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WASHINGTON, D. C. 20555

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50-368

MEMORANDUM FOR: Carlyle Michelson, Director
Office for Analysis and Evaluation
of Operational Data

FROM: Eugene V. Imbro, Lead Reactor Systems Engineer
Reactor Operations Analysis Branch

SUBJECT: REPETITIVE FAILURES OF EMERGENCY FEEDWATER FLOW VALVES AT
ARKANSAS UNIT 2 BECAUSE OF VALVE OPERATOR HYDRAULIC PROBLEMS

On December 12, 1981, during a routine review of Combustion Engineering LERs, it was decided to acquire more information on LER 81-32 of Unit 2 of the Arkansas Nuclear One Power Plant. This LER described two separate failures of redundant Emergency Feedwater (EFW) supply valves, 2CV-1038 and 2CV-1075, associated with the electric motor driven EFW pump. Specifically, on August 15, EFW supply valve 2CV-1038 failed to operate because of a blown power supply fuse and on September 1, valve 2CV-1075 would not operate due to a lack of hydraulic pressure to the valve operator caused by a leaking mechanical seal. Our attention was drawn to this LER by the reference to eight previously reported similar events on the LER form.

When each of the referenced LERs was examined, it was apparent that the fuse failure was an isolated event, and that valve operator hydraulic problems were a repetitive mode of failure in the EFW system. (There are only two hydraulically operated valves in the EFW system, 2CV-1025 and 2CV-1075 - see attached flow diagram.) It was found that some of the referenced LERs were not for problems similar to the original LER; however, the LERs that did pertain to valve operator hydraulic problems referenced some additional LERs that were not referenced in the original LER. This sequence of acquiring LERs on Emergency Feedwater flow control valve failures due to failures of the hydraulic operator was pursued until all relevant LERs were acquired. A draft table of the reported failures and the relevant LERs are attached.

In summary, in the past three years, there have been eight instances of a problem with the hydraulic valve operator system that prevented the closure of one-of-the-two Emergency Feedwater flow valves in the two loop system. In particular, valve 2CV-1025 failed to function on seven occasions as shown in the table below. In each case, the valve failed to close on demand from the control room. Failure-to-close would be the "safe" position for the valve in order to maintain auxiliary feedwater flow to the steam generators but one degree of redundancy would be lost if the valve was required to close on a main steam isolation signal (MSIS).^{1/} In each case, the redundant valve in the same loop and the valves in the alternate flow loop were tested operable.

^{1/} Footnote attached.

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PDR ADDCK 05000368
P PDR

Failure of Valve 2CV-1025 to Actuate

<u>Date</u>	<u>Reason for Failure</u>
10/6/78	Hydraulic pump motor failed making the valve inoperable.
6/9/79	Valve operator required to be filled and vented with oil.
11/22/79	Valve operator hydraulic pressure was low. Hydraulic system vented and pressure returned to normal.
11/24/79	Dirt in the valve operator hydraulic system.
11/25/79	Low valve operator hydraulic fluid - no leaks could be found.
12/1/79	Low fluid level in hydraulic accumulator due to leakage - accumulator replaced.
1/20/80	Lack of hydraulic pressure caused by air in the system.

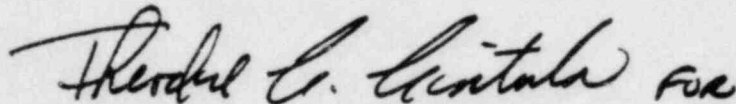
The frequency and repetitive nature of the information in this table would lead to the suspicion that either the maintenance/surveillance has not been optimized or a thorough understanding of the operation of the valve operator's hydraulic system is lacking. This thought is strengthened by the fact that valve 2CV-1025 failed to actuate four times in a 2-week period. While the failure of this valve to operate in the Emergency Feedwater system presents no apparent consequence greater than a loss of redundancy, the root cause of the repetitive failures was unknown.

On February 1, 1982, we telephoned the licensee to discuss our observations on the hydraulic operators in the Emergency Feedwater system at Arkansas-2. The licensee, too, had been familiar with the repetitive nature of the failures and had implemented a corrective program shortly after reporting LER-80-3 in January 1980 (the last reported failure of valve 2CV-1025). The licensee's modifications included replacing the manifold of the Borg-Warner operators with a manifold that had significantly less fittings to reduce total air leakage into the hydraulic system. The check valves were replaced with softer seated valves, an internal filtration system was added, and the individual hydraulic accumulators were modified to retain pressure longer. In addition, a periodic preventive maintenance program was initiated to detect potentially degraded operation appreciably before the event becomes reportable.

Apparently, the licensee has recognized the problem and has provided the proper corrective action. Since initiation of the hydraulic operator modifications and the preventive maintenance program, valve 2CV-1025 has not failed to function; valve 2CV-1075 failed once, but the problem was not directly related to the previous events.

In the last 20 months, 2CV-1075 has required two additions of hydraulic fluid and valve 2CV-1025 has had five additions. Previously, the systems were re-filled at more frequent intervals, i.e., when leakage was detected. This was generally before the valve became inoperable, and hence, before reportable. The EFW control valves are safety grade valves and are readily accessible during all conditions. They can be operated manually, if desired, by pumping the handle of a hand pump located on the side of the valve operator.

Although Arkansas-2 has apparently reduced the number of problems with the hydraulic valve actuation system to a reasonable level and adopted a successful monitoring program, we recommend that hydraulic valve operators be added to the AEOD "watch list." As a "watch list" item, similar problems at other operating plants can be trended and the dissemination of possible fixes, such as those in effect at Arkansas-2, can be transmitted to the licensees.



Eugene V. Imbro, Lead Reactor Systems Engineer
Reactor Operations Analysis Branch

Attachments:
As Stated

cc w/attachments:
E. Brown, AEDD
R. Martin, NRR
W. Johnson, IE

LICENSEE EVENT REPORT

EXHIBIT A

CONTROL BLOCK: (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

LICENSEE CODE: A R A N O 2 0 0 - 0 0 0 0 0 - 0 0 0 4 1 1 1 1

REPORT SOURCE: L 0 5 0 0 0 3 6 8 0 8 1 5 8 1 0 9 1 5 8 1

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES

On 8/15/81, during unit startup, Emergency Feedwater (EFW) flow valve, 2CV-1038, failed rendering one flowpath to "A" Steam Generator inoperable. On 9/1/81, during Mode 1 operation, EFW flow valve, 2CV-1075, would not operate from the Control Room, again rendering one flowpath to "A" Steam Generator inoperable. Alternate flowpath remained operable in both cases. The 8/15/81 occurrence is similar to LER's 50-368/78-026, 79-037. The 9/1/81 occurrence is similar to LER's 79-043, 79-036, 79-037, 79-090, 79-092 and 80-003. Reportable per 1.5.6.9.1.9.b.

System Code: H H H Cause Code: E Component Code: V I A L V I O P Report Type: A Z

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS

Valve 2CV1038 failed due to a power supply fuse blown caused by a relay failure. The relay was replaced and the valve was returned to operable status. Valve 2CV1075 failed due to a lack of hydraulic pressure caused by a low fluid level caused by a leaking mechanical seal. The seal was replaced and the valve was returned to operable status.

Facility Status: E Other Status: NA Method of Discovery: A Operator Observation

Activity Content Released: Z Amount of Activity: NA Location of Release: NA

Personnel Exposures: 0 0 0 Description: NA

Personnel Injuries: 0 0 0 Description: NA

Loss of or Damage to Facility: Z Description: NA

Publicity Issued: N Description: NA

NAME OF PREPARER: Chris N. Shively

PHONE: 501/968-2519

8111020206

LICENSEE EVENT REPORT

EXHIBIT A

CONTROL BLOCK: (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

01 A R A N O 2 0 0 - 0 0 0 0 0 0 - 0 0 4 1 1 1 1 0 0

CONF REPORT SOURCE L 0 5 0 0 0 3 6 8 0 1 2 0 8 0 0 2 1 5 8 0

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES

02 During Mode 3 operation, with the electric driven Emergency Feedwater
03 pump, 2P7B, in service as an auxiliary feedwater pump for normal start-up
04 Steam Generator feed, EFW flow control valve, 2CV-1025-1, failed to close
05 on demand from the Control Room. The valve failed in the EFW, or safe
06 position. The block valve was used to control level and all redundant
07 EFW valves were proven operable. Similar to LER 50-368/79-092, 79-090,
08 79-089, 79-088, and 79-043 Reportable per T S 6 9 1 9 b

09 SYSTEM CODE W B 11 CAUSE CODE E 12 CAUSE SUBCODE B 13 COMPONENT CODE V I A I V I 0 P 14 COMP SUBCODE A 15 VALVE SUBCODE Z 16
17 LER-IPD REPORT NUMBER 18 10 EVENT YEAR 19 27 SEQUENTIAL REPORT NO 20 0 1 0 3 21 OCCURRENCE CODE 22 0 1 3 23 REPORT TYPE 24 25 REVISION NO 26 10
ACTION TAKEN 27 FUTURE ACTION 28 EFFECT ON PLANT 29 SHUTDOWN METHOD 30 HOURS 31 ATTACHMENT SUBMITTED 32 N 23 NPD-4 FORM 33 PRIME COMP SUPPLIER 34 N 25 COMPONENT MANUFACTURER 35 W I I 2 7 26

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS

10 Investigation revealed that the valve failed to operate due to the lack
11 of hydraulic pressure caused by air in the system. The accumulator did
12 did not indicate low oil. The hydraulic system was vented & filled with
13 oil. The requirements of Action Statement T.S.3.7.1.2 were met. One
14 valve operator was returned to vendor for analysis.

15 FACILITY STATUS B 28 % POWER 10 11 12 13 OTHER STATUS NA 30 METHOD OF DISCOVERY A 31 DISCOVERY DESCRIPTION NA 32

16 RELEASED OF RELEASE Z 33 AMOUNT OF ACTIVITY NA 35 LOCATION OF RELEASE NA 36

17 PERSONNEL EXPOSURES 0 0 0 0 37 Z 38 NA 39

18 PERSONNEL INJURIES 0 0 0 0 40 NA 41

19 LOSS OF OR DAMAGE TO FACILITY Z 42 NA 43

20 PUBLICITY ISSUED N 44 NA 45

NAME OF PREPARER Chris N. Shively PHONE: 501/968-2519

8002200 446

LICENSEE EVENT REPORT

EXHIBIT A

CONTROL BLOCK: _____ (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

01 | A | R | A | N | C | 2 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 4 | 5
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
LICENSEE CODE LICENSE NUMBER LICENSE TYPE JO 57 CAT 58

CON'T
01 | L | 6 | 0 | 5 | 0 | 0 | 0 | 3 | 6 | 8 | 7 | 1 | 0 | 0 | 6 | 7 | 8 | 8 | 1 | 1 | 1 | 0 | 3 | 7 | 8 | 9
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
REPORT SOURCE DOCKET NUMBER EVENT DATE REPORT DATE

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

02 | During Post-Core Hot Functional Testing, prior to initial criticality,
03 | Mode 3 operation, Emergency Feedwater valve ZCV-1025-1
04 | hydraulic pump motor failed making the valve inoperable.
05 | Operability is required for associated flowpath per T.S.3.7.1.2.
06 | LER 50-368/78-2 also involved the Emergency Feedwater
07 | System, but was not similar in nature.
08 | _____
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

09 | W | B | 11 | E | 12 | B | 13 | V | I | A | L | V | I | O | P | 14 | C | 15 | G | 16 | 17
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SYSTEM CODE CAUSE CODE CAUSE SUBCODE COMPONENT CODE COMP SUBCODE VALVE SUBCODE
17 | LER/RO REPORT NUMBER | 7 | 8 | 9 | SEQUENTIAL REPORT NO. | 0 | 0 | 9 | OCCURRENCE CODE | 0 | 3 | REPORT TYPE | L | REVISION NO. | 0 |
ACTION TAKEN | A | 18 | FUTURE ACTION | Z | 19 | EFFECT ON PLANT | Z | 20 | SHUTDOWN METHOD | Z | 21 | HOURS | 0 | 0 | 0 | 22 | ATTACHMENT SUBMITTED | N | 23 | NRC-4 FORM SUB. | Y | 24 | PRIME COMP SUPPLIER | N | 25 | COMPONENT MANUFACTURER | B | 3 | 5 | 0 | 26 |
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

10 | The hydraulic pump motor for valve ZCV-1025-1 was
11 | replaced and successfully tested. The emergency
12 | feedwater flowpath was re-established within 27 hours
13 | meeting requirement of Action Statement T.S. 3.7.1.2.
14 | _____
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

15 | B | 28 | 0 | 0 | 0 | 29 | Post-Core HFT | A | 31 | NA | 32
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
FACILITY STATUS % POWER OTHER STATUS (30) METHOD OF DISCOVERY DISCOVERY DESCRIPTION (32)

16 | Z | 33 | Z | 34 | NA | 35 | NA | 36
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
ACTIVITY CONTENT RELEASED OF RELEASE AMOUNT OF ACTIVITY (35) LOCATION OF RELEASE (36)

17 | 0 | 0 | 0 | 37 | Z | 38 | NA | 39
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
PERSONNEL EXPOSURES NUMBER TYPE DESCRIPTION (39)

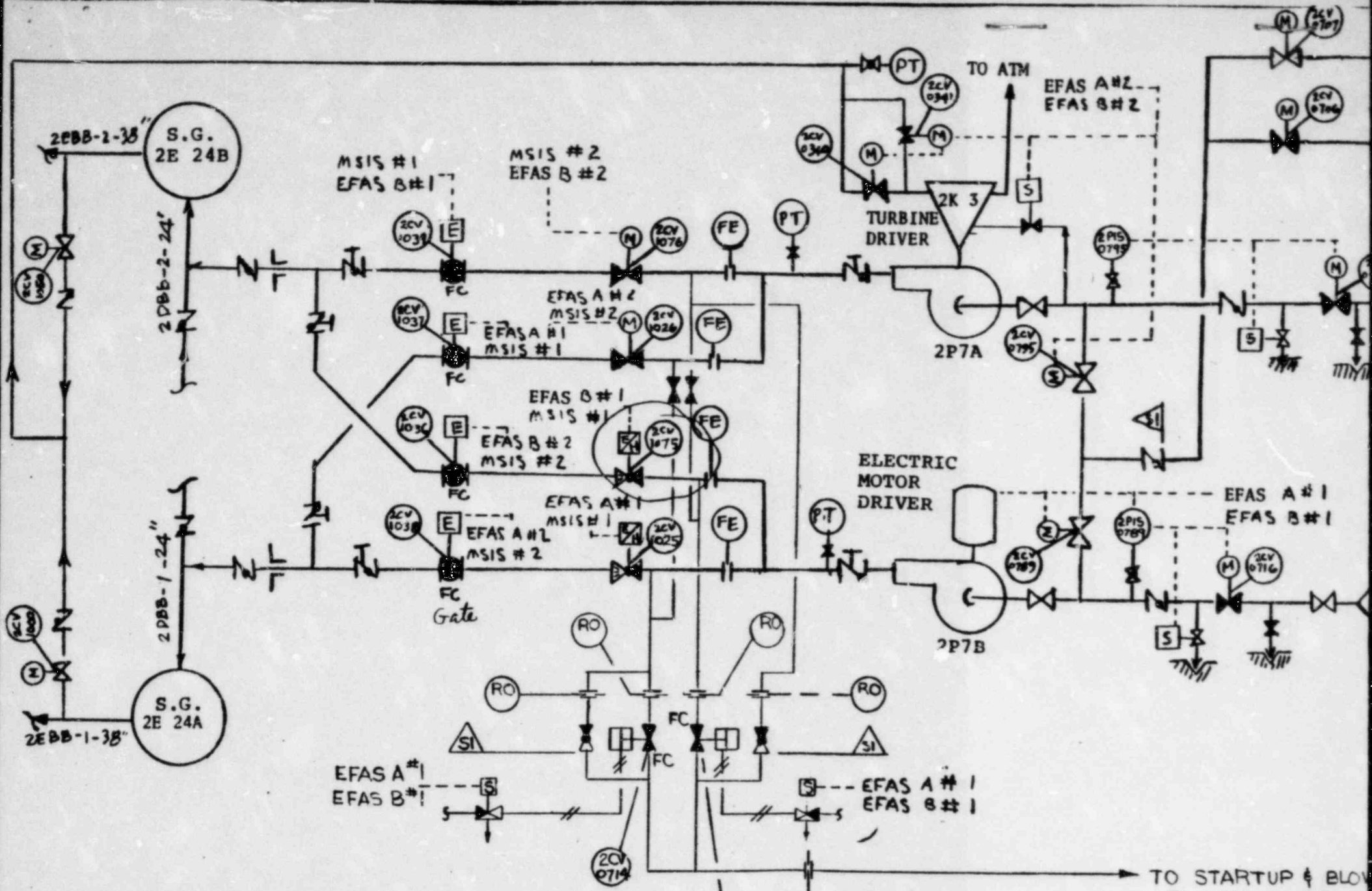
18 | 0 | 0 | 0 | 40 | NA | 41
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
PERSONNEL INJURIES NUMBER DESCRIPTION (41)




19 | Z | 47 | NA | 42
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
LOSS OF OR DAMAGE TO FACILITY TYPE DESCRIPTION (42)

20 | H | 44 | NA | 45
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
PUBLICITY ISSUED DESCRIPTION (45)

NAME OF PREPARER Chris N. Shively PHONE 501/968-2519

~~7811200191~~



- SYMBOLS:** EFAS - EMERGENCY FEED ACTUATION SYSTEM
 FC - FAIL CLOSED
 LO - LOCKED OPEN
 - ELECTRO-HYDRAULIC OPERATOR
 - SEISMIC I BOUNDARY
 - ELECTRIC-SPRING OPERATOR

FROM CONDENSATE
STORAGE TANK

FROM CONDENSER
HOTWELL

CV
711
SWS #2

SWS #1

DOWN

DIAGRAM
EMERGENCY FEEDWATER

AMENDMENT NO. 29

FIGURE NO