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August 17, 1994

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Subject: McGuire Nuclear Station, Unit 1 and 2
Docket Nos. 50-369 and 50-370
NRC Inspection Report No. 50-369, 370/94-08
Violation 50- 369, 370/94-08-01
Supplemental Information on NC Leakage Detection Systems

Gentlemen:

As requested, attached is supplemental information on NC leakage detection systems. Should there be any questions concerning this information, contact Randy Cross at (704) 875-4179.

Very Truly Yours,

T. C. McMeekin

Attachment

XC: (w/attachment)

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Response to NRC Request For Additional Information Re: McGuire NC Leakage Detection Systems

Problems with the NC leakage calculation program are documented in PIP 93-1253. Problems with the NC leakage detection systems are documented in PIP's 94-413 and 94-879.

I. Description of problems associated with NC leakage detection systems:

A. NC leakage calculation program:

The OAC Leakage Calculation Program performs the following calculations:

Total Leakage = (NC Mass Chng) + (VCT Mass Chng) + (PZR Mass Chng)
Identified Leakage = (NCDT Mass Chng) + (PRT Mass Chng)
Unidentified Leakage = Total Leakage - Identified Leakage

It was discovered that Refueling Water Storage Tank (FWST) water had a low probability but direct path into the Reactor Coolant Drain Tank (NCDT) and the Pressurizer Relief Tank (PRT) via valve stem leak-offs and relief valves. This resulted in FWST water being accounted for in the NC Leakage Calculation program as Identified NC leakage and thereby non conservatively lowering the value of Unidentified NC leakage. This program is used to monitor Technical Specification 3.4.6.2 limits of 10 gpm Identified Leakage and 1 gpm Unidentified Leakage.

Present operability for both Units was evaluated on 12/9/93. The OAC NC Leakage Calculation program was determined to be conditionally operable as long as Total Leakage remained less than 1 gpm. A subsequent operability evaluation for Unit 2, dated 12/10/93 was issued following procedural (locking out of PRT level indication during NC leakage calculation) and plant hardware changes (Temporary Modifications to remove non-NC inputs into the NCDT). This evaluation concluded that the OAC program was operable for Unit 2. A similar evaluation was issued for Unit 1 on 12/13/93 after plant modifications were performed. The operability evaluations were 93-08, 93-09, 93-10 and 93-11 issued on 12/9/93, 12/10/93, 12/10/93, and 12/13/93 respectively.

B. NC leakage detection systems:

McGuire was not in compliance with the FSAR commitments made for Regulatory Guide (RG) 1.45.

Originally, this problem was limited to operability on the Containment Radiation monitors; specifically EMF38 and EMF39. These monitors are used to satisfy Tech Spec 3.4.6.1 requirements for containment atmosphere gaseous and containment atmosphere particulate radioactivity monitoring systems. Further investigation into the problem revealed that there were also problems with the Containment Floor and Equipment (CF&E) Sump and with the Ventilation Unit Condensate Drain Tank (VUCDT) level indication. In each case, these systems had been in service, but technically, had not been operable because of their setpoints.

Specifically, these were the problems:

1. The particulate and gas radiation monitors did not meet RG 1.45 leak rate requirements due to their setpoints being set at 3 times background.

2. McGuire FSAR, SER, and RG 1.45 disagree on what the leakage rate detection capability should be.

3. RG 1.45 also addresses seismic qualification of EMF38.

4. Our EMF design basis document did not address RG 1.45.

5. 1 gpm leak would not be alarmed within 1 hour on Containment Floor and Equipment Sump.

6. 1 gpm leak would not be alarmed within 1 hour on Containment VUCDT.

Background information:

Catawba Nuclear Station had discovered that their Containment particulate and Containment gaseous radiation monitors may not have met the leakage detection requirements of RG 1.45. Catawba placed their setpoints at a level equal to their maximum release setting. McGuire traditionally placed the setpoints at (or near) three times background. With this, McGuire thought that the monitors would meet the RG 1.45 requirements. An operability evaluation concluded that the monitors would only meet this requirement if the background (normal process reading on the EMF) was sufficiently low.

Further investigation revealed that the McGuire EMF Design Basis Document did not include reference to RG 1.45. More specifically, this

document did not specify the NC leakage monitoring requirements for 1EMF38/39/40 or 2EMF38/39/40.

Further discussions led to the discovery that the CF&E sump and VUCDT level instrumentation were also deficient.

While researching information for updating the EMF Design Basis Document, licensing requirements were found that indicated that the containment particulate radiation monitor may be required to be seismically qualified to function through the safe shutdown earthquake (SSE). Further investigation revealed that the control room readout modules were fed from non-safety power which was never qualified to function through an SSE. A thorough review of documentation concerning the design basis for the NC leakage detection systems revealed that there was never any intention for these systems to be safety related or seismically qualified.

II. Describe how the problem was identified.

A. NC leakage calculation program:

The problem with the NC leakage calculation program was identified by System Engineering Review of Flow Diagrams and an understanding of the NC leakage calculation program.

B. NC leakage detection systems:

The problems with the NC leakage detection system were identified by discussions with Catawba personnel, further investigation at McGuire and during the update of the EMF and Liquid Radwaste System (WL) Design Basis Documents (DBD's).

III. Discuss applicable technical specifications.

The two Tech Specs concerning NC System Leakage are Tech Spec 3/4.4.6.1 - Leakage Detection Systems and Tech Spec 3/4.4.6.2 - Operational Leakage.

Tech Spec 3/4.4.6.1 details the systems required to be operable for NC leakage detection. The containment Atmosphere Gaseous Radioactivity Monitoring System (EMF39) is required to be operable in MODES 1 through 4. Either the CF&E sump level system or the flow monitoring system, and either the VUCDT level monitoring system or the containment Atmosphere Particulate Radioactivity Monitoring System (EMF38) are also required to be operable. With only two of the required three systems operable, plant operation is allowed for up to 30 days

with compensatory actions taken. This specification also details required surveillances to be performed on the equipment.

Tech Spec 3/4.4.6.2 details the limits on NC system leakage. These limits are:

a. No Pressure Boundary Leakage
b. 1 gpm Unidentified Leakage
c. 1 gpm total primary-to-secondary leakage through all steam generators and 500 gpd through any one steam generator
d. 10 gpm Identified Leakage from the NC system
e. 40 gpm Controlled Leakage at full system pressure, and
f. 1 gpm leakage at system pressure from any NC system pressure isolation valve, as specified.

With any Pressure Boundary Leakage the plant must be shut down. With any of the other leakage limits exceeded the leakage must be brought back within the limits or the plant must be shut down.

Surveillances to ensure compliance with the above limits are detailed in the Tech Spec surveillance requirements. The NC leakage calculation is required to be performed once every 72 hours while the plant is in MODES 1 through 4..

IV. <u>Determination of past inoperabilities of components and systems.</u>

A. NC leakage calculation program:

Following plant modifications the results of the NC leakage calculation program were analyzed to determine past operability. The difference in Total Leakage prior to the modifications and Total Leakage following the modifications was determined. For Unit 1 the difference was approximately .13 gpm and for Unit 2 the difference was approximately .34 gpm. By increasing the previous Unidentified Leakage values calculated during the current cycles by these amounts, it was concluded that Unit 1 Unidentified Leakage had not exceeded the Tech Spec limit of 1 gpm.

It was determined that with the uncertainty added, the Unit 2 Unidentified Leakage had unknowingly exceeded the 1 gpm Tech Spec limit several times during the current cycle (i.e., calculated Unidentified Leakage was greater than .87 gpm but less than 1 gpm). It was concluded that McGuire Unit 2 was past inoperable relative to the 1 gpm limit for unidentified leakage from the NC system.

The root cause for this problem was failure to recognize that inputs of water from non-NC systems to the NCDT and PRT would invalidate the results of the NC leakage calculation program. Failure to recognize these potential inputs and the subsequent effect on the calculation logic caused the calculation to be non-conservative. Since the plant personnel had not been aware of these potential inputs being accounted for as identified leakage, they were unaware of potentially exceeding the 1 gpm TS limit. Because they were unaware, no actions were taken to reduce the leakage or shutdown the unit as required by the Tech Spec. on the several occasions when the 1 gpm limit was apparently exceeded on Unit 2.

B. NC leakage detection systems:

The CF&E Sump and the VUCDT have been past inoperable due to not being able to detect and alert the operators to a 1 gpm leakage increase within 1 hour. The radiation monitors, EMF38(L) and EMF39(L) have been past inoperable depending on background levels in Containment.

V. <u>Determination of conditional operabilities and effectiveness of measures in place to maintain operability.</u>

A. NC leakage calculation program:

See response to I.A. above for a complete discussion of conditional operabilities for the NC leakage calculation program.

B. NC leakage detection systems:

As of 4/6/94, the leakage detection system, as described in Tech Spec 3.4.6.1 was declared conditionally operable.

a. The containment gaseous activity monitor, EMF39 was declared inoperable.

b. The CF&E sump was conditionally operable based on compensatory actions taken by Operations. The flow rate monitoring system had been declared inoperable per PIP #92-0449.

c. The VUCDT level instrumentation was conditionally operable based on compensatory actions taken by Operations.

d. The containment particulate activity monitor was conditionally operable based on compensatory actions taken by Operations and Radiation Protection.

Tech Spec 3.4.6.1 allows operation to continue for up to 30 days with only 2 of the above 3 items. Therefore, compliance with this Tech Spec was ensured since items b. and c. were at least conditionally operable.

Further, EMF38(L) was subsequently evaluated and deemed operable from a seismic mounting standpoint. RG 1.45 requires this monitor to withstand an SSE. Further evaluation revealed that this monitor was not designed to function through an SSE. Several discrepancies were found in licensing documents concerning the requirements for this monitor. These discrepancies are being evaluated.

VI. Describe corrective actions both subsequent to discovery and planned.

A. NC leakage calculation program:

1. Temporary Modification (TM) 6315 (Work Request # 93089150) was implemented on 12/13/93. TM 6314 (WR 93089055) was implemented on 12/11/93. All Safety Injection System (NI) Cold Leg Accumulator (CLA) and check valve test header valve stem leakoffs were properly removed from the WL drain header to the NCDT.

2. An investigation was conducted concerning the potential for relief valves 1,2NB-352 to leak Reactor Makeup Water Storage Tank (RMWST) water to the NCDT. 1,2NB-260B are normally closed containment isolation valves. In addition, 1,2NB-415 were closed by Operations as a second block to the relief valves. The probability of two valves in series leaking and the relief valve lifting was determined to be acceptably low. This handled the short term resolution on this input path.

3. An evaluation of the potential for Cold Leg Accumulator (CLA) drain and drain header to contribute Refueling Water System (FW) water to NCDT was conducted. Leakage from CLA drains to the NCDT was considered negligible by engineering judgment on the basis of triple isolation afforded by existing normally closed valves which preclude such leakage. Each CLA has two associated packless globe valves (that are normally closed by procedure) which isolate the CLA from the NCDT. In addition the drains from the four CLAs connect to a common drain which also has a normally closed packless globe valve (1/2WL-295). It is extremely unlikely that any leakage would get past the combination of three valves in series to result in leakage from the CLA(s) to the NCDT.

4. Procedures PT/1/A/4150/01B and PT/2/A/4150/01B were revised to include a step to lock out OAC point A0790 - Pressurizer Relief Tank Level while the NC leakage calculation program is being run. Locking this point out will cause the Leakage Program to read the same value for

PRT Level throughout the calculation which conservatively eliminates the PRT Level increase from the calculation.

5. An evaluation to permanently modify the TM changes which removed NI CLA and test header valve stem leakoffs as inputs to the NCDT will be conducted during the 1,2EOC9 outages since this cannot be done effectively while the units are on-line.

6. An evaluation of a more effective long term approach for removing 1,2NB-352 as source of non-NC/NV water to NCDT was performed.

1,2NB-260B are normally closed outside containment isolation valves. These valves are Type C leakage tested each outage which ensures excellent valve isolability. In addition, these valves are soft-seated, which also provides for better isolability under reasonable conditions. Finally, this flush header is rarely, if ever, used (to flush heat exchanger's (HX) for Maintenance). Relief valves 1,2NB-352 are set to relieve at 30 psig. These exist in the event that higher pressure leakage from the Chemical Volume and Control System (NV) (Regenerative or Excess Letdown HX flush isolation valves leaking) enters the Boron Recycle System (NB) header with the containment isolations closed. This leakage, in fact, would be valid NC/NV leakage relative to the NC leakage calculation and would not be a problem relative to this issue. Leakage from the RMWST/NB System through 1,2NB-260 would however be non-conservative leakage. The probability of this leakage to occur AND relief valves 1,2NB-352 to leak below setpoint is so remote as to be of no concern. (Normal NB pressure at this portion of NB would not lift the 30 psig reliefs.)

Therefore, it was judged acceptable to leave NB in its normal alignment for the long term approach to this concern.

7. An evaluation of a more effective long term approach for removing NI CLA drains/drain header from potential on-line NCDT input was conducted.

During 1,2EOC9 the CLA drain header to the NCDT will be tested to verify good isolability from the NCDT. Any valves found to be leaking will be evaluated for repair at the outage.

8. An evaluation to modify the relief valve discharge header was conducted. This modification would allow the inputs to the PRT to be used again in the NC leakage calculation. as a viable identified leakage component .

A modification to isolate the relief header from the PRT in the Auxiliary Building was scoped and estimated in mid February 1994. This modification was determined to be too costly. A smaller scope mod that allows manual draining of the PRT relief header in the event of leakage to the PRT, was evaluated. This modification was approved on May 26, 1994. Minor Mod's MM-4177 (Unit 1) and MM-4178 (Unit 2) have been assigned for this modification. They are currently planned for 2EOC9 and 1EOC10 implementation.

9. Appropriate information will be added to the DBD for the NC system to address the NC leakage calculation and the consequences of introducing inputs from other systems into the calculation.

10. Generic applicability screening was performed for the other Duke sites. This problem was determined to be applicable to Catawba and a PIP was generated. The Catawba PIP is C93-1147. Oconee has reviewed their procedures and leak paths and have determined that the problem is not applicable.

B. NC leakage detection systems:

1. Alarms for rate of change for EMF38(L) were added to both Unit 1 and Unit 2 Operator Aid Computers. These points are based on the existing EMF38(L) analog inputs (point A0055). Point P0590 is a 15 minute average of A0055. This value is updated each minute. Point P0592 looks at the difference between the current 15 minute average and the 15 minute average 60 minutes ago.

Based on calculation MCC-1223-.03-00-0038, with an increase in leakage of 1 gpm, after one hour there would be an increase of 752 CPM on EMF38(L).

Procedure IP/0/B/3006/04A defines a count rate of 85% of the reference count rate to be within tolerance for EMF39(L). For conservatism, the value for increased count rate after 58 minutes (706 CPM) was used rather than the count rate after one full hour. Therefore, a 1 gpm leak would be indicated by an increase of 706 x 85% = 600 CPM at the radiation monitor display. This value was supplied to Operations to be incorporated in the loss of OAC procedure.

For the OAC alarm, the data provided in calculation MCC-1223-03-00-0038 was first subjected to a 15 minute rolling average.

For conservatism, the value at 58 minutes (559 CPM) was used for the alarm setpoint. The following adjustments were then made:

559 x 85% = 475 CPM (85% calibration accuracy between EMF detector and readout module)

475 x 95% = 451 CPM (95% calibration accuracy between EMF readout module and OAC)

The high alarm on point P0592 was therefore conservatively set at 440 CPM. Thus an increase of 440 CPM in one hour on this point will alarm to indicate the possibility of a 1 gpm increase in NC leakage.

This OAC point was tested by locking out point A055 and inserting a constant value into the point. Later, this value was changed to another value. The table containing the raw data (A0055), the 15 minute average (P0590), and the "hourly difference" (P0592) was then printed out. Using the constant that the A0055 point had been set to, the 15 minute average and hourly difference were verified using a hand calculator.

Next, point A0055 was increased again, this time to a value that quickly caused the "hourly difference" to increase beyond the alarm setpoint. The alarm annunciated in the control room on both units as required. Point A0055 was then released to continue logging values fed from the readout module.

2. Updates to reflect capabilities for leakage detection for EMF38(L) and EMF39(L) will be incorporated in FSAR section 5.2.

3. The EMF design basis document (MCS-346.05-EMF-0001) will be updated to reflect the leakage detection requirements for EMF38(L) and EMF39(L).

4. An evaluation for moving the EMF38/39/40 skid closer to containment to eliminate some horizontal tubing runs and thus improve the transport efficiency for particulates has been conducted and has been determined to not be warranted.

5. Two software points were added to the OAC for EMF39. P0869 calculates a running 15 minute average of EMF39(L) (A0067). P0591 compares most recent 15 minute average with the 15 minute average calculated 60 minutes ago. If the average changes by 3200 CPM, the computer alarm is sounded. The high alarm setpoint, 3200, was calculated as follows:

Calculation MCC-1223.03-00-0038 showed that the expected count rate for a 0.1% failed fuel, 1 gpm leak from the NC system would produce a

count rate change of 4709 CPM after one hour. For conservatism, the value after 58 minutes was used in the calculations. For the reading taken from the EMF readout module, there is an 85% calibration accuracy between the EMF detector and the module. Therefore, the corrected value is 4553 x 85% = 3870 CPM. This value was provided to Operations for inclusion into their loss of OAC procedures.

The 15 minute average data (P0591) at 58 minutes (4006 CPM) was then evaluated for the OAC alarm setpoint.

The following corrections were made:

4006 x 85% = 3405 CPM (85% calibration between detector and readout module)

3405 x 95% = 3235 CPM (95% calibration accuracy between readout module and OAC).

The high alarm was set to 3200 CPM on P0591.

This software was functionally checked by locking out the EMF39 input point (A0067) to a specific value. A few minutes later, this value was changed. A tabular printout was then obtained. Values for the 15 minute average were verified by hand. Also, the "hourly difference" calculation was verified by hand.

Next, the input value (A0067) was set to a higher constant which caused the hourly difference to quickly approach the setpoint. The alarm was verified to properly annunciate when the "hourly difference" exceeded the high setpoint.

NOTE: initially, the effect of the 15 minute average was taken into account twice. The setpoint was originally set to 2850 CPM.

Since this error was in the conservative direction, it was left like this for a week or so until the EMF38 delta count rate software was installed on the OAC. The value was changed to 3200 CPM, as required, on 5/3/94.

6. Minor Mods 5483 (U1) & 5484 (U2) were approved by station on 4/26/94. These mods added analog computer points for CF&E Sump A level and CF&E Sump B level. Calculated points for flow rate for each sump and the total flow rate (Sump A + Sump B) were added to the software of the OAC. These points will be used to detect a 1 gpm or greater increase of NC leakage into the sumps within an hour, as outlined in RG 1.45.

Installation of MM 5483 was completed on 5/26/94 and installation of MM 5484 was completed on 6/16/94. A minor OAC software change was necessary and was performed on both units on 7/14/94.

7. Addition of a rate of change point for VUCDT level to OAC was evaluated.

The flow into the VUCDT has inputs from the Auxiliary Building ventilation systems as well as Containment Building inputs. Therefore, it is not prudent to add a rate of change point to this tank as a method of detecting NC leakage inside containment. An engineering evaluation will be done per Site Plan SP-94-0246 to determine a more appropriate detection method and will address Tech. Spec. 3.4.6.1 (c).

8. The loss of OAC procedures and annunciator/alarm response procedures will be updated as necessary for the changes made to the NC leakage detection systems.

9. A Generic Applicability review was performed. This PIP was initiated as a result of Catawba PIP #'s 0-C94-0352 and 1-C94-0334. PIP # 0-O94-0928 was initiated to investigate and resolve this problem at Oconee.

VII. Description of regulatory documents that provide the design basis; Reg. Guides, SERs

10 CFR 50, Appendix A, General Design Criteria 30 states that means shall be provided for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage.

FSAR Section 5.2.7 and NRC SER Section 5.2.5 discuss the NC System leakage detection systems at McGuire.

Regulatory Guide 1.45 - Reactor Coolant Pressure Boundary Leakage Detection Systems, is the pertinent Regulatory Guide. NRC Generic Letter 84-04 and Information Notice 94-46 also provide information concerning NC System leakage and leakage detection systems.

VIII. Discuss in view the safety significance of issue.

As stated in RG 1.45, the safety significance of leaks from the reactor coolant pressure boundary can vary widely depending on the source of the leak as well as the leakage rate and duration. A limited amount of leakage is expected from the Reactor Coolant Pressure Boundary and from Auxiliary systems within the containment such as from valve stem leakoffs and other equipment that cannot

practically be made 100% leak tight. Differentiating between Identified and Unidentified Leakage is necessary to provide prompt and quantitative information to the operators to permit them to take immediate corrective action should a leak become detrimental to the safety of the facility.

A. NC leakage calculation program:

The non-NC input in Identified Leakage for Unit 1 was approximately .13 gpm and for Unit 2 was approximately .34 gpm. Actual NC Unidentified Leakage would not have been greater than 1.34 gpm without compensatory measures taken and typically measures to reduce leakage are taken prior to Unidentified Leakage reaching the 1 gpm Tech Spec limit. The additional .34 gpm leakage would be insignificant in relation to onsite and offsite dose consequences.

Corrective measures were taken as soon as the calculation errors were detected. NC leakage calculations have been conducted as required by the Tech Spec surveillance requirements and are currently being performed once every 24 hours.

B. NC leakage detection systems:

While the NC System leakage detection systems may have been inoperable from a Reg. Guide 1.45 viewpoint (i.e., unable to alert the operators to a 1 gpm increase in NC leakage within 1 hour), these systems have been maintained operable through compliance with the applicable Tech Spec surveillance requirements. The design basis for these systems has been maintained throughout this time period.

In addition to the NC Leakage detection systems required by the Tech Specs, Volume control tank level and Pressurizer level along with charging pump flow provide the control room operators a continuous indication of total system leakage. These system parameters are continuously monitored and typically provide the operators with the first indication of an increase in NC system leakage. Also, containment sump level is another available measure of leakage inside containment.

With the variety of diverse detection systems, operator monitoring of the volume control tank and Pressurizer levels and the frequency of the performance of the leakage calculation program, it is highly unlikely that significant Unidentified Leakage would have gone undetected beyond the three day leakage calculation surveillance requirement.

IX. Describe current efforts for resolving on-going problem with the leakage detection calculation. Discuss your confidence in the current calculation.

See response to Section VI. for a description of the on-going corrective actions.

Upgrades to NC Leakage Calculation Program:

Prior to December 1993, when the leakage values did not account for the non-NC inputs, McGuire was using a simplified OAC program to calculate NC leakage. A new program was installed in early December. This program provides a sophisticated method that statistically analyzes the leakage values calculated and also calculates upper confidence leakage (UCL) limit values. The upper confidence leakage values provide a 95% confidence level that actual leakage is at or below these UCL's.

NC leakage calculations are currently being performed once every 24 hours. The current unidentified leakage values are reported in the daily status for each unit.

The NC system engineer monitors the leakage values and related system parameters daily to determine current NC leakage status and on-going trends. Weekly trend plots of NC leakage are provided to the Operations Staff Manager for his review. Conclusive step changes in NC leakage are communicated to the appropriate Operations personnel and management by the NC system engineer.

With the current procedural and plant modifications, the NC leakage calculation program is producing conservative values for Unidentified and Total Leakage. Thus we are confident that the NC leakage calculation program is capable of detecting unidentified leakage to assure operability of the NC System.