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Nuclear LLC

LR-N03-0450
OCT 2 2 2003

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Gentlemen:

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
SC-RR-03-V01 and V02
SALEM GENERATING STATION UNITS 1 AND 2
FACILITY OPERATING LICENSES NOS. DPR-70 AND DPR-75
DOCKET NOS. 50-272 AND 50-311

References:

PSEG Letter LR-N96437, Dated 12/26/1996 "Inservice Testing Program Relief Request V-24 and V-25.

NRC Letter Dated February 13, 1997 " Evaluation of Inservice Testing Program Relief Requests for Salem Nuclear Generating Station Units 1 and 2 (TAC NOS. M97480 and M97481)"

NRC Letter Dated September 10, 1998 Request for additional information regarding Relief Request V-24 and V25 (TAC NOS. M98259 and M98260)

PSEG Letter LR-N980515 Dated Nov 2, 1998 " Response to Request for Additional Information Regarding Testing of Accumulator Check Valves "

NRC Letter dated March 12, 1999, "Relief Requests V-24 and V-25 Regarding Testing of Accumulator Check Valves Salem Nuclear Generating Station Units 1 and 2 (TAC NOS. M98259 and M98260) {Granted Relief and Forwarded SE)

Pursuant to 10CFR50.55a(f)(5)(iii), PSEG Nuclear is submitting, in Attachment 1 to this letter, Inservice Inspection (ISI) relief requests SC-RR-03-V01 and V02 for NRC approval. These requests address Salem Units 1 and 2 and are revisions to previously approved Relief Request V-24 and V-25. The earlier requests were sought based on the impracticality of performing testing in accordance with the code requirements and in consideration of the burden on the Licensee if the Code requirements were imposed on the facility.

A047

Specifically, relief requests V-24 and V-25 sought approval for the use of an alternate testing methodology to the testing specified in IWV-3522(b) in order to allow the use of a partial accumulator dump test to verify that each check valve is verified to its safety position.

In the NRC's March 12, 1999 approval of Relief Requests V-24 and V-25, an acceptance criterion of 27.0 seconds was imposed by the staff on the alternate testing. Relief Request SC-RR-03-V01 and V02 seek to alter this acceptance criterion to 28.1 seconds due to physical plant changes which altered the original testing acceptance criterion basis.

Modifications were undertaken to the Unit 2 SJ54 Accumulator Isolation Valves to increase the valve stroke times in order to address a maintenance issue. The design change process failed to identify the function performed by the SJ54 valve's in the in service testing of the of the SJ55 and SJ56 check valves. With the SJ54 valves opening more slowly the system dynamics have changed and accordingly the measured time for the partial accumulator dump test has lengthened. This change does not invalidate the conclusions made in the original relief request. These changes are also planned for Unit 1.

Attachment 1 to this letter contains the specific relief requests, SC-RR-03-V01 and V02: Attachment 2 to this letter provides General Approach Proposed For Full Open Testing Of Accumulator Check Valves. Attachment 3 to this letter is calculation S-2-SJ-MDC-1394 Rev 2- "Accumulator Pressure Decay during Discharge Test" which is used to determine the acceptance criteria associated with the Alternate Testing. This calculation has been revised to reflect the new opening time of the SJ-54 valves.

This relief request is applicable to PSEG Nuclear Salem Generating Station Unit 1 and 2. PSEG Nuclear requests that the NRC approve this request by October 24, 2003 in order to support Salem Unit 2 refueling outage 2R13 in progress.

Should you have any questions regarding this request, please contact Mr. Howard Berrick at 856-339-1862.

Sincerely,

G. Salamon
Manager – Nuclear Licensing

Attachments

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Attachment 1

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
SC-RR-03-V01 and V02
SALEM GENERATING STATION UNITS 1 AND 2

FACILITY OPERATING LICENSE NOS. DPR-70 AND DPR-75
DOCKET NOS. 50-272 AND 50-311

Salem Units 1 and 2 Inservice Test Program
VALVE RELIEF REQUEST -
SC-RR-03-V01

COMPONENTS: 11SJ55, 12SJ55. 13SJ55. 14SJ55
21SJ55, 22SJ55, 23SJ55, 24SJ55

FUNCTION:

These check valves are located in the discharge lines from the respective safety injection accumulators. The valves perform an active safety function in the open and closed positions. The valves must be capable of opening during a large break LOCA to provide a flow path for SI accumulator discharge to the RCS cold legs when reactor pressure drops below accumulator pressure. The valve must be capable of closure to prevent divergence of safety injection and recirculation flow subsequent to the accumulators dumping their contents. This valve also functions as an RCS pressure isolation valve. This function prevents exposing the SI accumulators to RCS pressure which would compromise accumulator pressure boundary integrity.

CATEGORY: AC

CLASS: 1

TEST REQUIREMENTS:

Open & Closed Position - Check valves shall be exercised at least once every 3 months in accordance with the requirements of Part 10-4.3.2.1.

BASIS FOR RELIEF:

During power operation, these valves are maintained in the closed position by RCS pressure on the downstream side of the valve disk. Quarterly exercising these valves to the full or partially open position during power operation is impracticable because the only flow path is into the RCS. The operating accumulator pressure cannot overcome normal operating RCS pressure to establish flow. Full stroke exercising these valves at cold shutdown is impracticable because of the potential for low temperature overpressurization due to insufficient expansion volume in the RCS to accept required flow. This testing could also result in the intrusion of nitrogen into the core which could interrupt the normal circulation of cooling water flow. Partial stroke exercising these valves going into cold shutdown is burdensome without a commensurate increase in the level of quality and safety. The associated motor-operated isolation valve (one per accumulator) cannot be partially stroked, but must complete a full stroke before changing direction. This could cause a complete discharge of the water volume in the accumulator and possibly inject nitrogen into the reactor coolant system, causing gas binding of the residual heat removal pumps and a subsequent loss of shutdown cooling. These valves are also verified to close by leak testing per plant technical specifications for Pressure Isolation Valves (PIV's). Reverse exercising these check valves at any time other than refueling is burdensome without a commensurate increase in the level of

quality and safety. The valves are normally in the closed position. Accumulator pressure is continuously monitored to ensure that an adequate nitrogen blanket is maintained and to verify the lack of RCS inleakage.

ALTERNATE TESTING:

These check valves shall be full stroke exercised to the open position during refuelings utilizing a reduced pressure, partial accident flow test method. This controlled method is performed with the reactor vessel head removed. The test method establishes accumulator pressure between 67 and 70 psig, accumulator level between 96 and 100% and refueling cavity level between 125.5 and 126.5 feet. After establishment of the fixed parameters, the test then measures the time interval required for the pressure in the associated safety injection accumulator to drop from an initial pressure to 35 psig. Engineering calculation S-2-SJ-MDC-1394 - "Accumulator Pressure Decay during Discharge Test" establishes the test conditions and acceptance criterion and concludes that this methodology is adequate in determining the associated check valve disk moves to the full open position. Information from other nuclear stations was reviewed regarding partial flow, full stroke exercising using a calculational method. The testing performed at Salem provides a valid methodology for verifying the open function even though the test method differs from the various methods reviewed.

In attempting to utilize the guidance of NUREG 1482, Section 4.1.2 - "Exercising Check Valves with Flow and Nonintrusive Techniques", nonintrusive equipment was used during informational testing. These valves are Darling Valve & Manufacturing Co. "Clear Waterway" swing checks that are fabricated without a backstop. The valve design permits the disk to move sufficiently out of the flow path without contacting the valve body. Nonintrusive testing using acoustic and magnetic technology provides sufficient data for monitoring degradation on a periodic basis, however, full open acoustic indication is not detected nor is expected to show on the test trace. Nonintrusive testing does not verify full stroke exercising, however occasional use of this equipment during the pressure decay test provides useful condition monitoring information.

This method of forward flow check valve testing complies with the guidance provided in Generic Letter 89-04, Attachment 1, Position 1.

Regarding reverse flow exercise testing, these valves shall be verified in the closed position during the process of performing seat leakage testing at the frequency specified in Unit I TS 4.4.6.3 and Unit 2 TS 4.4.7.2.2.

The open stroke frequency change was previously approved in NRC Safety Evaluation April 15, 1994 (TAC Nos. M88144 and M881451)

The use of the alternate testing methodology was previously approved in NRC Safety Evaluation March 12, 1999 (TAC Nos M98259 and M98260)

Salem Units 1 and 2 Inservice Test Program
VALVE RELIEF REQUEST -
SC-RR-03-V02

COMPONENTS: 11SJ56, 12SJ56, 13SJ56, 14SJ56
21SJ56, 22SJ56, 23SJ56, 24SJ56

FUNCTION:

These check valves are located in the discharge lines from the respective safety injection accumulators downstream of the branch connection from RHR. The valves perform an active safety function in the open position. The valves must be capable of opening during, a large break LOCA to provide a flow path for SI accumulator discharge to the RCS cold legs when reactor pressure drops below accumulator pressure. The valve must also be capable of opening to provide a path for low head safety injection and cold leg recirculation flow. This valve also functions as an RCS pressure isolation valve. This function prevents exposing the SI accumulators and RHR system piping to RCS pressure.

CATEGORY: AC

CLASS, 1

TEST REQUIREMENTS:

Open & Closed Position - Check valves shall be exercised at least once every 3 months, in accordance with the requirements of Part 10-4.3.2.1.

BASIS FOR RELIEF:

During power operation, these valves are maintained in the closed position by RCS pressure on the downstream side of the valve disk. Quarterly exercising these valves to the full or partially open position during power operation is impracticable because the only flow path is into the RCS. The operating accumulator pressure cannot overcome normal operating RCS pressure to establish flow. Full stroke exercising these valves at cold shutdown is impracticable because of the potential for low temperature overpressurization due to insufficient expansion volume in the RCS to accept required flow. This testing could also result in the intrusion of nitrogen into the core which could interrupt the normal circulation of cooling water flow. The associated motor-operated isolation valve (one per accumulator) cannot be partially stroked, but must complete a full stroke before changing direction. This could cause a complete discharge of the water volume in the accumulator and possibly inject nitrogen into the reactor coolant system, causing gas binding of the residual heat removal pumps and a subsequent loss of shutdown cooling. These valves are also verified to close by leak testing per plant technical specifications for Pressure Isolation Valves (PIV's). Reverse exercising these check valves at any time other than refueling is burdensome without a commensurate increase in the level of quality and safety.

ALTERNATE TESTING:

These check valves shall be full stroke exercised to the open position during refuelings utilizing a reduced pressure, partial accident flow test method. This controlled method is performed with the reactor vessel head removed. The test method establishes accumulator pressure between 67 and 70 psig, accumulator level between 96 and 100% and refueling cavity level between 125.5 and 126.5 feet. After establishment of the fixed parameters the test then measures the time interval required for the pressure in the associated safety injection accumulator to drop from an initial pressure to 35 psig. Engineering calculation S-2-SJ-MDC-1394 - "Accumulator Pressure Decay during Discharge Test" establishes the test conditions and acceptance criterion and concludes that this methodology is adequate in determining that the associated check valve disk moves to the full open position. Information from other nuclear stations was reviewed regarding partial flow, full stroke exercising using a calculational method. The testing performed at Salem provides a valid methodology for verifying the open function even though the test method differs from the various methods reviewed.

In attempting to utilize the guidance of NUREG 1482, Section 4.1.2 - "Exercising Check Valves with Flow and Nonintrusive Techniques", nonintrusive equipment was used during informational testing. These valves are Darling Valve & Manufacturing Co. "Clear Waterway" swing checks that are fabricated without a backstop. The valve design permits the disk to move sufficiently out of the flow path without contacting the valve body. Nonintrusive testing using acoustic and magnetic technology provides sufficient data for monitoring degradation on a periodic basis however, full open acoustic indication is not detected or expected to show on the test trace. Nonintrusive testing does not verify full stroke exercising however occasional use of this equipment during the pressure decay test provides useful condition monitoring information.

The valves shall be partial stroke exercised at cold shutdown during normal RHR shutdown cooling operations.

This method of forward flow check valve testing complies with the guidance provided in Generic Letter 89-04, Attachment 1, Position 1.

Regarding reverse flow exercise testing, these valves shall be verified in the closed position during the process of performing seat leakage testing at the frequency specified in Unit 1 TS 4.4.6.3 and Unit 2 TS 4.4.7.2.2

The open stroke frequency change was previously approved in NRC Safety Evaluation April 15, 1994 (TAC Nos. M88144 and M88145).

The use of the alternate testing methodology was previously approved in NRC Safety Evaluation March 12, 1999 (TAC Nos M98259 and M98260)

Attachment 2

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
SC-RR-03-V01 and V02
SALEM GENERATING STATION UNITS 1 AND 2

FACILITY OPERATING LICENSE NOS. DPR-70 AND DPR-75
DOCKET NOS. 50-272 AND 50-311

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

PSEG procedure S2.OP-ST.SJ-0006(Q). Inservice Testing Safety Injection Valves Mode 6 provides instructions necessary to perform Inservice Inspection and Testing IAW Technical Specification 4.0.5 for the following Safety Injection (Accumulator) check valves:

- 21SJ55 and 21SJ56 - 21 Accumulator Discharge to Cold Leg
- 22SJ55 and 22SJ56 - 22 Accumulator Discharge to Cold Leg
- 23SJ55 and 23SJ56 - 23 Accumulator Discharge to Cold Leg
- 24SJ55 and 24SJ56 - 24 Accumulator Discharge to Cold Leg

The testing procedure involves open-stroke testing each tank's discharge check valves with the reactor depressurized and the vessel head removed. The initial tank liquid volume is set to 96 - 100%, and initial tank pressure is set at 67 - 70 psig. Flow is initiated by opening the tank MOV. Per the procedure, the valve is to be stroked fully open, left in the open position until the Accumulator reaches a pressure of 35 psig, and then closed. Tank pressure is set low enough t prevent injection of nitrogen gas into the RCS. Velocities achieved should also be sufficient to fully stroke the valves, according to calculation.

The bases for the testing is captured in Calculation No. S-2-SJ-MDC-1394, Accumulator Pressure Decay During Discharge Test. The purpose of this calculation is to establish a mathematical model of test conditions to develop acceptance criterion for establishing the valves tested go full open. The description, below, will describe the calculation with reactor head removed as is currently performed during testing.

The following parameters are fixed by procedure.

- The Unit is in Mode 6 (Defueled) with the Upper Internals installed.
- Safety Injection Accumulators are at a fixed and defined pressure.
- Safety Injection Accumulators are at a fixed and defined level.
- Refueling Cavity is at a fixed and defined level.
- Acceptance criteria - Maximum blowdown time in seconds.

During valve stroking, Accumulator pressure and level measurements, which are acquired from inputs from normal plant instrumentation, are recorded. Based on the measured level and pressure change with time, the relationship between the check valve disc angle, flow rate and pressure difference are calculated using information supplied by Westinghouse Letter PSE-90- 530 for full lift velocity for the valves being tested. Loss factor for the MOV isolation valve as well as friction losses associated with the piping system are calculated. Equations of motion are then solved simultaneously.

The calculation solves six unknown variables simultaneously using a FORTRAN computer program. The following are calculated to determine flow and pressure at a point in time under a variety of disc angles:

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

- Accumulator level elevation
- Accumulator gas pressure
- MOV loss factor
- Check valve Delta P
- Derivations
- Values at new time step

This will be the same for Unit 1.

Attachment 3

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
SALEM GENERATING STATION UNITS 1 AND 2

FACILITY OPERATING LICENSE NOS. DPR-70 AND DPR-75
DOCKET NOS. 50-272 AND 50-311

Calculation S-2-SJ-MDC-1394 (Rev 2)

FORM 1

CALC NO.: S-2-SJ-MDC-1394 REVISION: 2	CALCULATION COVER SHEET	Page 1 of 40

CALC. TITLE:	Accumulator Pressure Decay During Discharge Test						
# SHTS (CALC):	40	# ATT / # SHTS:	1/4	# IDV/50.59 SHTS:	11	# TOTAL SHTS:	55

CHECK ONE:

☒ FINAL ☐ INTERIM (Proposed Plant Change) ☐ FINAL (Future Confirmation Req'd) ☐ VOID

SALEM OR HOPE CREEK: ☒ Q – LIST ☒ IMPORTANT TO SAFETY ☐ NON-SAFETY RELATED
HOPE CREEK ONLY: ☐Q ☐Qs ☐Qsh ☐F ☐R

☒ STATION PROCEDURES IMPACTED, IF SO CONTACT RELIABILITY ENGINEER
☐ CDs/ADs INCORPORATED (IF ANY): _____

DESCRIPTION OF CALCULATION REVISION (IF APPL.):

DCP's 80017352, 80017353, 80017354, 80017355 changed the stroke times of valves 21SJ54, 22SJ54, 23SJ54, and 24SJ54. This change will increase the accumulator pressure decay time. The revised acceptable pressure decay time has been recalculated in this revision of the calculation.

PURPOSE:

Determine the acceptance criterion of the pressure decay time for the accumulator discharge test. The acceptance criterion will be incorporated in procedure S2.OP-ST.SJ-0006.

CONCLUSIONS:

The pressure decay time acceptance criterion is 28.1 seconds.

	Printed Name / Signature	Date
ORIGINATOR/COMPANY NAME:	Vijay Chandra/PSEG Nuclear Vijay Chandra	Oct. 21, 2003
REVIEWER/COMPANY NAME:	James Murphy/PSEG Nuclear	10/22/2003
VERIFIER/COMPANY NAME:	James Murphy/PSEG Nuclear	10/22/2003
PSEG SUPERVISOR APPROVAL:	Paul Lindsay	10/22/2003

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ATTACHMENT 1 (VALVE STROKE TIMES)

FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 2A

CALC. NO.: S-2-SJ-MDC-1394			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Oct. 20, 2003	2				
REVIEWER/VERIFIER,DATE		James Murphy 10/22/2003					

Revision History

Revision No.	Date	Description
0	Oct. 24, 1994	Calculation was issued to correct the existing acceptance criterion of 37 sec.
1	Feb. 5, 1996	Minor typographical errors were corrected. There was no change in the results.
2	Oct. 21, 2003	DCP's 80017352, 80017353, 80017354, 80017354 changed the stroke times of 21SJ54, 22SJ54, 23SJ54, and 24 SJ54 valves. This change would result in a revised acceptance criterion. A minor error in the accumulator tap elevation was corrected.

Page Revision Index

Page	Revision	Page	Revision	Page	Revision	Page	Revision
1	2	10	0	19	0	29	2
2	2	11	0	20	0	30	2
2A	2	12	0	21	1	31	2
3	2	13	0	22	0	32	2
4	0	14	0	23	0	33	2
5	0	15	0	24	02	34	2
6	0	16	0	25	2	35	2
7	0	17	0	26	1	36	2
8	2	17A	2	27	0	37	2
9	2	18	0	28	2	38	2

FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 3

CALC. NO.: S-2-SJ-MDC-1394			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Oct. 20, 2003	2				
REVIEWER/VERIFIER,DATE		James Murphy 10/22/2003					

1. INTRODUCTION

Accumulator dump test is done in Mode 6 in accordance with procedure S2.OP-ST.SJ-0006(Q), Rev. 8. According to this procedure, the reactor head is off during the test condition. In revision 1 of this calculation (S-2-SJ-MDC-1394), an acceptance criterion of the pressure decay time was calculated based on the 12.5 second opening stroke time of SJ54 valves. DCP's 80017352, 80017353, 80017354, 80017355, revised the stroke time of SJ54 valves. However, the acceptance criterion calculated in revision 1 was not revised. As a result, when discharge test was performed on 21 accumulator by opening 21SJ54 valve, the pressure decay time exceeded the acceptance criterion and 21SJ55 and 21SJ56 valves were declared inoperable (Notification 20162455).

In this revision of the calculation, a revised acceptance criterion of the accumulator pressure decay time has been calculated. The SJ54 valve opening stroke times were measured and are given in Attachment 1and were used.

Although the test is done with the reactor head off, the acceptance criterion was also calculated for the situation when the reactor head is on and the venting occurs through the pressurizer.

2. DESCRIPTION OF CONFIGURATION:

FIGURE 1A. SHOWS THE RELEVENT COMPONENTS THAT ARE INVOLVED IN THE TEST (REACTOR HEAD ON). THE VALVE SJ54 IS OPENED WHILE THE INITIAL GAS PRESSURE IN THE ACCUMULATOR IS BETWEEN 67 AND 70 PSIG. AS THE VALVE OPENS, THE WATER STARTS TO COME OUT OF THE ACCUMULATOR AND PRESSURIZER LEVEL RISES. THE PORV'S ARE OPEN. THE AIR FROM THE PRESSURIZER IS VENTED TO THE CONTAINMENT THROUGH OPENINGS CREATED BY REMOVING THE SAFETY VALVES.

FIGURE 1B. SHOWS THE RELEVANT COMPONENTS THAT ARE INVOLVED WHEN THE TEST IS DONE WITH THE REACTOR HEAD OFF. IN THIS SITUATION, THE WATER FROM THE ACCUMULATOR IS DISCHARGED TO THE REACTOR CAVITY.

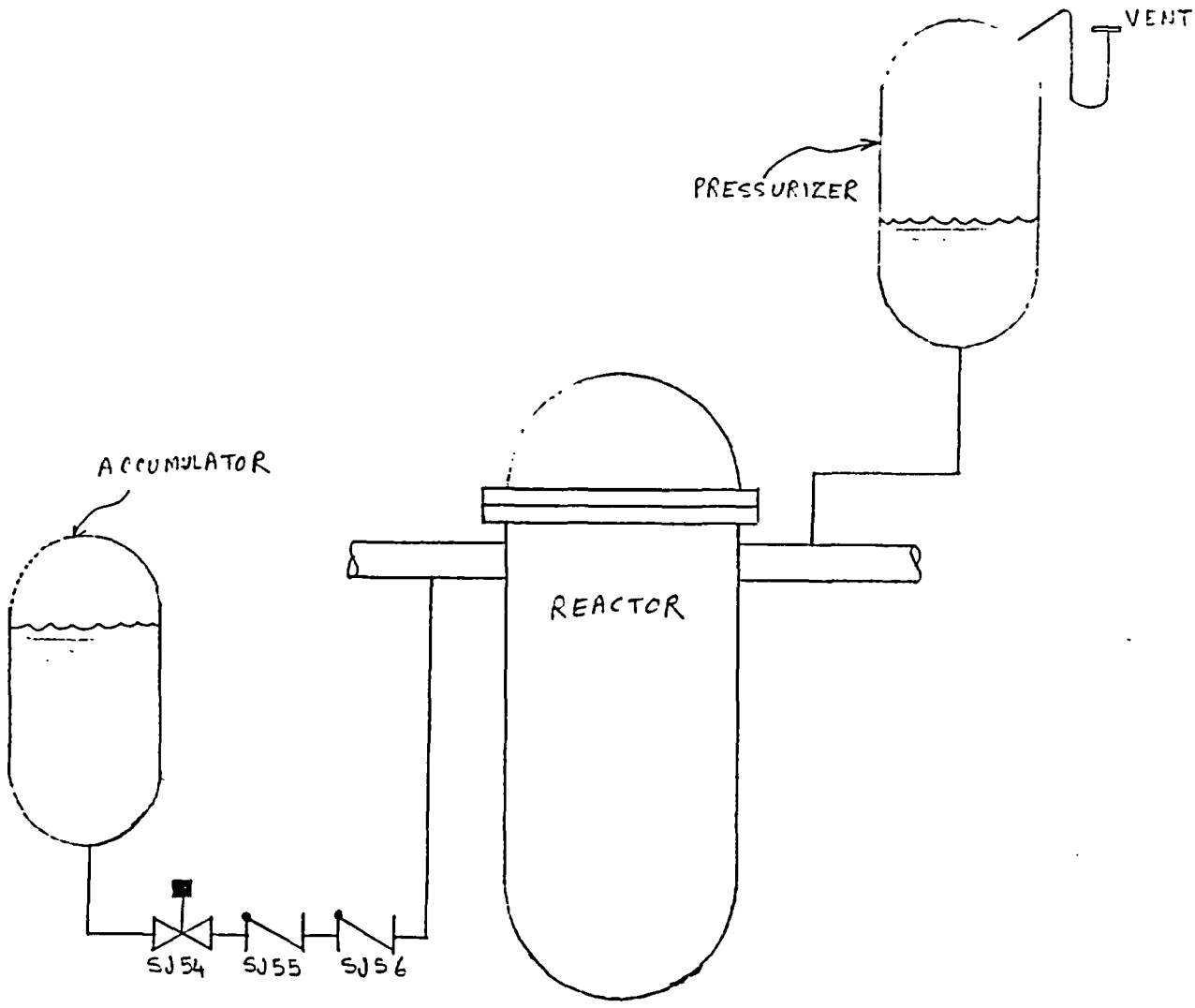


FIGURE 1A. SCHEMATIC ARRANGEMENT OF ACCUMULATOR, REACTOR, AND VENTED PRESSURIZER.
(TEST CONFIGURATION WITH REACTOR HEAD ON)

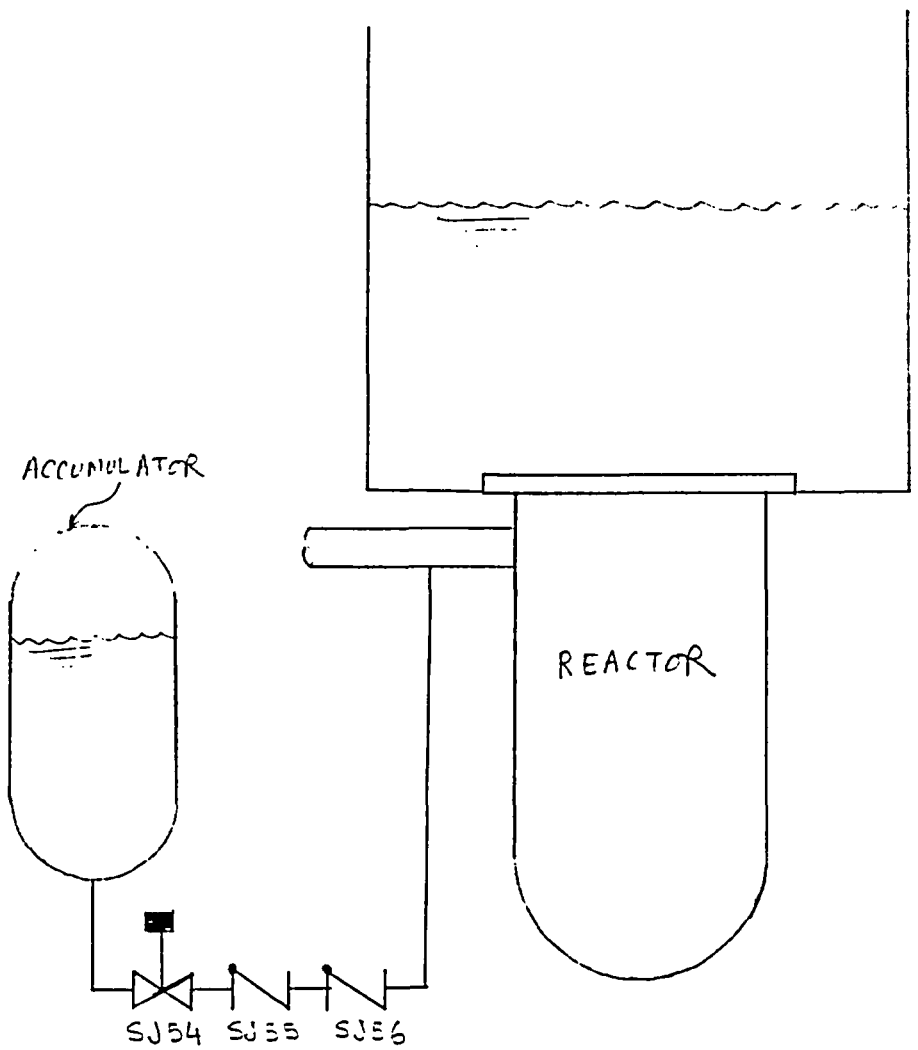


FIGURE 1B. SCHEMATIC ARRANGEMENT OF ACCUMULATOR, DISCHARGE VALVES AND REACTOR CAVITY (TEST CONFIGURATION WITH REACTOR HEAD OFF).

3. ANALYSIS

IN THIS SECTION A MATHEMATICAL MODEL OF ACCUMULATOR DUMP PROCESS HAS BEEN DEVELOPED. SINCE PRESSURE DIFFERENCE ACROSS THE ORIFICE IS RELATIVELY INSIGNIFICANT IT WILL NOT BE CONSIDERED.

THE INERTIAL EFFECTS OF ACCUMULATOR DISCHARGE PIPING AND PRESSURIZER SURGE PIPING HAVE BEEN CONSIDERED.

3.1 ACCUMULATOR

ACCUMULATOR LEVEL ELEVATION IS GIVEN IN FIGURE 2. TABLE 1 BELOW LISTS THE WATER VOLUME IN THE ACCUMULATOR AS A FUNCTION OF WATER LEVEL ELEVATION. [Ref. 5]

TABLE 1. ACCUMULATOR LEVEL, WATER VOLUME AND LEVEL ELEVATION.

LEVEL %	WATER VOLUME (ft^3)	ELEVATION OF WATER SURFACE (ft)	
100	939.7	91.46	
0	700.4	88.96	
NOT DEFINED	409.4	85.92	

LET

Z_A = ELEVATION OF WATER LEVEL IN THE ACCUMULATOR

V_{WA} = VOLUME OF WATER IN THE ACCUMULATOR 2

or $V_{WA} = 95.72 Z_A - 7814.85$; $85.92 \leq Z_A \leq 91.46$ ft.

INITIAL WATER VOLUME CORRESPONDS TO 96% LEVEL

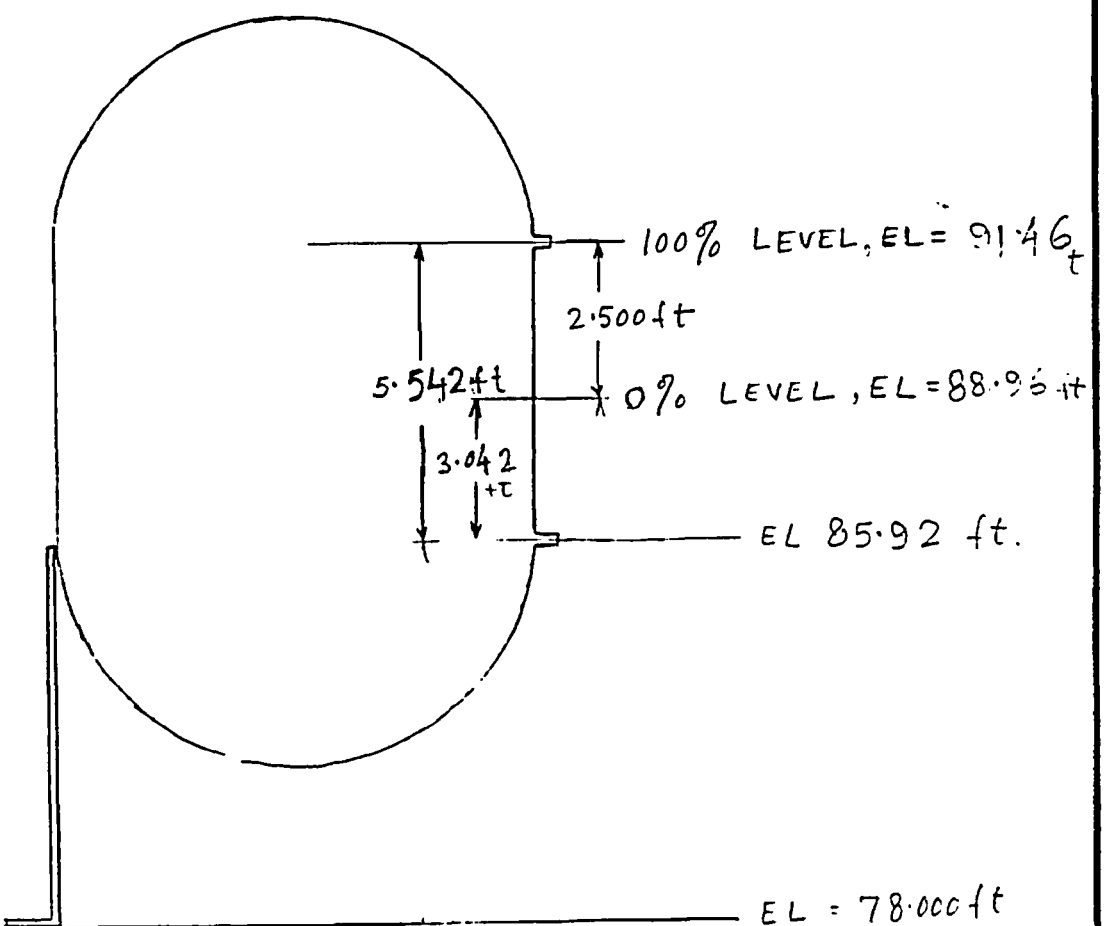
$= 930.1\ ft^3$

FROM UFSAR TABLE 6.3-2 Rev. 13 1

INITIAL NITROGEN VOLUME: $1350 - 930.1\ ft^3$

$= 419.9\ ft^3$

FIGURE 2. ACCUMULATOR LEVEL AND ELEVATION RELATIONSHIP [Ref 2, 3, 4]



3.2 PRESSURIZER

FIGURE 3 SHOWS THE PRESSURIZER LEVEL IN % Vs. ELEVATION OF WATER LEVEL. TABLE 2 BELOW SHOWS THE RELATIONSHIP BETWEEN WATER LEVEL ELEVATION, % LEVEL AND THE WATER VOLUME IN THE PRESSURIZER (R4.6).

TABLE 2. PRESSURIZER LEVEL, WATER VOLUME, AND LEVEL ELEVATION.

LEVEL %	WATER VOLUME (ft^3)	ELEVATION OF WATER SURFACE (ft)	
100%	1764.7	152.75	
40.1%	758.0	126.50	
22%	454.5	118.58	

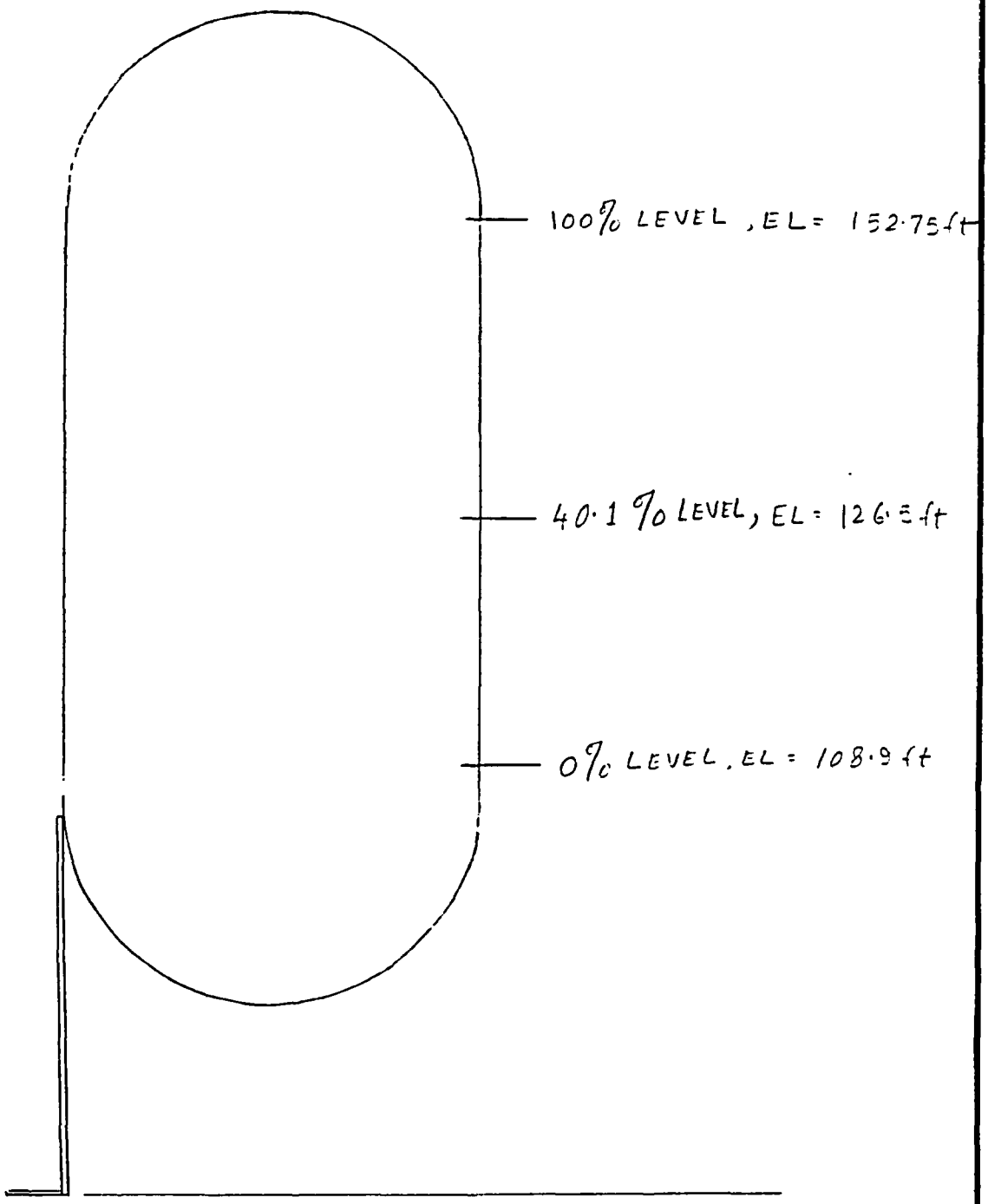
LET

Z_p = PRESSURIZER LEVEL ELEVATION (ft)

V_{wp} = WATER VOLUME IN PRESSURIZER (ft^3)

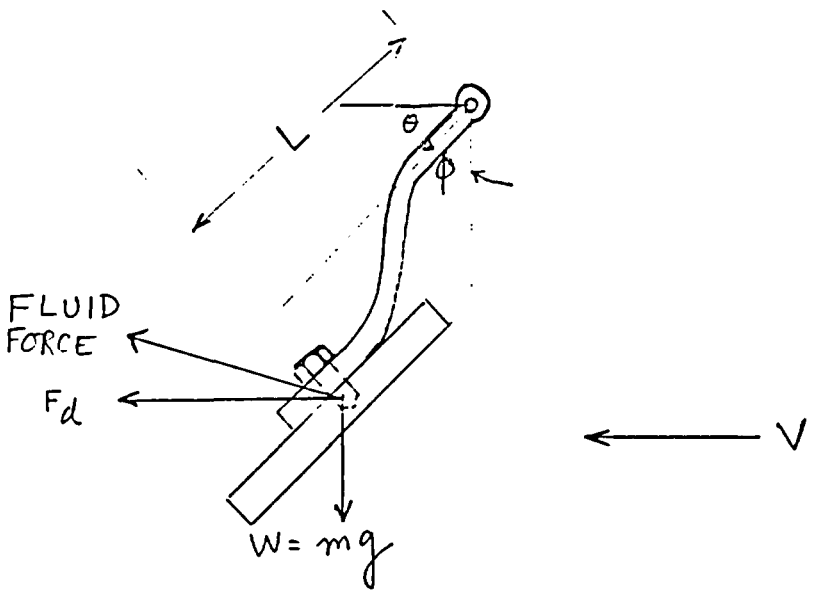
$V_{wp} = 38.34 Z_p - 4092.3$; $118.58 \leq Z_p \leq 152.75$ ft.

FIGURE 3. PRESSURIZER LEVEL AND ELEVATION RELATIONSHIP. [Ref. 6]



3.3 CHECK VALVE SJ155

IN THIS SECTION, THE RELATIONSHIP BETWEEN THE CHECK VALVE DISC ANGLE, FLOWRATE, AND PRESSURE DIFFERENCE HAS BEEN CALCULATED.



FROM EQ 3-1 ON PAGE 3-7 OF EPRI REPORT NP-5479 [Ref. 1], THE RELATIONSHIP BETWEEN, DISK WEIGHT, FLOW VELOCITY, AND DISK ANGLE IS

$$V = \sqrt{\frac{gC\,W_{eff.}\cos\theta}{K\rho A_D \sin^2\theta}}$$

OR

$$V = \sqrt{\frac{C\,m\,g\,\sin\phi}{K\,\rho\,A_D\,\cos^2\phi}}$$

W_{eff} = EFFECTIVE WEIGHT OF DISK. (lbf)
ρ = FLUID DENSITY IN $\frac{lbm}{ft^3}$
C = BUOYANCY FACTOR
m = DISK MASS IN SLUGS
ρ = FLUID DENSITY IN $\frac{SLUG}{ft^3}$
A_D = DISK AREA

$K = 2$ FROM TEST DATA

USING THE NOTATION OF FIGURE C-1 ON PAGE C-7 OF REF [1]

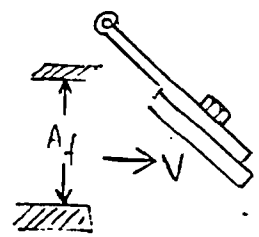
THE COMPONENT OF FLUID FORCE IN THE DIRECTION OF FLOW $= F_d \approx \dot{m}(V - V\cos\theta)\cdot\beta$

$\approx \dot{m} V (1-\sin\phi)\cdot\beta$

$= \rho A_F V^2 (1-\sin\phi)\cdot\beta$ $\quad A_F$ = VALVE FLOW AREA

ALSO

$$F_d \approx \Delta p\, A_{pipe}$$



$$\Delta p\, A_{pipe} = \rho A_F V^2 (1-\sin\phi)\beta$$

$$\Delta p = \frac{\rho A_F}{A_{PIPE}} \cdot (1-\sin\phi) \cdot V^2 \cdot \beta \qquad (4)$$

β = A CORRECTION FACTOR

$$= \tfrac{1}{2} k \rho V^2$$

$$k = 2\,\frac{A_F}{A_{PIPE}} \cdot (1-\sin\phi)\,\beta$$

FROM PREVIOUS PAGE

$$V^2 = \frac{C m g \sin\phi}{2 \rho A_D \cos^2\phi} \quad ; \quad \text{LET } \alpha = \frac{C m g}{2 \rho A_D}$$

or $\cos^2\phi = \dfrac{\alpha}{V^2}\sin\phi$

or $1 - \sin^2\phi = \frac{\alpha}{V^2}\sin\phi$

or $\sin^2\phi + \frac{\alpha}{V^2}\sin\phi - 1 = 0$

or $\sin\phi = \dfrac{-\frac{\alpha}{V^2} \pm \sqrt{\frac{\alpha^2}{V^4} + 4}}{2}$

CHOOSE THE POSITIVE SIGN

$$\sin\phi = \frac{1}{2}\left(\sqrt{\frac{\alpha^2}{V^4} + 4} - \frac{\alpha}{V^2}\right) \qquad (5)$$

EQUATIONS (4) AND (5) PROVIDE THE FLOW RATE Vs. PRESSURE DIFFERENCE RELATIONSHIP FOR THE CHECK VALVE.

$C m g = 0.9 * 65$ lbf (PHONE CONVERSATION WITH JOHN WIEDEMAN)

$\rho = 1.94 \frac{\text{SLUG}}{ft^3}$

$A_d \approx 0.394\ ft^2$

$$\alpha = \frac{0.9 * 65}{2 * 1.94 * 0.394} \frac{lbf}{\text{SLUG}} \frac{ft^3}{ft^2}$$

$$= 38.3 \frac{ft^2}{s^2}$$

FROM WESTINGHOUSE LETTER PSE-90-530 [Ref. 8].
THE FULL LIFT OCCURS AT 20ft/SEC VELOCITY
IN THE PIPE.

AT 20ft/SEC.

$$\frac{\alpha}{V^2} = \frac{38.3}{20^2} = 0.09575$$

$$\sin\phi_{MAX} = \frac{1}{2}\left(\sqrt{\left(\frac{\alpha}{V^2}\right)^2 + 4} - \frac{\alpha}{V^2}\right)$$

$$= \frac{1}{2}\left(\sqrt{(0.09575)^2 + 4} - 0.09575\right)$$

$$= 0.9532$$

$$K_{FULL\ OPEN} = 2\frac{A_F}{A_{PIPE}}(1 - \sin\phi)\beta$$

$A_F \approx A_{PIPE}$

$$= 2(1 - \sin\phi)\beta$$

$$= 2(1 - 0.9532)\beta$$

$$= 0.0935\beta$$

FROM VALVE DATA SHEET (PSBP 106230)

$\frac{L}{D}$ OF THIS VALVE = 60

OR $K_{FULL\ OPEN} = \frac{fL}{D} = 0.014 \times 60 = 0.84$

$0.0935\beta = 0.84$ OR $\beta = 8.98$

$$\Delta P_{CHECK\ VALVE} \approx \rho\,(1-\sin\phi)\,8.98\,V^2$$

$$= \rho\,8.98\,(1-\sin\phi)\cdot V^2$$

$$= \tfrac{1}{2}\rho\,[17.96(1-\sin\phi)]\,V^2 = \tfrac{1}{2}\rho V^2 k_{CHK}$$

FOR TWO CHECK VALVES IN SERIES

$$\Delta P_{2\ CHK\ VALVES} = 2 * \Delta P_{CHECK\ VALVE}.$$

FROM THE DEFINITION ABOVE

$$k_{CHK} = 17.96\,(1-\sin\phi)$$

3.4. GATE VALVE SJ54 (2)

VALVE OPENING STROKE TIME = SEE PAGE 17A

THE FOLLOWING TABLE SHOWS THE RELATIONSHIP BETWEEN VALVE OPEN FRACTION AND NON DIMENSIONAL VALVE C_V.

NON DIMENSIONAL VALVE $C_V = \frac{C_V}{C_{V_0}}$

WHERE C_{V_0} = FULL OPEN VALVE C_V.

VALVE OPEN FRACTION	$\frac{C_V}{C_{V_0}}$
0.00	0.0
0.05	0.0194
0.10	0.055
0.20	0.10
0.30	0.146
0.40	0.204
0.50	0.277
0.60	0.3536
0.70	0.4613
0.80	0.6086
0.90	0.767
1.00	1.0

FULL OPEN VALVE LOSS FACTOR = 0.15

LOSS FACTOR AT ANY POSITION = $\frac{0.15}{(C_V/C_{V_0})^2}$

FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 17A

CALC. NO.: S-2-SJ-MDC-1394			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Oct. 20, 2003	2				
REVIEWER/VERIFIER,DATE		James Murphy 10/22/2003					

ACTUAL MEASURED STROKE TIME OF FOUR SJ54 VALVES ARE AS FOLLOWS

VALVE	OPEN STROKE TIME (Sec.)	REFERENCE
21SJ54	19.9	ATTACHMENT 1
22SJ54	19.3	"
23SJ54	21.9	"
24SJ54	20.6	"

TO KEEP THE ANALYSIS CONSERVATIVE (SHORTEST TIME FOR ACCEPTANCE CRITERION) 19.3 SEC. OPEN STROKE TIME WILL BE USED.

3.5 PIPING BETWEEN ACCUMULATOR AND COLD LEG

TABLE 3. SHOWS THE PIPING AND FITTING DETAILS

$$\sum \frac{L_i}{A_i} = \frac{0.677}{0.437} + \frac{0.287}{0.547} + \frac{75.448}{0.394} + \frac{15.016}{0.548} \quad ft^{-1}$$

$$= 1.55 + 0.523 + 191.5 + 27.4 \quad ft^{-1}$$

$$= 221.0 \quad ft^{-1}$$

WHERE L_i = LENGTH OF PIPE SEGMENT HAVING AREA A_i

FOLLOWING ARE THE DETAILS OF FRICTION ELEMENTS

DESCRIPTION	REF. AREA (ft^2)	LOSS FACTOR K	$\frac{K}{A^2}$ (ft^{-4})
75.448 ft of 8" SCH 80 PIPE	0.394	1.62	10.4
APPROX 16 ft of 10.02" ID PIPE	0.548	0.29	0.97
ONE TEE BR	0.437	0.51	2.67
TWO TEE RUNS	0.394	0.12	0.77
FOUR LR 90°EL	0.394	0.8	5.13
TWO SR 90°EL	0.394	0.56	3.61
ONE LR 90°EL	0.548	0.18	0.60
THREE SR 90°EL	0.548	0.81	2.70
ONE ENTRANCE	0.394	0.5	3.22
ONE EXIT	0.394	1.0	6.45
(VALVES ARE NOT INCLUDED HERE).			$\sum \frac{K}{A^2} = 36.53\ ft^{-4}$

TABLE 3.23 ACCUMULATOR DISCHARGE PIPING

#23 ACCUM

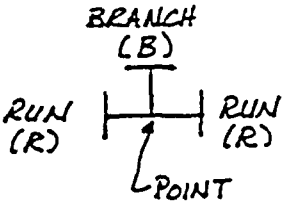
FROM POINT CONN @EL. 78'-10"

TO POINT RCP COLD LEG @EL. 97'-0"

PIPE		FITTINGS					VALVES		
I.D.	N° OF FT.	LR 90° ELL	SR 90° ELL	90° ELL 4.167' R.	TEE B	TEE R	FA-93	FA-32	
8.952"	0.677'				1				
10.019"	0.287'								
8.5"	75.448'	IIII (4)	II (2)	1		II (2)	I (1) II (2)	II (2)	
15.02	15.016'	I (1)	III (3)					~~I (1)~~	

FA-32 - CL. VALVE PSBP-106230 L/D=60

FA-93 - M.O.V. GATE PSBP 19164 L/D = 12



TEES

3.6 PIPING BETWEEN HOT LEG AND PRESSURIZER (SURGE LINE)

THIS PIPING IS ABOUT 65 FT LONG AND ITS I.D. IS 12".

$$\frac{1}{A} = \frac{65}{3.14} = 20.7\ ft^{-1}$$

$$\Sigma \frac{K}{A^2} \approx \frac{3}{3.14^2} = 0.304\ ft^{-4}$$

(THIS IS NEGLIGIBLE COMPARED TO $\frac{K}{A^2}$ OF ACCUMULATOR DISCHARGE LINE.)

3.7.1 EQUATIONS OF MOTION (FACTOR HEAD ON)

FOR FLOW THROUGH A SERIES OF VARIOUS DIAMETER PIPES THE FOLLOWING EQUATION OF MOTION IS APPLICABLE

$$\left(P_A + \rho g Z_A\right) - \left(P_p + \rho g Z_p\right) = \left(\sum_i \frac{\rho_i k_i}{A_i^2}\right)\frac{1}{2} Q^2 + \Delta P_{f\ VALVES} + \left(\sum_i \frac{L_i}{A_i}\rho_i\right)\frac{dQ}{dt}$$

$$\sum_i \frac{\rho_i L_i}{A_i} = 1.94\left(221 + 20.7\right)\frac{SLUG}{ft^3}\cdot\frac{1}{ft} = 468.9\ \frac{SLUG}{ft^4}$$

$$\frac{1}{2}\sum_i \frac{\rho_i k_i}{A_i^2} = \frac{1}{2}\left[1.94 * 36.53 + 1.94 * 0.304\right] = \frac{35.75}{33.82}\ \frac{SLUG}{ft^7}$$ (1)

or $$468.9\ \frac{dQ}{dt} = \left(P_A + \rho g Z_A\right) - \left(P_p + \rho g Z_p\right) - \frac{35.75}{33.82} Q^2 - \Delta P_{f\ VALVES}$$ (6)

$\Delta P_{f\ VALVES}$ = SUM OF FRICTIONAL PRESSURE DROP ACROSS SJ 34, SJ 35 AND SJ EG VALVES WHICH IS AVAILABLE FROM SECTIONS 3.3 AND [illegible].

NOTE: Q = LIQUID VOL. FLOWRATE
P_A = GAS PRESSURE IN THE ACCUMULATOR
P_p = GAS PRESSURE IN THE PRESSURIZER

FROM SECTION 3.1

$$Z_A = \frac{V_{WA} + 7869.6}{35.72} \quad (7)$$

FROM ACCUMULATOR GEOMETRY

$$V_{WA} = 1350 - V_{NA} \quad (8)$$

V_{WA} = WATER VOLUME IN ACCUMULATOR

V_{NA} = NITROGEN VOLUME IN THE ACCUMULATOR

GAS EXPANSION IS GOVERNED BY THE FOLLOWING EQUATION

$n \approx 1.3$

$$P_A V_{AN}^n = P_{AO} . V_{ANO}^n$$

OR

$$P_A = P_{AO} \left(\frac{V_{ANO}}{V_{AN}} \right)^n \quad (9)$$

THE RATE OF CHANGE OF GAS VOLUME IN THE ACCUMULATOR IS

$$\frac{dV_{AN}}{dt} = Q \quad (10)$$

FROM SECTION 3.2

$$Z_p = \frac{V_{WP} + 4092.3}{38.34} \quad (11)$$

ALSO

$$\frac{dV_{WP}}{dt} = Q \quad (12)$$

EQUATIONS (6) THROUGH (12) CAN BE SOLVED SIMULTANEOUSLY. THE UNKNOWN VARIABLES ARE Q, P_A, Z_A, Z_p, V_{WA}, V_{NA}, AND V_{WP}.

INITIAL CONDITIONS ARE

$V_{WA} = 330.1\ ft^3$

$V_{WP} = 758\ ft^3$

$P_A = 84.7\ psia$

$Q = 0\ ft^3/s$

$\phi = 0$ radian

EQUATIONS (6) THROUGH (12) HAVE BEEN SOLVED NUMERICALLY USING A FORTRAN COMPUTER PROGRAM THE LISTING OF COMPUTER PROGRAM IS SHOWN IN THE FOLLOWING PAGES.

S-2-SJ-MDC-1394 Rev. 2

COMPUTER PROGRAM LISTING

REACTOR HEAD IS ON
CHECK VALVE IS FREE
SJ54 OPENING TIME = 19.3 sec.

```
C     Last change:  VC   21 Oct 2003    4:22 pm
      DIMENSION VVOF(12),CVCV(12)
      OPEN(1,FILE='Acchon free.out', STATUS='old')
      DATA VVOF/0.,.05,.1,.2,.3,.4,.5,.6,.7,.8,.9,1./
      DATA CVCV/0., 0.0194, 0.055, 0.1, 0.146, 0.204,
     #       0.277,0.3536,0.4613,0.6086,0.767,1./
C  PARAMETERS
      GAM=1.3
      G=32.174
      RHO=1.94
      AREA=0.394
      DT=0.01
      PPRES=14.7*144.
C  INITIAL CONDITIONS
      TIME=0.1
      NSTEP=-1
      VNAZ=419.9
      VNA=VNAZ
      PAZ=84.7*144.
      PA=PAZ
      Q=.001
      VWP=758.
      WRITE(1,101)
  101 FORMAT(T19'TIME',  T28'ACCUMULATOR PRESSURE   FLOW RATE')
  103 FORMAT(T19'(SEC.)',T28'        (PSIG)           (GPM)  ',//)
      WRITE(1,103)
   31 NSTEP=NSTEP+1
      TIME=TIME+DT
C  CALCULATE ACCUMULATOR LEVEL ELEVATION
      VWA=1350.-VNA
      ZA=(VWA+7814.85)/95.72
C  CALCULATE PRESSURIZER LEVEL ELEVATION
      ZP=(VWP+4092.3)/38.34
C  CALCULATE ACCUMULATOR GAS PRESSURE
      PA=PAZ*(VNAZ/VNA)**GAM
C  CALCULATE SJ54 LOSS FACTOR
      VOT1=19.3
      GVKZ=.15
      IF(TIME .LT. VOT1) THEN
          VOF=TIME/VOT1
          CALL INTER(VOF,CVND,12,VVOF,CVCV)
          GVK=GVKZ/(CVND*CVND)
        ELSE
          GVK=GVKZ
      ENDIF
C  CALCULATE CHECK VALVE DP
      VEL=Q/AREA
      AV2=38.3/(VEL*VEL)
      SINPHI=0.5*(SQRT(AV2**2+4.)-AV2)
      IF (SINPHI .GE. 0.9532) SINPHI=0.9532
      DPCHK=2.*8.98*RHO*VEL*VEL*(1.-SINPHI)
C  CALCULATE DERIVATIVES
      DQDT=(PA+RHO*G*ZA-PPRES-RHO*G*ZP-35.75*Q*ABS(Q)
     #       -0.5*GVK*1.94*Q*ABS(Q)/AREA**2 - DPCHK)/468.9
      DVNADT=Q
      DVWPDT=Q
C  CALCULATE VALUES AT NEW TIME STEP
      QQ=Q+DQDT*DT
      VVNA=VNA+DVNADT*DT
      VVWP=VWP+DVWPDT*DT
      IF (TIME .LE. 2.) THEN
      IF(MOD(NSTEP,10) .EQ. 0)WRITE(1,102) TIME,+(PA/144.-14.7),
     #   Q*7.48*60.
      ELSE
      IF(MOD((NSTEP+10),100) .EQ. 0)WRITE(1,102) TIME,+(PA/144.-14.7),
     #   Q*7.48*60.
      ENDIF
  102 FORMAT(F23.3,8F17.2)
C  UPDATE THE OLD VARIABLES
         Q=QQ
         VNA=VVNA
         VWP=VVWP
      IF(TIME .GT. 40.) STOP
```

```
      GO TO 31
      END
      SUBROUTINE INTER(X,Y,N,XX,YY)
      DIMENSION XX(N),YY(N)
      IF(X .LT. XX(1) .OR. X .GT. XX(N)) GO TO 3
      DO 2 J=2,N
      IF(X .GE. XX(J-1) .AND. X .LE. XX(J)) GO TO 101
      GO TO 2
  101 Y=YY(J-1)+(YY(J)-YY(J-1))*(X-XX(J-1))/
     1   (XX(J)-XX(J-1))
      RETURN
    2 CONTINUE
    3 WRITE(6,1) X,(XX(I),I=1,N)
    1 FORMAT('  BEYOND RANGE',G10.4,5X,20G10.4)
      RETURN
      END
```

3.7 2. EQUATIONS OF MOTION (REACTOR HEAD OFF)

LET P_C = AIR PRESSURE IN THE CAVITY

Z_C = ELEVATION OF WATER SURFACE

$$(P_A + \rho g Z_A) - (P_C + \rho g Z_C) = \left(\sum_i \frac{\rho_i \cdot k_i}{A_i^2}\right) \frac{1}{2} Q^2 + \Delta P_{f\ VALVES} + \left(\sum_i \frac{L_i}{A_i} \rho_i\right) \frac{dQ}{dt}$$

$$\sum_i \frac{\rho_i \cdot L_i}{A_i} = 1.94 * 221 = 428.7 \ \frac{SLUG}{ft^4}$$

$$\frac{1}{2} \sum \frac{\rho_i \cdot k_i}{A_i^2} \approx \frac{35.75}{\cancel{39.82}} \ \frac{SLUG}{ft^7} \qquad \text{(1)}$$

$$428.7 \frac{dQ}{dt} = (P_A + \rho g Z_A) - (P_C + \rho g Z_C) - \frac{35.75}{\cancel{39.82}} Q^2 - \Delta P_{VALVES} \qquad (13)$$

$$Z_A = \frac{V_{WA} + 7869.6}{95.72} \qquad (14) \quad \text{SAME AS EQN. (7)}$$

$$V_{WA} = 1350 - V_{NA} \qquad (15) \quad \text{SAME AS EQN (8)}$$

$$P_A = P_{AO} \left(\frac{V_{ANO}}{V_{AN}}\right)^n \qquad (16) \quad \text{SAME AS EQN (9)}$$

$$\frac{dV_{AN}}{dt} = Q \qquad (17) \quad \text{SAME AS EQN (10)}$$

DURING THIS TEST, THE AIR PRESSURE IN THE CAVITY AND THE WATER LEVEL CHANGES ARE NEGLIGIBLE. THEREFORE, $Z_C = 127$ ft WILL BE USED

$$p_C = 14.7 \times 144 \ \frac{lb_f}{ft^2}$$

EQUATIONS (13) THROUGH (17) CAN NOW BE SOLVED SIMULTANEOUSLY.

p. 28

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COMPUTER PROGRAM LISTING

REACTOR HEAD IS OFF
CHECK VALVE IS FREE
SJ 54 OPENING TIME = 19.3 Sec.

```
C     Last change:  VC   21 Oct 2003    4:28 pm
      DIMENSION VVOF(12),CVCV(12)
      OPEN(1,FILE='Acchoff free.out', STATUS='OLD')
      DATA VVOF/0.,.05,.1,.2,.3,.4,.5,.6,.7,.8,.9,1./
      DATA CVCV/0., 0.0194, 0.055, 0.1, 0.146, 0.204,
     #       0.277,0.3536,0.4613,0.6086,0.767,1./
C  PARAMETERS
      GAM=1.3
      G=32.174
      RHO=1.94
      AREA=0.394
      DT=0.01
      PCAV=14.7*144.
C  INITIAL CONDITIONS
      TIME=0.1
      NSTEP=-1
      VNAZ=419.9
      VNA=VNAZ
      PAZ=84.7*144.
      PA=PAZ
      Q=.001
      ZCAV=127.
      WRITE(1,101)
  101 FORMAT(T19'TIME',  T28'ACCUMULATOR PRESSURE   FLOW RATE')
  103 FORMAT(T19'(SEC.)',T28'        (PSIG)           (GPM)  ',//)
      WRITE(1,103)
   31 NSTEP=NSTEP+1
      TIME=TIME+DT
C  CALCULATE ACCUMULATOR LEVEL ELEVATION
      VWA=1350.-VNA
      ZA=(VWA+7814.85)/95.72
C  CALCULATE ACCUMULATOR GAS PRESSURE
      PA=PAZ*(VNAZ/VNA)**GAM
C  CALCULATE SJ54 LOSS FACTOR
      VOT1=19.3
      GVKZ=.15
      IF(TIME .LT. VOT1) THEN
          VOF=TIME/VOT1
          CALL INTER(VOF,CVND,12,VVOF,CVCV)
          GVK=GVKZ/(CVND*CVND)
        ELSE
          GVK=GVKZ
      ENDIF
C  CALCULATE CHECK VALVE DP
      VEL=Q/AREA
      AV2=38.3/(VEL*VEL)
      SINPHI=0.5*(SQRT(AV2**2+4.)-AV2)
      IF (SINPHI .GE. 0.9532) SINPHI=0.9532
      DPCHK=2.*8.98*RHO*VEL*VEL*(1.-SINPHI)
C  CALCULATE DERIVATIVES
      DQDT=(PA+RHO*G*ZA-PCAV-RHO*G*ZCAV-35.75*Q*ABS(Q)
     #       -0.5*GVK*1.94*Q*ABS(Q)/AREA**2 - DPCHK)/428.7
      DVNADT=Q
C  CALCULATE VALUES AT NEW TIME STEP
      QQ=Q+DQDT*DT
      VVNA=VNA+DVNADT*DT
      IF (TIME .LE. 2.) THEN
      IF(MOD(NSTEP,10) .EQ. 0)WRITE(1,102) TIME,+(PA/144.-14.7),
     #   Q*7.48*60.
      ELSE
      IF(MOD((NSTEP+10),100) .EQ. 0)WRITE(1,102) TIME,+(PA/144.-14.7),
     #   Q*7.48*60.
      ENDIF
  102 FORMAT(F23.3,8F17.2)
C  UPDATE THE OLD VARIABLES
          Q=QQ
          VNA=VVNA
      IF(TIME .GT. 41.) STOP
      GO TO 31
      END
      SUBROUTINE INTER(X,Y,N,XX,YY)
      DIMENSION XX(N),YY(N)
      IF(X .LT. XX(1) .OR. X .GT. XX(N)) GO TO 3
```

```
      DO 2 J=2,N
      IF(X .GE. XX(J-1) .AND. X .LE. XX(J)) GO TO 101
      GO TO 2
  101 Y=YY(J-1)+(YY(J)-YY(J-1))*(X-XX(J-1))/
     1   (XX(J)-XX(J-1))
      RETURN
    2 CONTINUE
    3 WRITE(6,1) X,(XX(I),I=1,N)
    1 FORMAT('  BEYOND RANGE',G10.4,5X,20G10.4)
      RETURN
      END
```

4. RESULTS

THE FOLLOWING THREE CASES WERE RUN FOR REACTOR HEAD ON CONFIGURATION.

1. CHECK VALVE IS FREE
2. CHECK VALVE MAXIMUM SWING ANGLE FROM CLOSED POSITION IS 60 DEGREES.
3. CHECK VALVE MAXIMUM SWING ANGLE FROM CLOSED POSITION IS 30 DEGREES.

TABLES 4.1, 4.2, AND 4.3 SHOW THE ACCUMULATOR PRESSURE TIME HISTORY AND DISCHARGE FLOW RATE TIME HISTORY FOR EACH CASE. THESE CURVES ARE PLOTTED IN FIGURES 4.1 AND 4.2.

CASE 4 WAS RUN FOR REACTOR HEAD OFF CONFIGURATION. AND THE CHECK VALVE WAS CONSIDERED FREE TO MOVE. THE ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATES ARE SHOWN IN TABLE 4.4.

BY COMPARISON OF RESULTS OF TABLE 4.1 AND 4.4, IT IS CONCLUDED THAT THE PRESSURE DECAY TIME IS NEARLY EQUAL WHETHER THE TEST IS DONE WITH THE HEAD ON OR OFF. (ACTUALLY, THE PRESSURE DECAY TIME WITH REACTOR HEAD OFF IS 0.5 SEC LESS THAN THE PRESSURE DECAY TIME WITH HEAD ON. ADJUSTMENT FOR THIS WILL BE MADE WHEN ACCEPTANCE CRITERIA IS ESTABLISHED).

TABLE 4.1 ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATE

TIME (SEC.)	ACCUMULATOR PRESSURE (PSIG)	FLOW RATE (GPM)
0.110	70.00	0.45
0.210	69.99	164.18
0.310	69.98	241.78
0.410	69.97	318.75
0.510	69.95	394.99
0.610	69.92	470.45
0.710	69.89	545.13
0.810	69.86	619.07
0.910	69.82	692.35
1.010	69.78	772.14
1.110	69.73	887.79
1.210	69.67	1010.82
1.310	69.61	1134.00
1.410	69.54	1256.11
1.510	69.47	1376.81
1.610	69.39	1495.91
1.710	69.30	1613.26
1.810	69.20	1728.74
1.910	69.10	1842.21
2.010	68.99	1947.45
3.010	67.69	2638.34
4.010	66.09	3170.58
5.010	64.31	3589.22
6.010	62.42	3874.58
7.010	60.48	4107.54
8.010	58.55	4257.08
9.010	56.64	4361.32
10.010	54.79	4404.47
11.010	53.02	4404.78
12.010	51.33	4377.50
13.010	49.73	4340.18
14.010	48.21	4285.90
15.010	46.77	4222.96
16.010	45.41	4148.19
17.010	44.12	4066.23
18.010	42.91	3981.22
19.010	41.77	3895.71
20.010	40.69	3805.64
21.010	39.67	3711.51
22.010	38.71	3618.71
23.010	37.80	3528.14
24.010	36.94	3428.49
25.010	36.13	3322.20
26.010	35.36	3215.85
27.011	34.64	3111.24
28.011	33.96	3008.78
29.011	33.32	2908.51
30.011	32.72	2810.37
31.011	32.15	2714.27
32.011	31.61	2620.13
33.010	31.09	2527.84
34.010	30.61	2437.36
35.010	30.15	2348.62
36.010	29.72	2261.57
37.010	29.31	2176.19
38.010	28.92	2092.45
39.009	28.55	2010.35
40.009	28.20	1929.90

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CHECK VALVE IS FREE
REACTOR HEAD IS ON
SJ54 V.O.T. = 19.3 Sec.

> TIME = 26.5 Sec. WHEN P= 35 psig

TABLE 4.2 ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATE

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TIME (SEC.)	ACCUMULATOR PRESSURE (PSIG)	FLOW RATE (GPM)
0.110	70.00	0.45
0.210	69.99	164.18
0.310	69.98	241.78
0.410	69.97	318.75
0.510	69.95	394.99
0.610	69.92	470.45
0.710	69.89	545.13
0.810	69.86	619.07
0.910	69.82	692.35
1.010	69.78	772.14
1.110	69.73	887.79
1.210	69.67	1010.82
1.310	69.61	1134.00
1.410	69.54	1256.11
1.510	69.47	1376.81
1.610	69.39	1495.91
1.710	69.30	1613.26
1.810	69.20	1728.74
1.910	69.10	1842.21
2.010	68.99	1947.45
3.010	67.70	2582.12
4.010	66.16	3015.34
5.010	64.48	3323.85
6.010	62.74	3532.50
7.010	60.97	3695.60
8.010	59.21	3790.50
9.010	57.49	3849.96
10.010	55.83	3865.05
11.010	54.23	3851.21
12.010	52.70	3819.73
13.010	51.25	3782.07
14.010	49.86	3733.64
15.010	48.55	3680.10
16.010	47.30	3619.34
17.010	46.11	3554.57
18.010	44.98	3488.44
19.010	43.91	3422.33
20.010	42.90	3353.34
21.010	41.93	3282.19
22.010	41.01	3212.35
23.010	40.14	3144.20
24.010	39.31	3077.69
25.010	38.52	3012.73
26.010	37.76	2949.23
27.011	37.04	2887.12
28.011	36.35	2826.31
29.011	35.69	2766.73
30.011	35.06	2708.33
31.011	34.46	2651.03
32.011	33.88	2594.79
33.010	33.32	2539.54
34.010	32.79	2485.24
35.010	32.28	2431.85
36.010	31.79	2379.31
37.010	31.32	2327.60
38.010	30.86	2276.66
39.009	30.43	2226.47
40.009	30.01	2176.98

CHECK VALVE MAXIMUM SWING = 60 DEG

REACTOR HEAD ISOL SJ54 OPENING STROKE TIME = 19.2 Sec.

> TIME = 30.1 Sec. WHEN [illegible]

TABLE 4.3 ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATE

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CHECK VALVE MAXIMUM SWING ANGLE = 30 DEG.

REACTOR HEAD IS ON SJ54 OPENING STROKE TIME = 19.3 SEC.

TIME (SEC.)	ACCUMULATOR PRESSURE (PSIG)	FLOW RATE (GPM)
0.110	70.00	0.45
0.210	69.99	164.18
0.310	69.98	241.78
0.410	69.97	318.75
0.510	69.95	394.99
0.610	69.92	470.45
0.710	69.89	545.13
0.810	69.86	619.07
0.910	69.82	692.35
1.010	69.78	772.14
1.110	69.73	887.79
1.210	69.67	1008.44
1.310	69.61	1124.97
1.410	69.54	1236.94
1.510	69.47	1344.11
1.610	69.39	1446.32
1.710	69.30	1543.50
1.810	69.21	1635.61
1.910	69.12	1722.68
2.010	69.02	1799.65
3.010	67.87	2226.40
4.010	66.57	2475.50
5.010	65.20	2624.60
6.010	63.81	2709.49
7.010	62.43	2765.92
8.010	61.08	2789.03
9.010	59.76	2796.51
10.010	58.48	2786.43
11.010	57.25	2766.27
12.010	56.06	2740.57
13.010	54.92	2712.97
14.010	53.82	2682.00
15.010	52.76	2649.57
16.010	51.75	2615.01
17.010	50.77	2579.47
18.010	49.83	2543.88
19.010	48.93	2508.46
20.010	48.07	2472.12
21.010	47.23	2435.41
22.010	46.43	2399.42
23.010	45.66	2364.17
24.010	44.91	2329.62
25.010	44.19	2295.74
26.010	43.50	2262.51
27.011	42.83	2229.88
28.011	42.19	2197.84
29.011	41.56	2166.36
30.011	40.96	2135.42
31.011	40.37	2104.99
32.011	39.81	2075.06
33.010	39.26	2045.60
34.010	38.73	2016.60
35.010	38.22	1988.04
36.010	37.72	1959.90
37.010	37.24	1932.17
38.010	36.77	1904.83
39.009	36.32	1877.87
40.009	35.88	1851.27

TABLE 4.4 ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATES

1.34

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CHECK VALVE IS FREE

REACTOR HEAD IS OFF

SJ 54 V.O.T. = 19.3 sec.

TIME (SEC.)	ACCUMULATOR PRESSURE (PSIG)	FLOW RATE (GPM)
0.110	70.00	0.45
0.210	69.99	164.61
0.310	69.98	242.41
0.410	69.97	319.57
0.510	69.94	395.99
0.610	69.92	471.63
0.710	69.89	546.48
0.810	69.86	620.59
0.910	69.82	694.04
1.010	69.78	774.60
1.110	69.73	892.36
1.210	69.67	1016.66
1.310	69.61	1140.75
1.410	69.54	1263.64
1.510	69.47	1385.05
1.610	69.38	1504.82
1.710	69.29	1622.79
1.810	69.20	1738.85
1.910	69.09	1852.87
2.010	68.98	1958.04
3.010	67.68	2645.61
4.010	66.08	3179.17
5.010	64.29	3599.07
6.010	62.40	3885.53
7.010	60.46	4122.29
8.010	58.51	4275.47
9.010	56.60	4384.67
10.010	54.74	4432.70
11.010	52.96	4438.69
12.010	51.26	4417.98
13.010	49.64	4387.92
14.010	48.11	4340.99
15.010	46.65	4285.74
16.010	45.28	4218.67
17.010	43.97	4144.63
18.010	42.74	4067.87
19.010	41.58	3990.75
20.010	40.48	3908.79
21.010	39.44	3822.80
22.010	38.46	3738.42
23.010	37.52	3656.46
24.010	36.64	3576.87
25.010	35.80	3497.20
26.010	35.00	3407.30
27.011	34.25	3315.17
28.011	33.53	3224.22
29.011	32.85	3135.23
30.011	32.21	3048.34
31.011	31.60	2963.48
32.011	31.02	2880.56
33.010	30.47	2799.50
34.010	29.94	2720.20
35.010	29.44	2642.58
36.010	28.97	2566.58
37.010	28.52	2492.12
38.010	28.08	2419.14
39.009	27.67	2347.60
40.009	27.28	2277.46
41.009	26.90	2208.67

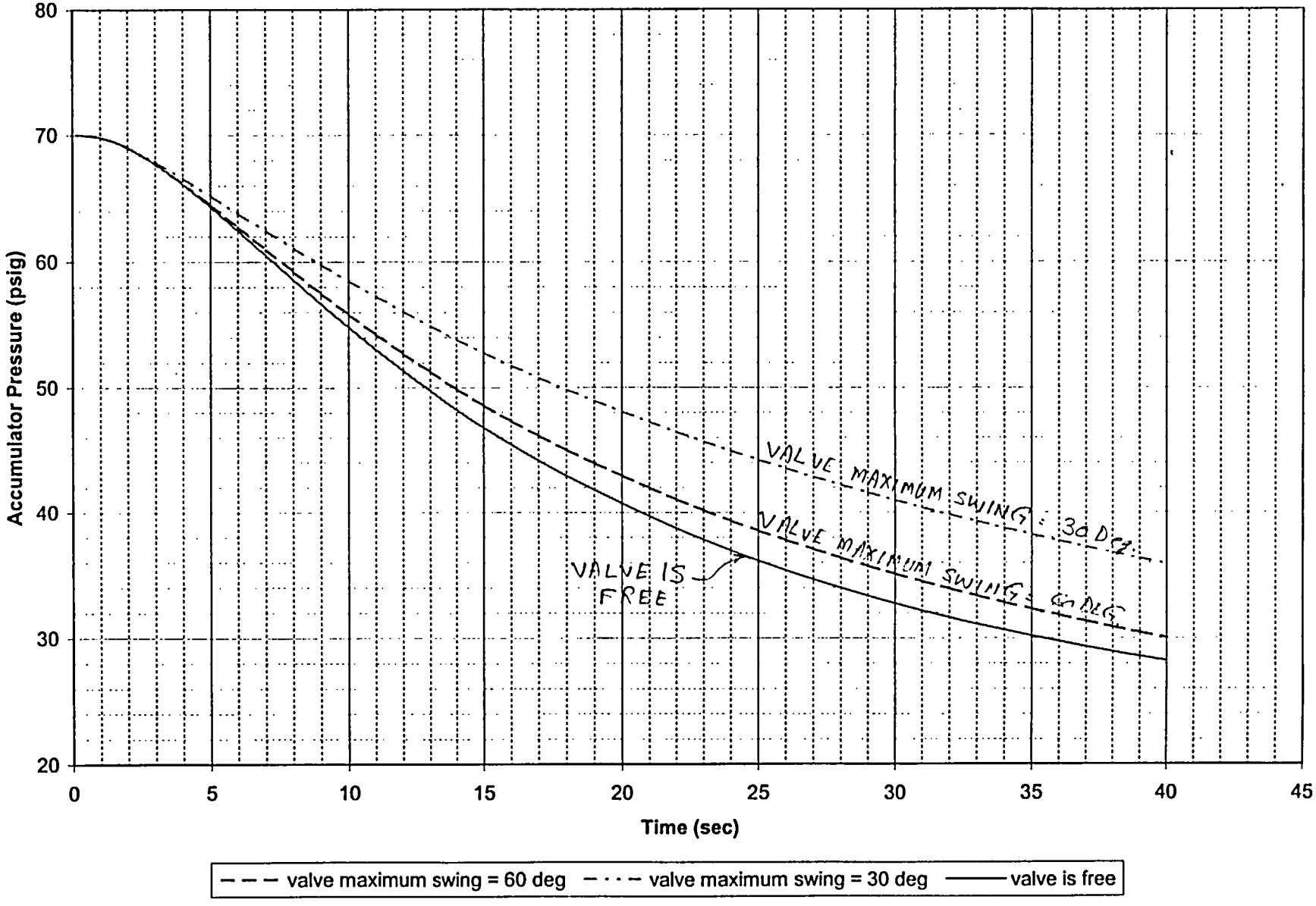

FIG 4.1 ACCUMULATOR PRESSURE TIME HISTORY (REACTOR HEAD ISOLATION V.O.T. = 19.2 Sec.)

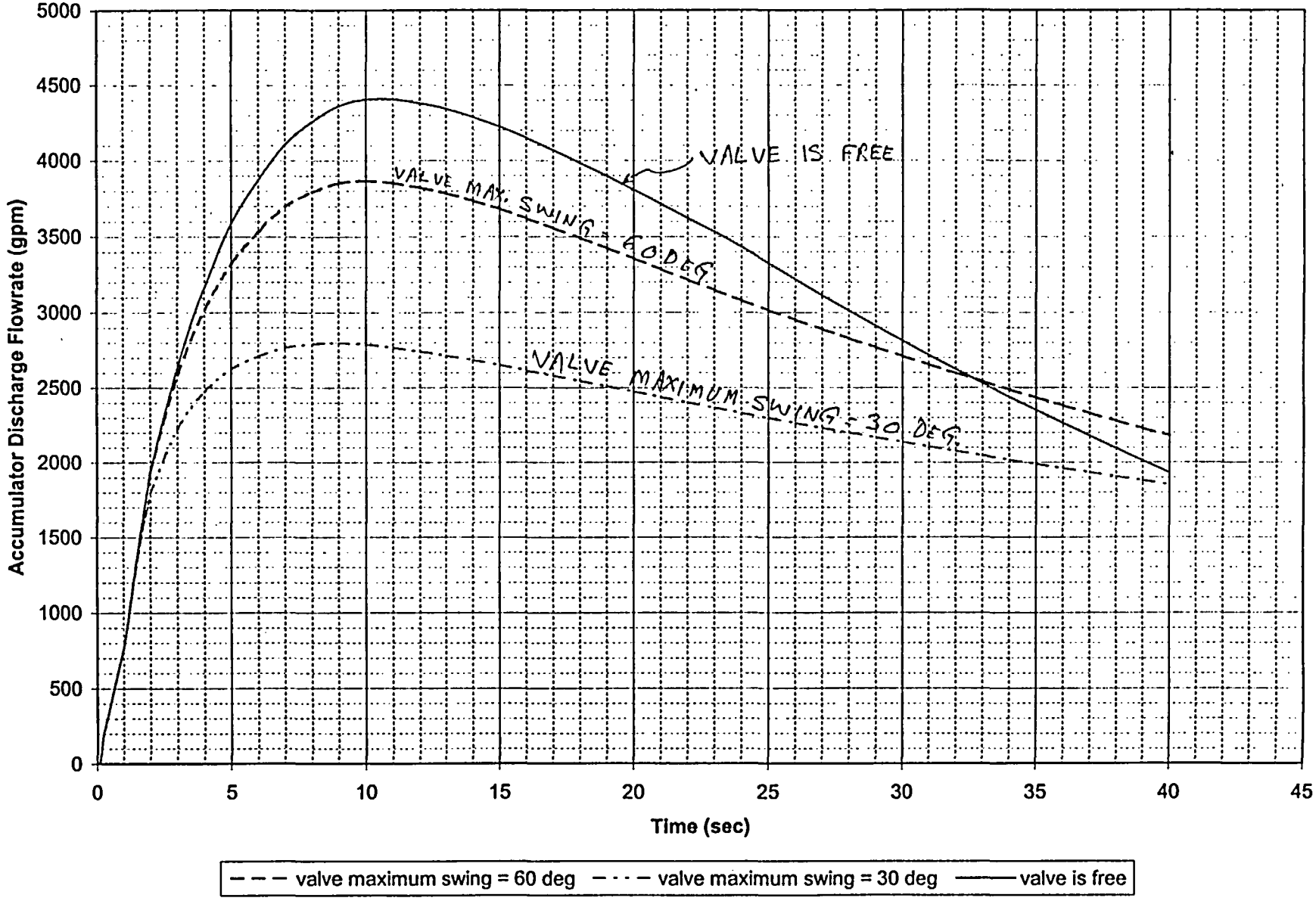

FIG 4.2 DISCHARGE FLOW RATE TIME HISTORIES (REACTOR HEAD LOSS V.O.T. = 19.3 Sec.)

FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 37

CALC. NO.: S-2-SJ-MDC-1394			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Oct. 20, 2003	2				
REVIEWER/VERIFIER,DATE		James Murphy 10/22/2003					

5. CONCLUSIONS

As calculated in Section 4.0, the pressure decay time from 70 psig to 35 psig is nearly 26.5 seconds when the check valves are free. The pressure decay time when the check valve swings to a maximum open angle of 60 degrees is 30.1 seconds. As recommended in SER 99-028 issued for Relief Request V-24 and V-25 on March 12, 1999, the acceptance criterion should be 1.5 second less than the pressure decay time for 60 degree swing case. This would reduce the acceptance criterion to 28.6 seconds. Also since the test is done with reactor head off, the pressure decay time acceptance criterion will be further reduced by 0.5 seconds because the pressure decay time with the reactor head off is 0.5 second less than the pressure decay time with the head on. Therefore, the acceptance criterion to declare the valves operable shall be 28.1 seconds.

It is clear from the plots of flow rate (Fig. 4.2), the maximum flow rate during the test exceeds the minimum flow rate required (3537 gpm corresponding to 20 ft/sec velocity in 0.394 ft^2 flow area) to open the valve to its full open position.

A 50.59 Safety Evaluation ~~and the commitment change forms are~~ IS attached to this calculation.

6. LIST OF REFERENCES

1. "APPLICATION GUIDELINES FOR CHECK VALVES IN NUCLEAR POWER PLANT", EPRI REPORT EPRI NP-5479. JAN 1988.
2. PSEG DRAWING 218213 Rev. 18; ACCUMULATOR AND ASSOCIATED PIPING ARRANGEMENT.
3. PSBP 109847. DELTA SOUTHERN CO. DRAWING OF UNIT 2 ACCUMULATOR.
4. S2.OP.TM-ZZ-0002, Rev. 7 (2)
5. SALEM 2 ACCUMULATOR VOLUME VS. % LEVEL CURVE
6. CBD DE-CB.RC-0042(Q) Rev. 1 PAGE F17-1.
7. PRESSURIZER WATER VOLUME VS. % LEVEL CURVE
8. LETTER FROM WESTINGHOUSE, NO. PSE-90-530 DT. MAY 21, 1990

ON-THE-SPOT CHANGES MUST BE ATTACHED FOR FIELD USE

S-2-SJ-MDC-1394 Rev. 2.
Att 1, P 1 of 4

ATTACHMENT 15 (Cont'd)

Orders # 60016464 Valve ID 21 SS 54

TEST DATA REVIEW

TEST PARAMETERS	TARGET SETPOINTS (Pre - Job)		TEST RESULTS (AS FOUND) TEST TYPE ____ TEST NO. ____ TEST DATE ____		TEST RESULTS (AS LEFT) TEST TYPE Static TEST NO. 18, 20 TEST DATE ____	
	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN
Target Thrust @ (CST)	n/a	N/A		N/A	12523	N/A
Min Req Torque @ (CST) (FT-LBS)	n/a	N/A		N/A	n/a	N/A
Maximum Allowable Thrust Reading Att. 13	85901	85901			69911	18784
Maximum Torque Switch Setting (TSS)	3.0	3.0	n/a		3.0	3.0
Maximum Allowable Torque (FT-LBS)	(C14) n/a (C16)			N/A	n/a	N/A
Assumed Stuffing Box Load (SBL) - (LBS) (packing load)	2500 ~~48-130-4~~		AVG: MAX:	AVG: MAX:	AVG: 2448 MAX: 3757	AVG: 2590 MAX: 3757
Maximum Stroke Time (SECONDS)	23.2	23.2			20.8	19.9
Open Bypass Time 15 - 50 %	N/A	n/a	N/A		N/A	46%
Indication SAT/UNSAT	None				Sat	Sat

Limit Seated

Data Obtained By: H. CAMPBELL Reviewed By: L Keene

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ATT 1. P 2 OF 4

ATTACHMENT 15 (Cont'd)

Orders # 60016465 Valve ID 225J54

TEST DATA REVIEW

TEST PARAMETERS	TARGET SETPOINTS (Pre - Job)		TEST RESULTS (AS FOUND) TEST TYPE ____ TEST NO. ____ TEST DATE ____		TEST RESULTS (AS LEFT) TEST TYPE Stat.c TEST NO. 15 TEST DATE ____	
Limit Sated	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN
LK ~~Target Thrust @ (CST)~~	n/a	N/A		N/A	37818	N/A
Min Req Torque @ (CST) (FT-LBS)	n/a	N/A		N/A	n/a	N/A
Maximum Allowable Thrust Reading Att. 13	85001	85601	n/a		80512	53637
Maximum Torque Switch Setting (TSS)	3.0	3.0			3.0	3.0
Maximum Allowable Torque (FT-LBS)	(C14) n/a (C16)			N/A	n/a	N/A
Assumed Stuffing Box Load (SBL) - (LBS) (packing load)	1500		AVG: MAX:	AVG: MAX:	AVG: 1860 MAX: 2690	AVG: 1763 MAX: 2380
Maximum Stroke Time (SECONDS)	Expected 23.2	ST 23.2			20.6	19.3
Open Bypass Time 15 - 50 %	N/A	* n/a	N/A		N/A	30% Missed
Indication SAT/UNSAT	None				Sat	Sat

Data Obtained By: J. RADFORD Reviewed By: L Keen

* Torque Switch Set @ 3.0/3.0

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ATT 1. p 3 of 4

ATTACHMENT 15 (Cont'd)

Orders #60016462 Valve ID 23 - SJ - 54

TEST DATA REVIEW

TEST PARAMETERS	TARGET SETPOINTS (Pre - Job)		TEST RESULTS (AS FOUND) TEST TYPE ____ TEST NO. ____ TEST DATE ____		TEST RESULTS (AS LEFT) TEST TYPE Static TEST NO. 9 & 11 TEST DATE 4/27/02	
	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN
Target Thrust @ (CST)	n/a	N/A		N/A	26817	N/A
Min Req Torque @ (CST) (FT-LBS)	n/a	N/A		N/A	438	N/A
Maximum Allowable Thrust Reading Att. 13	86066 ~~85965~~ LK	81352			90979	53304
Maximum Torque Switch Setting (TSS)	3.0	3.0	n/a		* 3.0	3.0
Maximum Allowable Torque (FT-LBS)	(C14) 1279 (C16) 2243			N/A	438 1297	N/A
Assumed Stuffing Box Load (SBL) - (LBS) (packing load)	2500		AVG: MAX:	AVG: MAX:	AVG: 3116 MAX: 3455	AVG: 2870 MAX: 4771
Maximum Stroke Time (SECONDS)	n/a				22.9	21.9
Open Bypass Time 15 - SEC'S	N/A	—	N/A		N/A	56.8
Indication SAT/UNSAT	None		✓		Sat	Sat

* Limit Seated

Data Obtained By: JRADFORD Reviewed By: C Keens

PEN AND INK CHANGES MUST BE ATTACHED FOR FIELD USE

S-2-SJ-MDC-1394, Rev. 2
ATT 1, Pg 4 OF 4,

ATTACHMENT 15 (Cont'd)

Orders # 600 16465 Valve ID 2151 54

TEST DATA REVIEW

TEST PARAMETERS	TARGET SETPOINTS (Pre - Job)		TEST RESULTS (AS FOUND) TEST TYPE ____ TEST NO. ____ TEST DATE ____		TEST RESULTS (AS LEFT) TEST TYPE Static TEST NO. 10 & 12 TEST DATE 4/26/02	
	CLOSE	OPEN	CLOSE	OPEN	CLOSE	OPEN
Target Thrust @ (CST)	n/a	N/A		N/A	11685	N/A
Min Req Torque @ (CST) (FT-LBS)	n/a	N/A		N/A	n/a	N/A
Maximum Allowable Thrust Reading Att. 13	85901	85901	n/a		77627	40900
Maximum Torque Switch Setting (TSS)	3.0	3.0			3.0	3.0
Maximum Allowable Torque (FT-LBS)	(C14) n/a (C16)			N/A	n/a	N/A
Assumed Stuffing Box Load (SBL) - (LBS) (packing load)	2500 Ib +30%		AVG: MAX	AVG: MAX:	AVG: 2835 MAX: 3339	AVG: 3153 MAX: 3339
Maximum Stroke Time (SECONDS)	13.2	13.2			11.7	20.6
Open Bypass Time 15 - 50 %	N/A	—	N/A		N/A	37%
Indication SAT/UNSAT	None				Sat	Sat

Data Obtained By: H. CAMPBELL Reviewed By: L. Keene

FORM-1

CERTIFICATION FOR DESIGN VERIFICATION
(SAP Standard Text Key "NR/CDV1")

Reference No. S-2-SJ-MDC-1394, Revision 2

SUMMARY STATEMENT

The calculation revision affected pages were reviewed line-by-line. All revised input was reviewed and it corresponding output was reviewed and found acceptable. The methodology of devising the acceptance criteria is equivalent to the SER and is considered acceptable. An additional margin of 0.5 seconds was given to the acceptance criteria to account for when the IST is done with the reactor head is off is acceptable and conservative.

The individual named below in the right column hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated. SAP Order/Operation final confirmations are the legal equivalent of signatures.

Design Verifier Assigned By (print name of Manager/Director)*	Name of Design Verifier* / Date
Paul Lindsay	James Murphy / October 21, 2003

*If the Manager/Supervisor acts as the Design Verifier, the name of the next higher level of technical management is required in the left column.

FORM-2

COMMENT / RESOLUTION FORM FOR DESIGN DOCUMENT REVIEW/CHECKING OR DESIGN VERIFICATION (SAP Standard Text Key "NR/CDV2")

REFERENCE DOCUMENT NO. /REV.	S-2-SJ-MDC-1394, Revision 2

COMMENTS

1.0 Section 1: See minor editorial comments on marked up sheet. ✓

2.0 Calculation needs to Reference the following DCPs for the following valves: ✓
- 21SJ54 - DCP 80017352
- 22SJ54 - DCP 80017353
- 23SJ54 - DCP 80017354
- 24SJ54 - DCP 80017355

3.0 Section 3.1 & Figure 2: Elevation of taps for Accumulator Level could not be verified through References given. Drawing 218213 states that drawings RH23, sheet 16 and 17, give the elevation of taps to be approximately 91.46 feet and 85.92 feet versus the calculation values of 92.03 and 86.49. This is a difference of 0.57 feet and 0.57 feet respectively. Make necessary adjustments. ✓

4.0 Reference 4 (S2.OP-DD.ZZ-OD74) is now voided and should be replaced by S2.OP-TM.ZZ-0002, revision 7. ✓

5.0 Section 3.4: Valve stroke times are for closing stroke times but the calculation is using it for valve opening stroke times. Make a note in the calculation that the two are approximately equal (if they are). If opening stroke times are different then reanalyze the calculation. ✓

6.0 Add calculation and revision number to figures 4.1 and 4.2. ✓

7.0 Since the SER actually used 1.5 seconds from the decay time of the 60 degree case to determine the acceptance criteria, the calculation should also use 1.5 seconds from 30.8 seconds plus the additional 0.5 seconds for the reactor head off difference for a new acceptance criteria of 28.8 seconds. ✓

RESOLUTION

1. DONE
2. ALL FOUR DCP'S WERE LISTED.
3. ELEVATIONS WERE REVISED. ANALYSIS WAS REVISED ACCORDINGLY.
4. DONE
5. OPENING STROKE TIMES WERE USED. ATTACHMENT 1 IS INCLUDED.
6. DONE
7. DONE

ACCEPTANCE OF RESOLUTION

All resolution responses are acceptable.

James Murphy	October 21, 2003	Vijay Chandra	OCT. 21, 2003
SUBMITTED BY	DATE	RESOLVED BY	DATE

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-2-SJ-MDC-1394 Revision: 2

Title: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

Activity Description: The acceptance criteria for Accumulator pressure decay time has been increased due to an increased stroke time of the SJ54 valves (see Screening for a more detailed description).

Note that more than one process may apply. If unsure of any answer, contact the cognizant department for guidance.

Activities Affected	No	Yes	Action
1. Does the proposed activity involve a change to the Technical Specifications or the Operating License?	☒	☐	If Yes, contact Licensing; process in accordance with NC.NA-AP.ZZ-0035(Q) LCR No. _____
2. Does the proposed activity involve a change to the Quality Assurance Plan? Examples: • Changes to Chapter 17.2 of UFSAR	☒	☐	If Yes, contact Quality Assessment; process in accordance with ND.QN-AP.ZZ-0003(Q)
3. Does the proposed activity involve a change to the Security Plan? Examples: • Change program in NC.NA-AP.ZZ-0033(Q) • Change indoor/outdoor security lighting • Placement of component or structure (permanent or temporary) within 20 feet of perimeter fence • Obstruct field of view from any manned post • Interfere with security monitoring device capability • Change access to any protected or vital area •	☒	☐	If Yes, contact Security Department; process in accordance with NC.NA-AP.ZZ-0033(Q)
4. Does the proposed activity involve a change to the Emergency Plan? Examples: • Change ODCM/accident source term • Change liquid or gaseous effluent release path • Affect radiation monitoring instrumentation or EOP/AOP setpoints used in classifying accident severity • Affect emergency response facilities or personnel, including control rm • Affect communications, computers, information systems or Met tower	☒	☐	If Yes, contact Emergency Preparedness
5. Does the proposed activity involve a change to the ISI Program Plan? Examples: • Affect Nuclear Class 1, 2, or 3 Piping, Vessels, or Supports (Guidance in NC.DE-AP.ZZ-0007(Q) Form-11)	☒	☐	If Yes, contact Reliability Programs ISI/IST; process in accordance with NC.NA-AP.ZZ-0027(Q)
6. Does the proposed activity involve a change to the IST Program Plan? Examples: • Affect the design or operating parameters of a Nuclear Class 1, 2, or 3 Pump or Valve (Guidance in NC.DE-AP.ZZ-0007(Q) Form-15)	☒	☐	If Yes, contact Reliability Programs ISI/IST; process in accordance with NC.NA-AP.ZZ-0070(Q)

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-2-SJ-MDC-1394 Revision: 2
Title: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

Activities Affected	No	Yes	Action
7. Does the proposed activity involve a change to the Fire Protection Program? Examples: • Change program in NC.DE-PS.ZZ-0001(Q) • Change combustible loading of safety related space • Change or affect fire detection system • Change or affect fire suppression system/component • Change fire doors, dampers, penetration seal or barriers • See NC.DE-AP.ZZ-0007, Forms 3, 4 and 14 for details	☒	☐	If Yes, contact Design Engineering; process in accordance with NC.DE-PS.ZZ-0001(Q)
8. Does the proposed activity involve Maintenance which restores SSCs to their original design and configuration? Examples: • CM or PM activity • Implements an approved Design Change? • Troubleshooting (which does not require 50.59 screen per SH.MD-AP.ZZ-0002)	☒	☐	If Yes, process in accordance with NC.WM-AP.ZZ-0001(Q)
9. Is the proposed activity a temporary change (T-Mod) which ***meets all the following conditions***? • Directly supports maintenance and is NOT a compensatory measure to ensure SSC operability. • Will be in effect at power operation **less than 90 days.** • Plant will be restored to design configuration upon completion. • SSCs will NOT be operated in a manner that could impact the function or operability of a safety related or Important-to-Safety system.	☒	☐	If Yes, contact Engineering; process in accordance with NC.DE-AP.ZZ-0030(Q)
10. Does the proposed activity consist of changes to maintenance procedures which do NOT affect SSC design, performance, operation or control? Note: Procedure information affecting SSC design, performance, operation or control, including Tech Spec required surveillance and inspection, ***require 50.59 screening***. Examples include acceptance criteria for valve stroke times or other SSC function, torque values, and types of materials (e.g., gaskets, elastomers, lubricants, etc.)	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q)
11. Does the proposed activity involve a *minor* UFSAR change (including documents incorporated by reference)? Examples: • Reformatting, simplification or clarifications that do not change the meaning or substance of information • Removes obsolete or redundant information or excessive detail • Corrects inconsistencies within the UFSAR • Minor correction of drawings (such as mislabeled ID)	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0035(Q)
12. Does the proposed activity involve a change to an Administrative Procedure (NAP, SAP or DAP) governing the conduct of station operations? Examples: • Organization changes/position titles • Work control/ modification processes	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q) and NC.DM-AP.ZZ-0001(Q)

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-2-SJ-MDC-1394 Revision: 2
Title: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

Activities Affected	No	Yes	Action
13. Does the proposed activity involve a change to a regulatory commitment?	☐	☒	If Yes, contact Licensing and process in accordance with NC.NA-AP.ZZ-0030(Q)
14. Does the activity impact other programs controlled by regulations, operating license or Tech Spec? Examples: • Chemical Controls Program • NJ "Right-to-know" regulations • OSHA regulations • NJPDES Permit conditions • State and/or local building, electrical, plumbing, storm water management or "other" codes and standards • 10CFR20 occupational exposure	☒	☐	If Yes, process in accordance with applicable procedures such as: NC.NA-AP.ZZ-0038(Q) NC.LR-AP.ZZ-0037(Q)
15. Has the activity already received a **10CFR50.59 Screen or Evaluation** under another process? Examples: • Calculation • Design Change Package or OWD change • Procedure for a Test or Experiment • DR/Nonconformance • Incorporation of previously approved UFSAR change	☒	☐	Take credit for **10CFR50.59 Screen or Evaluation** already performed. ID: _____

If any other program or regulation *may be* affected by the proposed activity, contact the department indicated for further review in accordance with the governing procedure. If responsible department determines program is not affected, attach written explanation.

If ALL of the answers on the previous pages are "No," then check A below:

A. ☐ None of the activity is controlled by any of the processes above, therefore a 10CFR50.59 review **IS** required. Complete a 10CFR50.59 screen.

If one or more of the answers on the previous pages are "Yes," then check either B or C below as appropriate and explain the regulatory processes which govern the change:

B. ☐ All aspects of the activity are controlled by one or more of the processes above, therefore a 10CFR50.59 review **IS NOT** required.

C. ☒ Only part of the activity is controlled by the processes above, therefore a 10CFR50.59 review **IS** required. Complete a 50.59 screen.

Explanation: _____

Preparer: James Murphy (Printed Name) _____ (Signature) October 22, 2003 (Date)

Reviewer: Vijay Chandra (Printed Name) Vijay Chandra (Signature) October 22, 2003 (Date)

FORM-2
10CFR50.59 SCREENING

Revision 0

Document I.D.: S-2-SJ-MDC-1394 Revision: 2

Title: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

Applicability:

___ Salem 1	___ Salem 3 (Gas Turbine)	___ PSEG Common
X Salem 2	___ Hope Creek	
___ Salem 1 & 2 Common	___ Hope Creek & Salem Common	

1. Brief Description of activity
Change to: ☒ Facility ☒ Procedures ☐ Methodology ☐ Test/Experiment ☐ Fission Barrier

What is being changed and why

Surveillance test procedure S2.OP-ST.SJ-0006, Revision 8, tests that the forward flow of check valves SJ55 and SJ56 for Accumulators Numbers 21, 22, 23, and 24 are unobstructed and the valve disc is non-degraded or free moving. The procedure and Relief Requests V-24 and V-25 satisfy Technical Specification section 4.0.5 requiring that in-service testing of ASME Code Class 1, 2 and 3 components be performed in accordance with ASME Section XI. The Accumulator check valves are said to be full open in the existing ST procedure when the Accumulator pressure reaches 35 psig in a time period no longer than 27 seconds. The justification for the time limit acceptance criteria is found in design calculation S-2-SJ-MDC-1394, Revision 1. The NRC accepted the results of the calculation (with some modifications) as a sufficient means of testing the Accumulator check valves (Reference SER 99-028).

Since the issuance of SER 99-028, the time to stroke isolation valve SJ54 for Accumulator Numbers 21, 22, 23, and 24 has increased (DCPs 80017352, 80017353, 80017354 and 80017355). The DCPs increased the stroke times and neglected to incorporate the appropriate configuration changes in design documentation. As a result of the increased stroke time of SJ54, the pressure decay time in 2R13 exceeded 27.0 seconds for 21 Accumulator (Reference Notification 20162455). Increasing the stroke time of SJ54 will increase the acceptance criteria for forward flow of the Accumulator check valves. As a result of the increased stroke times, design calculation S-2-SJ-MDC-1394 was revised to determine the appropriate acceptance criteria of 28.1 seconds.

Design Functions

The design function of check valves SJ55 and SJ56 is to freely open during a large break loss of coolant accident (LOCA) and provide a flow path for the Safety Injection (SI) Accumulator discharge to the cold legs of the Reactor Coolant System (RCS). The check valves must be capable of freely closing to prevent divergence of SI and Recirculation flow after Accumulator discharge. The check valves must also prevent leakage from the RCS back into the Accumulator when they are normally closed.

Effect on Design Functions

The revision of S-2-SJ-MDC-1394 to increase the forward flow acceptance criteria from 27 seconds to 28.1 seconds does not affect the check valves capabilities of opening, closing or the prevention of back leakage. It does not affect the reliability of the check valves to perform it design function of opening, closing or to prevent back leakage. It does not affect the time it would take for the check valves to open or close during a postulated accident. It does not affect the check valves ability to prevent back flow from the RCS to the Accumulator during normal operating conditions.

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The revised acceptance criteria does not alter the performance of the check valves during a design basis event. This is used to validate that the check valves achieve the full open position and as precursor to indicate valve obstruction or degradation.

2. Summarize regulatory change determination (Other applicable regulatory processes identified on Form-1)

   The proposed activity requires a change to SER 99-028, a regulatory commitment.

3. Does the proposed activity require a change to Technical Specifications or the Operating License? Yes ☐ No ☒

   If YES, then a License Amendment is required prior to implementation of the activity.

   LCR Number: N/A

4. Does the proposal require a UFSAR change? Yes ☐ No ☒

   UFSAR Change Notice No N/A (See below)

   Describe UFSAR change:

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5. 50.59 Screening Questions

	Answer ALL screening questions	Yes	No
a.	Does the proposed activity involve a change to the facility that *adversely* affects a UFSAR described design function?	☐	☒
b.	Does the proposed activity involve a change to procedures that *adversely* affects how UFSAR described SSC design functions are performed or controlled?	☐	☒
c.	Does the proposed activity revise or replace evaluation methodology described in the UFSAR that either: • is used in the safety analyses or • establishes the design bases?	☐	☒
d.	Does the proposed activity involve a test or experiment NOT described in the UFSAR? (SSC is utilized or controlled in a manner that is outside the reference bounds of its design or inconsistent with analyses or descriptions in the UFSAR)	☐	☒
e.	Does the proposed activity *affect* a design basis limit for a fission product barrier (fuel cladding, reactor coolant system boundary or containment?	☐	☒

6. If a 50.59 Evaluation is not required, provide justification for that determination:

Calculation S-2-SJ-MDC-1394, Revision 2, determined that the Accumulator would reach a pressure of 35 psig from 70 psig in 26.5 seconds with a free check valve disc. The time span is based on an increased stroke time of SJ54 , with the reactor head on and non-degraded check valve discs that are free floating and able to fully open to approximately a travel angle of 72.4 degrees. Partially degraded valves whose discs only traveled 60 degrees from the fully closed position were able to decay the Accumulator from 70 psig to 35 psig in 30.1 seconds. Recent measured decay times from 2R13 indicate that the Accumulator pressure decay times are in the range of 24.0 to 27.9 seconds (21 Accumulator is 27.9 seconds; 22 Accumulator is 24.4 seconds; 23 Accumulator is 24.0 seconds; 24 Accumulator is 27.0 seconds: Reference Operation Logs on October 15, 2003 for Procedure S2.OP-ST.SJ-0006). The revised acceptance criteria used in the ST procedure is chosen based on a decay time that is less than the decay time determined for the case with the valve 60 degrees open and greater than the decay time determined for the free disc case. In addition, the calculation states the decay time is 0.5 second less when the reactor head is off. In order to be consistent with SER 99-028, the acceptance criteria is determined to be 1.5 seconds less than the decay time for the 60 degree case and an additional 0.5 second less for when the IST is performed with the reactor head off or 28.1 seconds. The acceptance criteria of 28.1 seconds is considered to bound the analysis data and all future In-service Tests to ensure the Accumulator check valves are non-degraded and unobstructed.

The proposed activity does not involve a change to the facility that adversely affects a UFSAR described design function. The design functions of the Accumulator check valves as stated in Section 1 of this Screening are to freely open without obstruction during a LOCA and provide a flow path for the SI Accumulator discharge to the cold legs of the RCS. The check valves must be capable of closing to prevent divergence of SI and Recirculation flow after Accumulator discharge. The check valves must also prevent leakage from the RCS back into the Accumulator when they are normally closed. The In-service Test determines the time the Accumulator pressure decays to ensure the check valves are non-degraded and free of obstruction. The decay

time has changed due to a longer stroke time of motor-operated SJ54 valve during the IST. During normal operating conditions though, the SJ54 valves are normally open to ensure an unobstructed and free flow path from the Accumulator to the RCS. Therefore, the proposed activity of increasing the acceptable value of the Accumulator's pressure decay time does not hinder or alter by any means the check valves' abilities to perform their design functions to freely open, close or prevent back leakage.

The proposed activity does not involve a change to procedures that adversely affects how UFSAR described SSC design functions are performed or controlled. The operation of the Accumulator check valves is not specifically proceduralized in the UFSAR, but Section 5.2.8 does state how the Accumulator check valves should be inspected. The Salem UFSAR states that In-service Testing of ASME Code Class 1, 2 and 3 components be performed in accordance with ASME Section XI. This is accomplished through Procedure S2.OP-ST.SJ-0006 and Relief Requests V-24 and V-25. The proposed change does not alter the purpose or methodology of the procedure or adversely affect the way in which the check valves will operate during a postulated accident. The increased acceptance criteria of decay time will ensure the Accumulator check valves are non-degraded and unobstructed. Therefore, the proposed activity does not adversely affect how the UFSAR described design functions are performed or controlled.

The proposed activity does not revise or replace evaluation methodology described in the UFSAR that is used in safety analyses or to establish design bases. Calculation S-2-SJ-MDC-1394 is used to establish acceptance criteria to demonstrate the time it would take to decay the Accumulator pressure with non-degraded and unobstructed check valves. Although the methodology and results of the calculation are not used in safety analyses or used to establish design bases, it can still be shown that the methodology has not been altered to establish the new acceptance criteria for decay time. The only revision to the calculation is the input parameter for stroke time for valve SJ54 and does not constitute a fundamental change to the methodology used to establish the decay time.

The revision of the calculation to determine pressure decay time does not involve a test or experiment of any kind. Therefore, the proposed activity does not involve a test or experiment NOT described in the UFSAR.

The design functions of the Accumulator check valves and consequently the Accumulator are unaffected. Therefore, the Accumulator will deliver the required flow to the RCS as analyzed during a postulated accident and the design basis limits for a fission product barrier are unaffected.

All the Screening questions, as explained in section 5 and 6, are answered NO. Therefore, further evaluation is not warranted.

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6. Conclusions:

☒ If all Screening questions in Section 5 are answered NO, then a 50.59 Evaluation is not required.

☐ If any Screening question is YES, then perform a 50.59 Evaluation (Form-3).

50.59 Evaluation No: _____

7. List the documents reviewed containing relevant information, including section numbers (UFSAR, Tech Specs, and others):

UFSAR Sections

5.2.7.1.5	Intersystem Leakage Detection, Revision 20
5.2.8	Inservice Inspection Program, Revision 20
5.5.3	Reactor Coolant Piping, Revision 20
6.3	Emergency Core Cooling System, Revision 20

UFSAR Tables

Table 6.3-10	Accumulator Inleakage, Revision 6

Technical Specifications

4.0	Salem Unit 1 Applicability, Surveillance Requirements, sub-section 4.0.5, Amendment 256
4.0	Salem Unit 2 Applicability, Surveillance Requirements, sub-section 4.0.5, Amendment 237
SER 99-028	Relief Requests V-24 and V-25 Regarding Testing Of Accumulator Check Valves, Salem Nuclear Generating Station, Unit Nos. 1 and 2 (TAC No. M98259 and M98280), March 12, 1999.

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COMPLETION AND APPROVAL

PREPARER (SIGN)	October 21, 2003 DATE	James Murphy NAME (PRINT)	February 20, 2004 QUAL EXPIRES
REVIEWER (SIGN)	October 22, 2003 DATE	Vijay Chandra NAME (PRINT)	February 20, 2004 QUAL EXPIRES
APPROVAL (SIGN)	October 22, 2003 DATE	Paul Lindsay NAME (PRINT)	3/5/04 QUAL EXPIRES