NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
McGuire Nuclear Station - Unit 2	0 5 0 0 0 3 7 0	1 OF 0 5

TITLE (4): Control Rod Drive Mechanism Fabrication Error

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER(S)
1 2	0 7	8 4	8 4	0 3 2	0 1	0 8	2 6	8 5	Catawba Unit 1	0 5 0 0 0 4 1 3
									Catawba Unit 2	0 5 0 0 0 4 1 4

OPERATING MODE (9): 1

POWER LEVEL (10): 0 5 5

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	X 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)	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)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER AREA CODE	
R. L. Gill, Jr.	7 0 4	3 7 3 - 5 8 2 6

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

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)

On the afternoon of December 5, 1984, Duke Power was notified by Westinghouse of an event at the Korean Unit 5 reactor concerning the Control Rod Drive Mechanism (CRDM) design similar to the one installed at McGuire Unit 2 (the McGuire Unit 1 design is completely different). Based on initial information it was considered by Westinghouse to be an isolated event. On the afternoon of December 6, 1984, Westingouse notified Duke of the results of inspections at several plants and of the impact on the operation of McGuire Unit 2. Duke began a safety assessment of continued operation of McGuire Unit 2, the results of which were provided to NRC personnel on the afternoon of December 7, 1984 by conference telephone call.

The investigation at the Korean Unit 5 reactor had determined that the control rod drive mechanism (CRDM) heavy drive rod assembly guide screw rotated out of position fell from the drive rod and landed on top of the CRDM latch assembie where it became lodged and prevented driveline motion. The guide screw is normally locked into position by a welded-in pin that intersects the mating threads thus preventing the guide screw from rotating out of position. The loose guide screw could cause rod binding.

The safety implications of continued operation of McGuire 2 were evaluated and actions were taken to assure the continued health and safety of the public.

Upon inspection, 5 out of the 53 breech guide screws inspected did not meet the Westinghouse acceptance criteria and were redrilled and repinned or replaced.

8509040019 850826
PDR ADOCK 05000370
S PDR

IE22
1/1

NRC Form 366 (9-83)

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
McGuire Nuclear Station-Unit 2	0 5 0 0 0 3 7 0	8 4	— 0 3 2	— 0 1	0 2 OF 0 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Introduction

On the afternoon of December 5, 1984, Duke Power was notified by Westinghouse of an event at the Korean Unit 5 reactor concerning the Control Rod Drive Mechanism (CRDM) design similar to the one installed at McGuire Unit 2 (the McGuire Unit 1 design is completely different). Based on initial information it was considered by Westinghouse to be an isolated event. On the afternoon of December 6, 1984, Westinghouse notified Duke of the results of inspections at several plants and of the impact on the operation of McGuire Unit 2. Duke began a safety assessment of continued operation of McGuire Unit 2, the results of which were provided to NRC personnel on the afternoon of December 7, 1984 by conference telephone call. The following discussions document the statements made by Duke during the call.

Background and Description

On November 19, 1984, the Korean Unit 5 site reported a CRDM stuck drive rod. The rod became stuck during downward stepping while performing hot rod drops as part of pre-operational testing. The plant had not achieved initial criticality. The unit was subsequently cooled down. Westinghouse engineers were dispatched to the site on November 22, 1984 to assist in the evaluation and determine corrective action.

On November 29, 1984, the on-site investigation had determined that the control rod drive mechanism (CRDM) heavy drive rod assembly guide screw rotated out of position, fell from the drive rod and landed on top of the CRDM latch assembly where it became lodged and prevented driveline motion. The guide screw is normally locked into position by a welded-in pin that intersects the mating threads thus preventing the guide screw from rotating out of position. (See enclosures)

On December 1, 1984, a reverse torque test was performed at the Korean Unit 5 site on the remaining 51 guide screws. This test was done by applying twice the torque used to install the screws, but in the opposite direction. Three additional guide screws were removed in this test.

The function of the breech guide screw in the heavy drive rod assembly is to provide alignment and guidance during coupling and uncoupling the drive rod from the rod cluster control assembly during refueling.

The guide screw is .52 inches in length and .433 inches in diameter. If the guide screw rotates out of the drive rod assembly, then it will fall down the annulus between the external breech and the rod travel housing. (This annulus is nominally 3/8 inch wide but is flexible enough to allow the guide screw to be able to travel down.) The guide screw would land on top of the latch assembly guidetube and could not pass this point because the clearance between the guide tube and the drive rod assembly is only .055 inches.

The guide screw can cause binding and misstepping of the rod if it becomes wedged in this annulus. If the rod is fully withdrawn, the loose screw could also bind between the drive rod steps and the guide tube. The effect is to possibly prevent rod from tripping.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
McGuire Nuclear Station - Unit 2	0 5 0 0 0 3 7 0	8 4	— 0 3 2	— 0 1	0 3 OF 0 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Bases for Continued Operation

The continued operation of McGuire Unit 2 was based upon an engineering assessment of the low likelihood of multiple failures, the McGuire rod movement test history, the impact of stuck rods on shutdown margin, the accident analysis impact, the limited exposure in the remaining cycle length, and the commitment to perform rod movement checks at an increased frequency.

1. Low Likelihood of Multiple Failures - The inspection results from many plants showed that most guide screws are properly secured. In addition, these results have shown that only one of the four guide screws at Korea 5 which failed the reverse torque test backed out of position. Experience indicated that it was highly unlikely that multiple potentially loose guide screws would become actual loose parts at the same time. Because of the variable resistance to removal of the guide screws during inspections, it is most likely that the times for any potentially loose guide screw to actually back out of position would be highly variable.

2. McGuire Rod Movement Test History - Substantial rod movement testing has been conducted during lifetime of McGuire with no rod stepping anomolies observed attributable to mechanical binding. During Pre-Fuel Load, Initial Startup, Zero Power, and Power Escalation Testing, many rod movement tests were performed. The testing is discussed in FSAR Chapter 14 and the results were provided in the Startup Report, initially submitted May 8, 1984. Additionally, rod movement periodic surveillance testing has been successfully conducted about 15 times pursuant to Technical Specification 4.1.3.1.1. Finally, there have been more than twenty five reactor trips of McGuire Unit 2 with no anomalous rod behavior observed.

3. Impact of Stuck Rods on Shutdown Margin - McGuire 2 had a planned cycle length of 377 EFPD. The Nuclear Design Report (WCAP-10182) Table 6.3 evaluates the available shutdown margin at EOC (387 EFPD). From this table, the available margin with the highest worth rod assumed stuck out of the core was 2.46% $\Delta\rho$. Additional Duke Power calculations show that the shutdown margin was 1.48% $\Delta\rho$ with the highest worth pair of rods assumed stuck. While this was less than the 1.6% $\Delta\rho$ margin assumed available in the transient analyses for McGuire 2 Cycle 1, it does show that the plant could have been brought subcritical with the worst combination of two rods stuck out of the core. More recent Westinghouse analyses showed acceptable transient results using a shutdown margin of 1.3% $\Delta\rho$. This value would be met even with two rods stuck. Althouth it was not explicitly analyzed, it is evident that there was sufficient negative reactivity inserted to bring the reactor subcritical with most combinations of three rods stuck.

   Based on the above calculations, there existed sufficient shutdown margin at EOC to justify continued operation.

4. Accident Analysis Impact - During a transient or accident which results in a reactor trip, the purpose of the control rods is to provide enough negative reactivity insertion to shut down the reactor. The shutdown margin assumed for the McGuire 2 Cycle 1 accident analyses was 1.6% $\Delta k/k$. McGuire 2 Cycle 2 (and McGuire/Cycle 2) have an assumed margin of 1,3% $\Delta k/k$, which has been shown to be acceptable. Therefore, there was already a conservatism in the accident analysis shutdown margin.

TEXT (If more space is required, use additional NRC Form 366A's) (17)

The actual end-of-cycle shutdown margin was predicted to be 3.59% $\Delta k/k$ with all rods inserted and 2.46% $\Delta k/k$ with the most reactive rod stuck out of the core. Since the transient and accident analyses assumed this rod to be stuck, a further margin of 2.46 - 1.3 = 1.16% $\Delta k/k$ remains to account for an additional stuck rod or rods without violating the 1.3% shutdown margin assumption.

The most limiting accident from a shutdown margin point of view is the double-ended rupture of a main steam line, resulting in (for the analyzed FSAR casw) a loss of shutdown margin due to cooldown induced moderator feedback and a return to some partial power level. As mentioned above, one stuck rod is already assumed in this analysis. The analysis also assumes 1) an initial condition of hot zero power and 2) no decay heat. These assumptions maximize the cooldown, and hence the positive reactivity insertion. For the remainder of Cycle 1 such an event would probably have started from some higher power level and would certainly have substantial decay heat. Therefore, the consequences of a steam line break during the remainder of Cycle 1 would have been less severe than those analyzed in the FSAR.

For accidents in which DNB is the limiting consideration, more than one stuck rod may have some negative impact due to a reduction in the rate of power decrease following the trip. However, this should have been offset by the DNBR margin inherent in the current analyses, For overpressure events substantial margin existed both between the calculated results and the safety limit and in the relief valve capacity available to mitigate a pressure increase. For large break LOCA events, no credit is taken for control rod scram in the analysis. For other accidents, stuck rods are either not important or are compensated for by negative reaction insertion of the borated ECCS injection water.

5. <u>Limited Exposure in the Remaining Cycle Length</u> - The only incident of a stuck rod in the subject plant population occurred during pre-operational tests. No occurrences of multiple stuck rods are evident. McGuire Unit 2 has completed preoperational testing, startup testing and more than one year of power operation with no occurrence of rod drive interference from loose guide pins. The unit had approximately 35 EFPD, or less than 2 months, of power operation left before the end of the cycle when the problem was discovered at the Korean Unit. This represented a short and acceptable exposure window with respect to the probability of a multiple stuck rod situation. Further, with the implementation of the augmented rod movement test the exposure window was reduced to a week since successful rod movement tests confirmed the ability of the rods to scram at the time of the test.

6. <u>Increased Frequency of Rod Movement Checks</u> - It is extremely unlikely that an accident situation, such as a seismic event of 2g's force or less, could cause a loose guide pin to move inasmuch as normal rod stepping motions impart loads in the range of 20-30g. Therefore, any loose guide screw migration would most likely be caused by normal rod stepping and any impedance of rod motion would be identified by stepping tests. Duke performed rod movement checks required by Technical Specification 4.1.3.1.1 nominally on a weekly basis throughout the remainder of the Unit 2 cycle. No mechanical stepping anomalies occurred during these tests.

NRC Form 366A
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
McGuire Nuclear Station - Unit 2	0 5 0 0 0 3 7 0	8 4	0 3 2	0 1	0 5 OF 0 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Actions Taken/Planned

1. As noted above, Duke increased the frequency of control rod stepping tests from monthly to weekly. This increased testing was initiated with the first test successfully completed on December 7, 1984. No mechanical stepping anomalies occured during these tests.

2. If rod stepping anomalies of a mechanical nature had occurred during these stepping tests or during any normal rod stepping, Unit 2 would have been shutdown per existing procedures and the rod drive assemblies would be inspected.

3. As part of shift turnover, actions 1 and 2 were reviewed and the potential for this event at McGuire is noted.

4. Since no rod stepping anomalies of a mechanical nature occurred during the remainder of this Unit 2 cycle, the rod drive assemblies were inspected during the refueling outage. The subject inspection was completed on February 23, 1985. The results were:

   Five breech guide screws of the 53 inspected did not meet the Westinghouse acceptance criteria.

   Four of the five drive rods were redrilled and repinned.

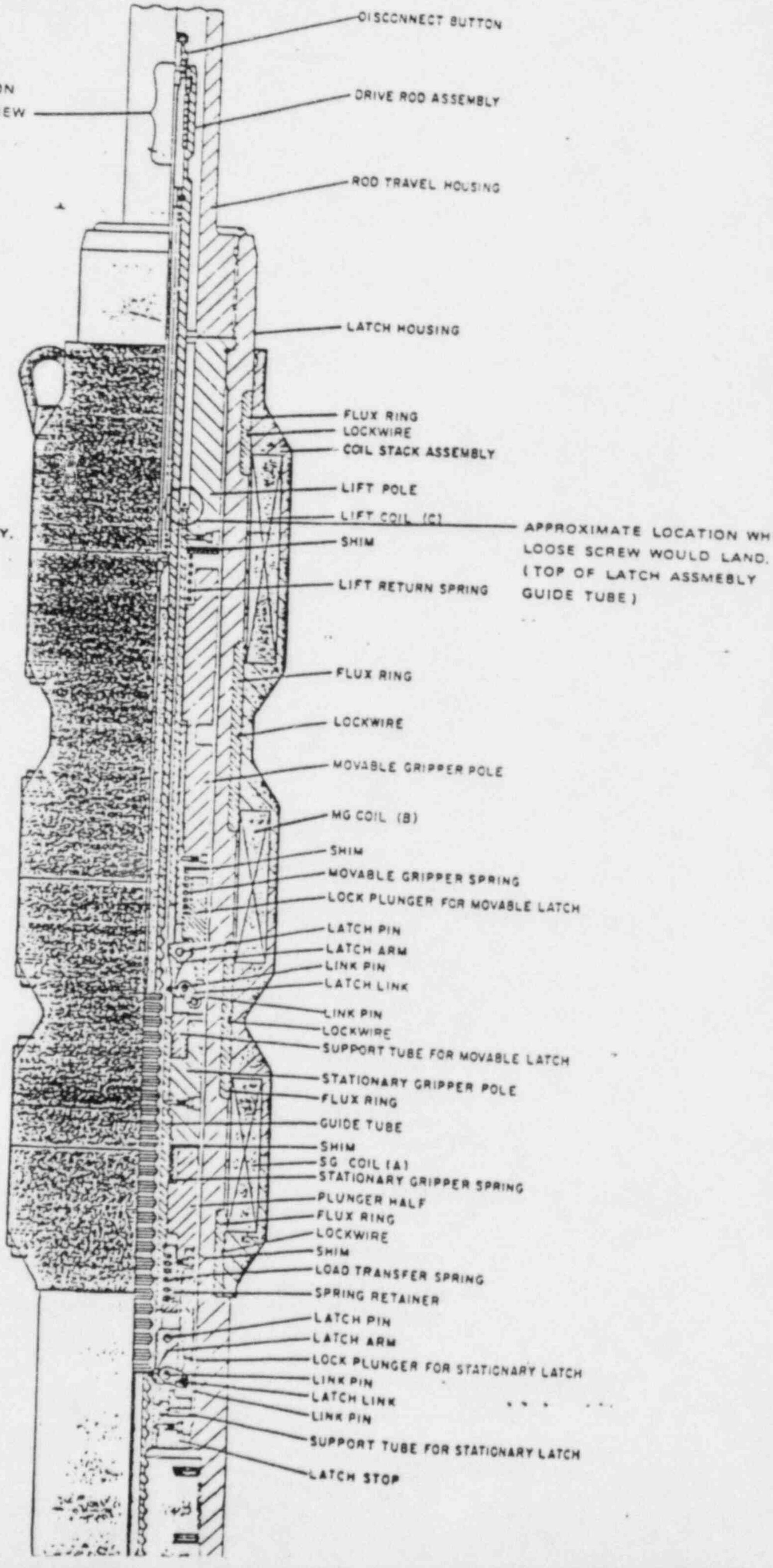
   The fifth drive rod was misdrilled during repair, but was replaced with a spare drive rod from Catawba Nuclear Station.

5. Each operating shift reviewed a description of the Korean reactor event and was advised of the potential for a similar occurrence at McGuire Unit 2.

Conclusion

Duke evaluated the implication of the Korean event on continued operation of McGuire Unit 2 and determined that such operation through the remainder of the fuel cycle did not pose any undue risk to the public. No mechanical stepping anomalies occurred through the remainder of the cycle. The drive mechanisms were inspected and repaired as necessary during the outage.

Enclosure 1.0.

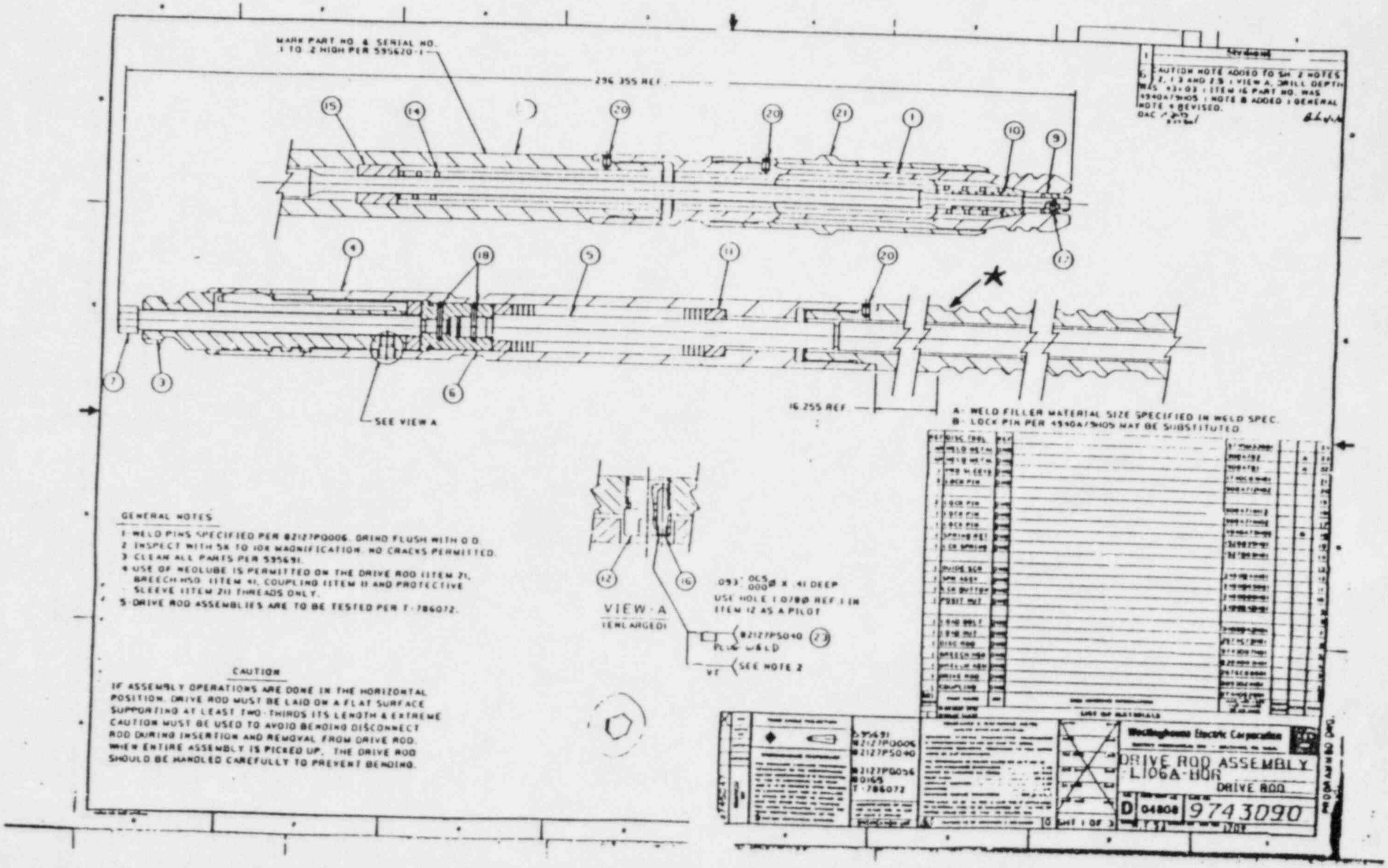


NOTE: THIS DRAWING IS OF THE REGULAR CRDM, NOT THE HEAVY DRIVE ROD ASSEMBLY. IT IS PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

DPC/MNS
IIR No. 2-84-45
LER # 370/84-32

ENCLOSURE 2.0

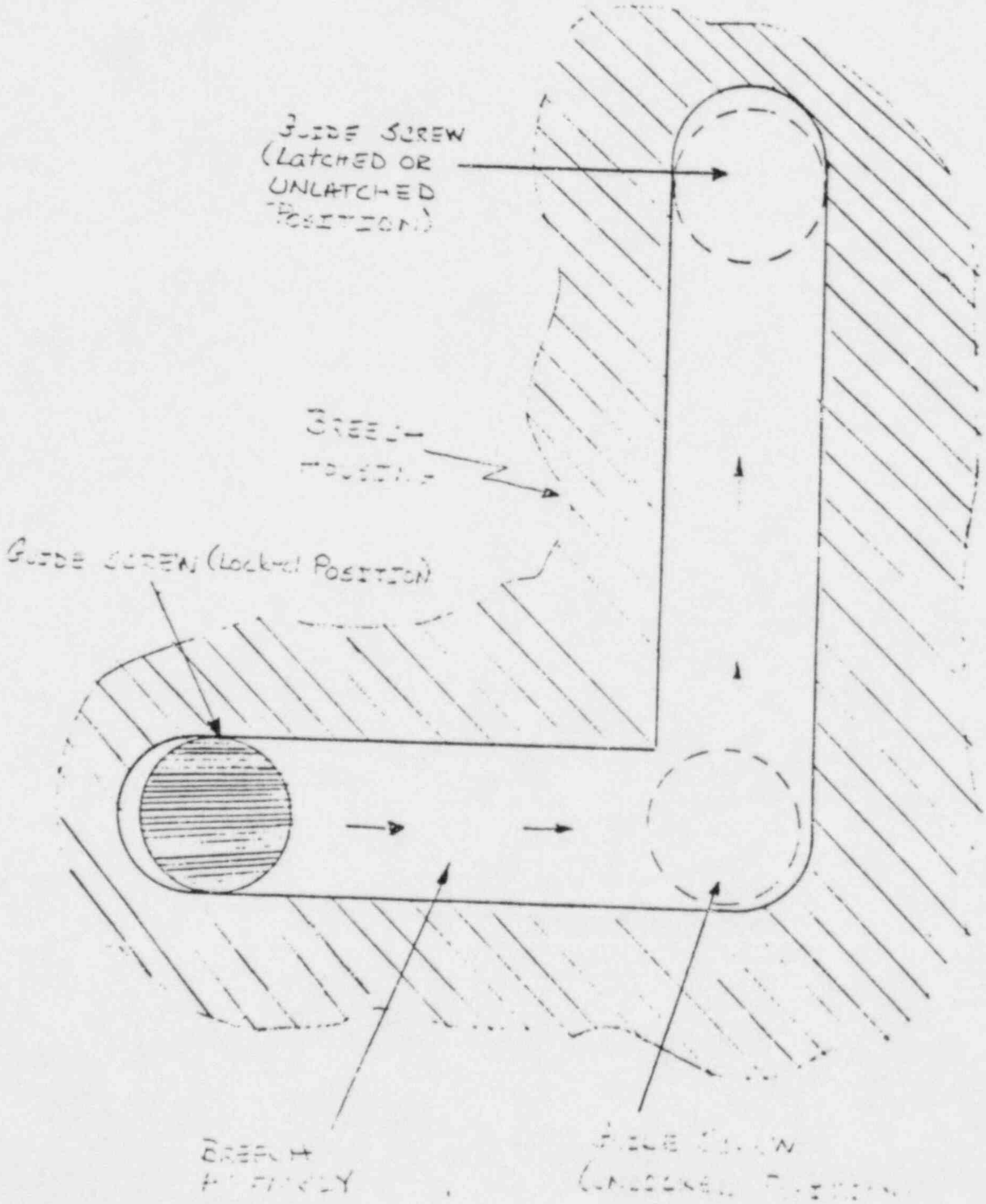
Drive Rod Assembly



DPC/MNS
IIR No. 2-84-45
LER # 370/84-32

ENCLOSURE 3.0

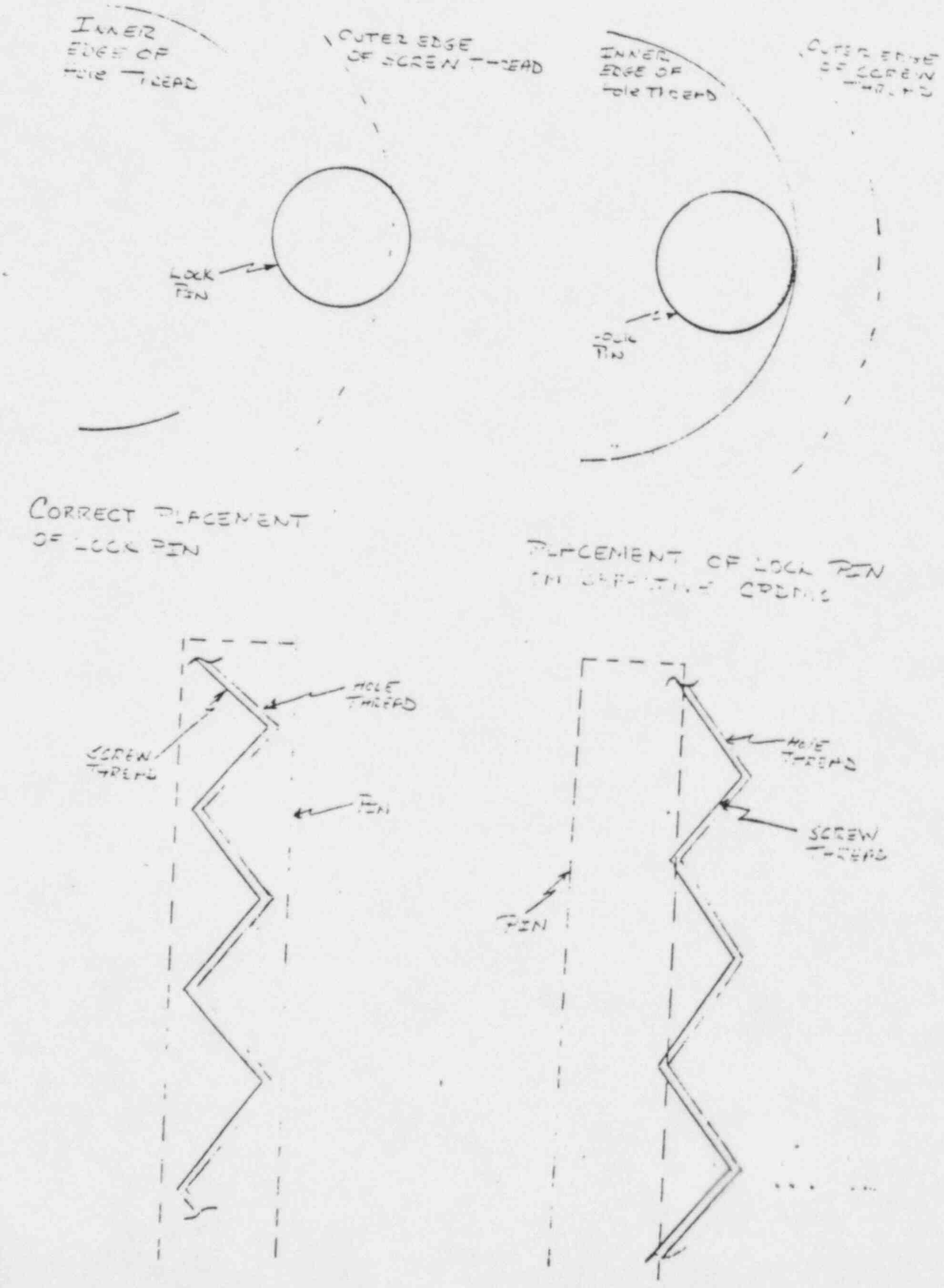
CRDM Slot Position



DPC/MNS
IIR No. 2-84-45
LER # 370/84-32

ENCLOSURE 4.0

Lock Pin Schematic



DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

August 26, 1985

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

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-370
LER 370/84-32-01

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 370/84-32, Revision 1 concerning a control rod drive mechanism (CRDM) fabrication error. This revision provides the results of inspections and corrective actions set forth in the original submittal of January 9, 1985. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

H.B. Tucker /JBD
Hal B. Tucker

JBD/hrp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

INPO Records Center
Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339

American Nuclear Insurers
c/o Dottie Sherman, ANI Library
The Exchange, Suite 245
270 Farmington Avenue
Farmington, CT 06032

M&M Nulcear Consultants
1221 Avenue of the Americas
New York, New York 10020

Mr. W. T. Orders
NRC Resident Inspector
McGuire Nuclear Station

IE22
1/1