated that it is standard practice to always use the tap location when calculating water legs. IAE technicians have been instructed to use the water leg values from the water leg data sheets or perform the water leg calculations after having measured differences in reference and instruments elevations. Water leg calculation training is incorporated into the Fundamental IAE training. However, IAE Management personnel were not aware of unique situations which would require using a reference location as listed in the I&C List as opposed to using the tap location to determine the water leg value and therefore did not provide adequate guidance to the IAE technicians. Therefore, there was no statement on the water leg data sheet that would have indicated to the IAE technician that these instruments were unique.

MES Management personnel have stated that the treatment of water leg calculations for pressure switch setpoints in the I&C List are unreliable due to inconsistencies of incorporating water leg calculations in the document over the years. Some pressure switch setpoints appear to include water leg calculations, others do not. There appears to be no differentiation between the two methods used that would alert the IAE technicians performing the calibrations whether to account for water legs or not. As a result of this IAE Management concern, a water leg data program was initiated in 1987. However, this program did not have adequate controls to ensure that all water leg value determinations were made correctly by IAE technicians.

This event is also assigned a cause of Design Deficiency attributable to inconsistent and incomplete information contained on the I&C list.

For the subject pressure switches, a note appears on the I&C List which states "set 2 psig decr, opens (associated valve) on low suction pressure, calibrated w/in +/- 6" centrlne pipe el. at flw elemnt." This note does not indicate whether the pressure switch should be set at 2 psig exactly or whether to compensate for the water leg with this value. Interviews with IAE technicians and MES Management confirmed that the meaning of the statement is obscure and not understandable to them.

Design Engineering personnel have stated that current practice is to account for waterleg calculations in the setpoints unless there is a note on the I&C list to the contrary. However, they were aware that this practice had not been consistently applied in previous

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years. This could not be confirmed or refuted however because the individuals involved are no longer available. The I&C List historically has not been considered a controlled document and it has not received the same level of review as other design documents. Therefore it could have contained inconsistent information. This was recognized by IAE and Design Engineering Management and efforts to upgrade the I&C List to a controlled document were initiated. Also, Design Study MGDS-0050 was initiated in 1989 for Design Engineering personnel to perform a comprehensive review and upgrade of the McGuire Units 1 and 2 I&C List data. MGDS-0050 also evolved as a result of concerns which were associated with instrument setpoints, calibration data, and design basis. A related Design Study, MGDS-0123, will perform the design basis documentation of all QA Condition 1, technical specification related or other important nuclear safety related systems. MGDS-0123 will verify nuclear safety instrumentation and establish the design basis. MGDS-0050 will then issue a functional data sheet for the instrumentation. The planned completion date for the entire project is 1995.

A review of the Operating Experience Data Base for the previous 24 months prior to this incident revealed no events involving operability of the TD CA Pump as a result of Management or Design Deficiency. Therefore this event is not considered recurring.

This incident is Nuclear Plant Reliability Data System (NPRDS) reportable due to the incorrect calibration of Pressure Switches 2CAPS5380, 5381, 5390.

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive material as a result of this incident.

**CORRECTIVE ACTIONS**

Immediate: The pressure switches were re-calibrated as directed by work request 601014IAE.

Subsequent: 1) Design Engineering personnel performed an operability study which determined the required Net Positive Suction Head to the TD CA pump would not have been maintained with the actual pressure switch settings.

2) A "Water Leg Calculation" IAE crew information package was developed.

3) An MES staff engineer was assigned to permanently administer a water leg program and review completed instrument and water leg data sheets.

4) Instrument and water leg data sheets were revised by MES-IAE personnel to clarify the water leg pressure compensation calculation.

5) Additional information was added by MES-IAE personnel to the instrument

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and water leg data sheets for Pressure Switches 2CAPS5380, 5381, and 5390.

Planned: 1) This incident will be reviewed with IAE crew personnel and training will be given by MES Engineering personnel on water leg calculations.

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**SAFETY ANALYSIS**

Completion of the safety analysis is ongoing by Design Engineering personnel and will be transmitted to the NRC in a revision to this LER.

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