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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 persued until all relevant LERs were acquired. A draft table of the reported frailures 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). In each case, the redundant valve in the same loop and the valves in the alternate flow loop were tested operable.

Failure of Valve 2CV-1025 to Actuate

Date	Reason for Failure
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 fiuid 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 refilled 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.

Therdal C. Centala For

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

CONTROL BLOCK:
A R A N 0 2 0 0 - 0 0 0 0 - 0 0 0 0
SOURCE TO ST DOCKET NUMBER OF EVENT DATE 14 TO HEPORT DATE SO
012 On 8/15/81, during unit startup, Emergency Feedwater (EFW) flow valve,
[0]3 L 2CV-1038, failed rendering one flowpath to "A" Steam Generator inoperable,
On 9/1/81, during Mode 1 operation, EFW flow falve, 2CV-1075, would not
os operate from the Control Room, again rendering one flowpath to "A" Steam
Generator inoperable. Alternate flowpath remained operable in both cases,
OT7 L 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. COMPONENT CODE CODE CODE CODE SUBCODE COMPONENT CODE SUBCODE SUBCODE
HIH 11 E 12 B 13 VIAIL IV 10 P 10 A 13 Z 16
TO REPORT 18 1 1 10 1312 1 10 13 1 1 10 10 10 10 10 10 10 10 10 10 10 10
ACTION PUTURE EFFECT SHUTDOWN HOURS (27) ATTACHMENT NPRD-4 PRIME COMP COMPONENT METHOD HOURS (27) SUBMITTED FORM SUR SUPPLIER MANUFACTURER
B 18 Z 19 Z 20 Z 20 1 0 0 0 0 0 N 20 Y 20 A 2 A 3 S CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)
[10] Valve 2CV1038 failed due to a power supply fise 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.
STATUS OPERATOR OF DISCOVERY DESCRIPTION 32
ACTIVITY CONTENT RELEASED OF RELEASE NA LOCATION OF RELEASE 36
PERSONNEL EXPOSURES PAUMBER TYPE DESCRIPTION 39 NA 11 12 13
PERSONNEL INJURIES NUMBER DESCRIPTION 41 1 NA DESCRIPTION 12
LOSS OF OR DAMAGE TO FACILITY 43
PUBLICITY ISSUED DESCRIPTION 45 NAC USE ONLY
Chris N Shively 501/068 2510
PHONE:
8111020206

CUNTROL BLOCK: THE ALL REQUIRED INFORMATION
A R A N 0 2 0 0 0 0 0 0 0 0
During Mode 3 operation, with the electric driven Emergency Feedwater
[0] Lpump, 2P7B, in service as an auxiliary feedwater pump for normal start-up.
Steam Generator feed, EFW flow control valve, 2CV-1025-1, failed to close
ols on demand from the Control Room. The valve failed in the EFW, or safe
old (position. The block valve was used to control level and all redundant
[6]7 [EFW valves were proven operable. Similar to LER 50-368/79-092, 79-090,
[0]8 179-089, 79-088, and 79-043. Reportable per T S 5 9 1 9 h
IN IN IE O IE O IN IN IN IN IT OF IT
TAKEN ACTION ON PLANT METMOD HOLAS (2) ATTACHMENT PRODUCT ON SUPPLIER WANUFACTURER B 13 22 22 24 26 27 28 20 20 20 20 20 20 20 20 20 20 20 20 20
ITO Unvestigation revealed that the valve failed to operate due to the lack
of hydraulic pressure caused by air in the system. The accumulator did
[1] Idid not indicate low oil. The hydraulic system was vented & filled with
[1] [oi]. The requirements of Action Statement T.S.3.7.1.2 were met. One
[1] Lyalve operator was returned to vendor for analysis.
STATIS OTHER STATUS 30 METHOD OF DISCOVERY DESCRIPTION 32
ACTIVITY CONTENT ACCIVITY CONTENT ACCIVITY (35) 1. 6 Z (32) 17 34 NA NA NA LOCATION OF HELEASE (36)
TYPE DESCRIPTION 39 1 0 0 0 0 0 0 NA NA
TENSONNEC INJUNIES NUMBER DESCRIPTION (41) NA
LOSS OF OR DAWAGE TO FACILITY (43) TYPE DESCRIPTION 1 2 47 NA
PUBLICITY ISSUED DESCRIPTION (5) NAC USE ONLY
NAME OF PREPARES Chris N. Shively 501/968-2519

	CONTROL BLOCK: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
01	AIR A N 0 2 3 0 0 - 0 0 0 0 - 0 0
OIT	SOURCE SO ST DOCKET NUMBER SO EVENT DATE 14 75 HEPORT DATE SO EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)
0 2	During Mode 2 operation, with the electric driven Emergency Feedwater
013	pump, 2P7B, in service as an auxiliary feedwater pump for normal startup
014	Steam Generator feed. EFW flow control valve. 2CY-1025-1, failed to closel
015	on demand from the Control Room. The valve failed in the EFW, or safe.
06	redundant EFW valves were successfully stroked from the
07	Control This occurrence is similar to LER 50-368/79-090, 79-089.
(ole)	79,088 and 79-043. Other LER's involving valve 2CV-1025-1 are 50-368/ 79-068, 79-054, 79-051, 79-035, 78-028 and 73-009. Reportable per T.S.6.9.91.9
0 9	MINO ED BO LAININION POR PORTO
	CAUSE DESCRIPTION AND CORRECTIVE ACTIONS 27
10	Investigation revealed that the valve failed to operate due to the lack of
<u>u</u>	I hydraulic pressure caused by a low fluid level in the hydraulic accumula-
117	tor because of leakage. The accumulator was replaced and the system was
13	filled and vented. The valve was declared operable within 19 hours,
7 .	I meeting the requirements of Action Statement T.S. 3.7.1.2.
15	STATUS SONTENT 12 13 OTHER STATUS 30 METHOD OF DISCOVERY DESCRIPTION 32 AS 45 45 45
	ELEASED OF RELEASE AMOUNT OF ACTIVITY (13) PERSONNEL EXPOSURES AND NA LOCATION OF RELEASE (16) AND AND PERSONNEL EXPOSURES
17	O O O O O O O O O O O O O O O O O O O
	O O O O O NA.
1 2	Z O NA
20	*SSUED DESCRIPTION 45 NAC USE ONLY TO THE PROPERTY OF THE PR
	NAME OF PREPARER Chris N. Shively CHE 501/968-2519
	7912310409

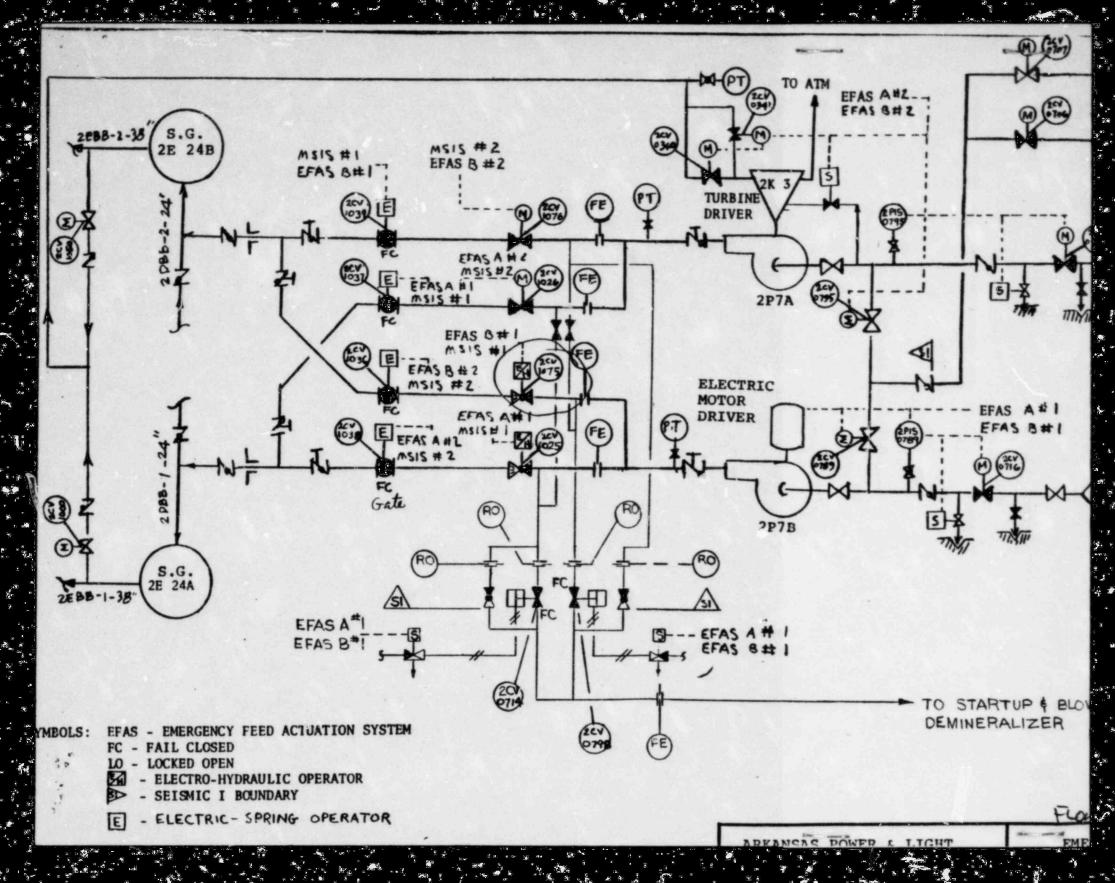
	CONTROL BLOCK: THE ALL REQUIRED INFORMATIONS
1	AIR A N 0 2 3 0 0 - 0 0 0 - 0 0 3 4 1 1 1 1 1 1 1 1 1
	1 10 15 0 10 16 13 1 6 18 1 1 1 1 2 15 1 7 10 10 11 12 1 2 1 1 7 1 9 0
<u>o</u> n	During Mode 3 operation, with the Electric driven Emergency Feedwater
(i)II	pump, 2P7B, in service as an auxiliary feedwater pump for normal startup;
010	LSteam Generator feed, EFW flow control valve, 2CV-1025-1, failed to closel
0 3	on demand from the Control Room. The valve failed in the EFW, or safe,
0 6	Lossition. All redundant FFW valves were successfully stroked from the
07	[Control Room. This occurrence is similar to LER 50-368/79-089, 79-088,
210	79-043. Other occurrences involving 2CV-1025-1 are 50-368/79-068, 79-054, 79-051, 79-035, 78-028 and 78-009. Reportable per J.S. 6.9.1.9.b.
09	WIB O LEIO BO VIALLINOIP A DIZIO
	TAKEN AUTUME OF ACTION AND CORRECTIVE ACTIONS (27)
10	Linvestigation revealed that the valve operator's hydraulic system was low!
111	Lof fluid. No leaks could be found. The system was filled and the valve
1 2	I was declared operable within four (4) hours, meeting the requirements of
1)	L Action Statement T.S. 3.7.1.2.
N.	
15	STATUS OTHER STATUS & SECURENY DESCRIPTION (3)
	CETIVITY CONTENT CLEASED OF RELEASE AMOUNT OF ACTIVITY (35) NA OCATION OF RELEASE (36) PERSONNEL EXPOSURES
117	10 1 01 01 01 01 01 01 01 01 01 01 01 01
	0 0 0 0 NA
1 2	Type Description (3)
•	PUBLICITY STUDE OF SECURITION (S)
210	NI® NA
	WAME OF PREPARES Chris N. Shively 501/968-2519

	CONTROL BLOCK: THE ALL REQUIRED INFORMATIONS
01	AIR A N 0 2 3 0 0 - 0 0 0 0 - 0 0
OT1	SOURCE SO ST DOCKET NUMBER SS EVENT DATE 14 7 19 8 11 12 12 11 71 9 9 10 PROPERTORE SO EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)
0 2	During Mode 3 operation, with the electric driven Emergency Feedwater
0]3	pump, 2P7B, in service as an auxiliary feedwater pump for normal startup
014	Steam Generator feed, EFW flow control valve, 2CV-1025-1, failed to closel
015	on demand from the Control Room. The valve failed in the EFW. or safe.
016	position. All redundant EFW valves were successfully stroked from the
07	Control Room. This occurrence is similar to LER 50-368/79-088 and 79-043L
016	Other occurrences involving 2CV-1025-1 are 50-368/79-068, 79-054, 79-051 J 79-035, 78-028 and 78-009. Reportable per T.S. 6.9-1.9.b DALVE SUBCODE
09	MINO ED BO NIVITATORIO PO TO
	SEQUENTIAL DOCUMENTIAL REPORT TO THE EVENT YEAR PEPORT TO THE STORY OF THE COTE TO THE STORY OF THE COTE TO THE STORY OF THE STORY OF THE COTE TO THE STORY OF THE COMPONENT METHOD HOURS (27) ATTACHMENT WARDA PRIME COMPONENT WANDFACTURER OF THE CO
110	Linvestigation revealed trash in the valve operator's hydraulic system and
11	the hydraulic snubber out of adjustment, restricting oil flow in one
112	direction. The hydraulic system was cleaned, the hydraulic snubber was
113	ladjusted, the valve stroked satisfactorily and declared operable within
CIO.	13 hours, meeting the recuirements of Action Statement T.S. 3.7.1.2.
115	STATUS OTHER STATUS (30) DISCOVERY DESCRIPTION (32)
	ELEASED OF RELEASE AMOUNT OF ACTIVITY (35) NA LOCATION OF HELEASE (36) NA LOCATION OF HELEASE (36)
17	O O O O O O O O O O O O O O O O O O O
1 ×	NUMBER DESCRIPTION (41) NA NA
1 2	TYPE DESCRIPTION I NA
210	SSUED DESCRIPTION (S) NAC USE ONLY NAC USE ONLY OF 65
	NAME OF PREPARED Chris N. Shively 501/968-2519

	CONTROL BLOCK:
01	AIR A N 0 2 3 0 0 - 0 0 0 0 - 0 0
CONT.	HEPORT LL (6)0 5 0 0 0 3 6 8 0 1 1 2 2 7 9 (8) 1 2 2 1 7 9 (9) 1 2 2 1 7 9 (9) 1 2 2 1 7 9 (9) 1 2 2 1 7 9 (9) 1 2 2 1 7 9 (9) 1 2 2 1 7 9 (9) 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 3 1 3 3 3 3 3 3
0 2	During Mode 3 operation, with the electric driven Emergency Feedwater
0]3	pump, 2P7B, in service as an auxiliary feedwater pump for normal startup
014	Steam Generator feed, EFW flow control valve, 2CV-1025-1, failed to close!
0 5	Lon demand from the Control Room. The valve failed in the EFW. or safe.
0 6	Lossition. All redundant FFW valves were successfully stroked from the
0 7	[Control Room. This occurrence is similar to LER 50-368/79-043. Other
, .	Cocurrences involving valve 2CV-1025-1 are 50-368/79-068, 79-054, 79-051, 79-035, 78-028 and 78-009 Reportable per T.S. 6.9-1,9.6 VALVE COOK SUBCODE SUBCODE COMPONENT COURS
0 9	MINO LETO BIO LAINTINOIDO LATO
	17 AFFORT STORY FLANT SHUTDOWN METHOD MOUNS (27) ATTACHMENT SUBMITTED FORM SUIP SUPPLIER VANUE ACTURER SUPPLIER VANUE ACTURER SUBMITTED FORM SUPPLIER VANUE ACTURER VANUE
110	Linvestigation revealed that the valve operator's hydraulic pressure was
111	llow. The hydraulic system was vented, the reservoir was returned to
112	normal level, and the hydraulic pressure was adjusted. The valve was
13	successfully stroke tested and declared operable within 29 hours, meeting
	the requirement of Action Statement T.S. 3.7.1.2.
, 115 ·	STATUS OTHER STATUS (3) METHOD OF DISCOVERY DESCRIPTION (32)
	TLEASED OF RELEASE AMOUNT OF ACTIVITY (25) NA LOCATION OF RELEASE (36) PERCONNEL EXPOSURES
1 7	O O O O O O O O O O O O O O O O O O O
1 ×	O O O O NA
10	Type DESCRIPTION TO NA
210	SSUED DESCRIPTION (S) NAC USE DIVLY NAC USE DIVLY
	NAME OF PREPARER Chris N. Shively

	CONTROL BLOCK IFLEASE PRINT OR TYPE ALL REQUIRED INFORMATION
(III)	AIR A N O 2 O O O O O O O O
(ONT	SOUTH LE CO 15 0 10 10 13 16 18 (10 16 10 19 17 19 10 16 12 17 17 19 19 10 16 12 17 17 19 19
0 2	During Mode 3 operation, Emergency Feedwater flow control valves
0 2	[from the electric driven EFW pump, 2P7A, to the "A" Steam
014	[Generator, 2CV-1025-1 and 2CV-1038-1, failed to close from a
0 5	control room demand signal. The open position is required for EFAS; therefore,
0 6	the EFW flowpath would be uneffected in an emergency situation. The remainder
07	of the EFW valves were successfully tested from the control room. Occurrence
08	similar to 50-368/79-035, 78-028, & 78-009. Reportable per T.S.6.1.9.1(b)
09	W B 10 E 17 B 19 V ALL V 10 P 14 A 10 Z 16
	12 LEBYRO E ENT YEAR SEQUENTIAL REPORT NO. 13 PHACHT TO THE STREET SHUTDOWN METHOD HOURS 27 ATTACHMENT SUBMITTED FORM SUR SUPPLIER COMPONENT MANUS ACTION ACTION ON PLANT METHOD HOURS 27 ATTACHMENT SUBMITTED FORM SUR SUPPLIER MANUS ACTURER E 2 9 9 36 CAUSE DESCR. TION AND CORRECTIVE ACTIONS 20 41 41 41 41
110	Investigation revealed that 2CV-1038-1 would not operate due to
111	a loose wire on the handswitch. Valve 2CV-1025-1 required to be
112	[filled and vented with oil. The valves were operable within
113	the -2 hours as required by Action Statement T.S.3.7.1.2.
ļ.	
115	TATLE TOWER OTHER STATUS 30 WE THOU OF SISCOVERY DESCRIPTION 32
	Z 3
ıı, i	O I O I O I O I I I I I I I I I I I I I
ı,	0 1 0 1 0 1 0 1 NA
أنت	COLUMN ON DAMAGE TO FACILITY (3)
210 j	NHC USE (X4L Y
	NAME OF PROCEEDING Chris N. Shively 501/968-2519

CONTROL BLOCK:
SOUNCE SOUNCE SO 61 DOCKET HUMBER SS 59 EVENT DATE 74 75 REPORT DATE 50
During Post-core Hot Functional Testing, prior to initial criticality
1013 Made 3 operation, Emergency Feedwater valve 201-1025-1
1 hydisulic pump motor failed making the valve inoperable.
1 Operability is required for associated flowpath per T.S.3.7.1.2.
DIE ILER 50-368/78-2 also involved the Emergency Feedwater
1) System, but was not similar in nature.
7 60
SYSTEM CAUSE CODE SUBCODE SUBC
TEQUENTIAL OCCURRENCE REPORT REVISION NO.
NUMBER 21 22 23 24 26 27 28 29 30 31 32 ACTION PUTURE EFFECT SHUTDOWN ATTACHMENT NPRO4 PRIME COMPONENT
TAKEN ACTION ON PLANT METHOD HOURS (22) SUBMITTED FORM SUB SUPPLIER MANUFACTURER (23) 12 (20)
CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (2)
The hydrantic pump motor for velvezcy-1025-1 was
replaced and successfully tested. The emergency
teedwater flowpath was re-established within 27 hours
meeting requirement of Action Statement T.S. 3.7.1.2.
FACILITY SPOWER OTHER STATUS 30 METHOD OF DISCOVERY DESCRIPTION (32)
III BIB DOLO Post-core HFT A DINA
RELEASED OF RELEASE AMOUNT OF ACTIVITY 35
7 4 9 10 11 44 45 80
O O O O O O CONTROL OF TAR
PERSONNEL INJURIES NUMBER DESCRIPTION 41
COSS OF OR CAMAGE TO FACILITY (42)
TI Z O CESCAIRT WA
PUBLICITY ISSUED DESCRIPTION 45 NRC USE ONLY
1 4 9 10
NAME OF PREPARER Chris N. Shively PHONE 501/968-2519



FROM CONDENSATE

FROM CONDENSER HOTWELL

SWS #2

SWS #1

NOOWN

DIACICAM AMENDMENT NO. 29

RGENC FEEDWATER

FIGURE NO