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JUL 0 9 2004

LR-N04-0299

PSEG Nuclear LLC

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

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
S1-RR-04-V01 and V02
SALEM GENERATING STATION UNIT 1
FACILITY OPERATING LICENSES NO. DPR-70
DOCKET NO. 50-272

References:

PSEG Letter LR-N96437, Dated December 26, 1996, "Inservice Testing Program Relief Request Salem Generating Station Unit Nos. 1 and 2".

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

NRC Letter dated January 2, 2004, "Relief Requests S2-RR-03-V01 and S2-RR-03-V02 Regarding Testing of Accumulator Check Valves Salem Nuclear Generating Station Unit 2 (TAC NO. MC1102)".

Pursuant to 10CFR50.55a(f)(5)(iii), PSEG Nuclear is submitting, in Attachment 1 to this letter, Inservice Testing (IST) Relief Requests S1-RR-04-V01 and V02 for NRC approval. These requests address Salem Unit 1 and are revisions to the engineering basis for the previously approved Relief Requests 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.

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 safety injection (SI) Accumulator Outlet Check Valves 11SJ55, 12SJ55, 13SJ55, 14SJ55, 11SJ56, 12SJ56, 13SJ56 and, 14SJ56 could perform their safety function.

A047

On March 12, 1999 the NRC approved Relief Requests V-24 and V-25 that imposed an acceptance criterion of 27.0 seconds for alternate testing. In addition, relief requests S2-RR-03-V01 and S2-RR-03-V02 sought to increase the acceptance criteria from 27 to 28.1 seconds to reflect new system dynamics due to modifications of the safety injection (SI) Accumulator Isolation Valves 21SJ54, 22SJ54, 23SJ54, 24SJ54 valves. These relief requests were approved in a letter dated January 2, 2004 (TAC No. MC1102).

The same modifications for Salem Unit 1 Accumulator Isolation Valves 13SJ54 and 14SJ54 were made during 1R16. Similar changes are planned for 11SJ54 and 12SJ54 during 1R17. The modification increases the valve stroke time to address a maintenance issue and results in an increase in the acceptance criteria from 27 to 28.1 seconds for the SJ55 and SJ56 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. The engineering calculations for Relief Requests S1-RR-04-V01 and V02 change the acceptance criterion to 28.1 seconds due to physical plant changes, which altered the original testing acceptance criterion basis.

Accumulator Isolation Valve testing is performed during shutdown prior to entering refueling. Since, Accumulator Isolation Valves 13SJ54 and 14SJ54 have been modified, this relief request allows valves 13SJ55, 56 and 14SJ55, 56 to be tested to the 28.1 second acceptance criteria. Accumulator Isolation Valves 11SJ54 and 12SJ54 are being modified during 1R17, valves 11SJ55, 56 and 12SJ55, 56 will be tested to the current 27 second acceptance criteria for 1R17 and the 28.1 second acceptance criteria in subsequent refueling outages.

Attachment 1 to this letter contains the specific relief requests, S1-RR-04-V01 and V02. Attachment 2 to this letter provides the General Approach Proposed For Full Open Testing Of Accumulator Check Valves. Attachment 3 to this letter is calculation S-1-SJ-MDC-1539 Rev 1, "Accumulator Pressure Decay Time During Discharge Test", which is used to determine the acceptance criteria associated with the Alternate Testing. This calculation has been revised based on the revised opening time of the SJ54 valves.

This relief request is applicable to PSEG Nuclear Salem Generating Station Unit 1. PSEG Nuclear requests that the NRC approve this request by August 31, 2005 in order to support Salem Unit 1 refueling outage 1R17.

Should you have any questions regarding this request, please contact Mr. Michael Mosier at 856-339-5434.

Sincerely,

Steven R. Mannon
Manager – Nuclear Safety and Licensing

Attachments

C: Regional Administrator – NRC Region I
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King of Prussia, PA 19406

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U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

USNRC Senior Resident Inspector - Salem (X24)

Mr. K. Tosch, Manager IV
Bureau of Nuclear Engineering
PO Box 415
Trenton, New Jersey 08625

Attachment 1

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
S1-RR-04-V01 and V02
SALEM GENERATING STATION UNIT 1

FACILITY OPERATING LICENSE NO. DPR-70
DOCKET NO. 50-272

Salem Unit 1 Inservice Test Program
VALVE RELIEF REQUEST -
S1-RR-04-V01

COMPONENTS: 11SJ55, 12SJ55, 13SJ55 and, 14SJ55

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 Loss of Coolant Accident (LOCA) to provide a flow path for Safety Injection (SI) accumulator discharge to the Reactor Coolant System (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 that 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 OMa-1988, 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 over pressurization 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. 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 refueling 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 of 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-1-SJ-MDC-1539 Rev. 1, "Accumulator Pressure Decay Time 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 Technical Specification (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 Unit 1 Inservice Test Program
VALVE RELIEF REQUEST -
S1-RR-04-V02

COMPONENTS: 11SJ56, 12SJ56, 13SJ56 and, 14SJ56

FUNCTION:

These check valves are located in the discharge lines from the respective safety injection accumulators downstream of the branch connection from Residual Heat Removal System (RHR). The valves perform an active safety function in the open position. The valves must be capable of opening during, a large break Loss of Coolant Accident (LOCA) to provide a flow path for Safety Injection (SI) accumulator discharge to the Reactor Coolant System (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 OMa-1988, 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 over pressurization 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 refueling 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-1-SJ-MDC-1539 Rev. 1, "Accumulator Pressure Decay Time 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 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.

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 Technical Specification (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
S1-RR-04-V01 and V02
SALEM GENERATING STATION UNIT 1

FACILITY OPERATING LICENSE NO. DPR-70
DOCKET NO. 50-272

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

PSEG procedure S1.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:

- 11SJ55 and 11SJ56 - 13 Accumulator Discharge to Cold Leg
- 12SJ55 and 12SJ56 - 14 Accumulator Discharge to Cold Leg
- 13SJ55 and 13SJ56 - 13 Accumulator Discharge to Cold Leg
- 14SJ55 and 14SJ56 - 14 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 70 psig. Flow is initiated by opening the tank motor operated valve (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 to prevent injection of nitrogen gas into the reactor coolant system (RCS). Velocities achieved should also be sufficient to fully stroke the valves, according to calculation.

The bases for the testing are captured in Calculation No. S-1-SJ-MDC-1539 Rev.1, Accumulator Pressure Decay Time 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 describes 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.
- Failure of testing to result in corrective action for both SJ55 and 56.

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. The 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.

General Approach Proposed For Full Open Testing Of Accumulator Check Valves

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:

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

Attachment 3

INSERVICE INSPECTION PROGRAM RELIEF REQUESTS
S1-RR-04-V01 and V02
SALEM GENERATING STATION UNIT 1

FACILITY OPERATING LICENSE NO. DPR-70
DOCKET NO. 50-272

Calculation S-1-SJ-MDC-1539 (Rev 1)

OUTSTANDING CHANGES MUST BE ATTACHED FOR WORKING COPY
20040706

NC.DE-AP.ZZ-0002(Q)

FORM 1

CALC NO.: S-1-SJ-MDC-1539 REVISION: 1	CALCULATION COVER SHEET	Page 1 of 26

CALC. TITLE:	Accumulator Pressure Decay Time During Discharge Test						
# SHTS (CALC):	26	# ATT / # SHTS:	0/0	# IDV/50.59 SHTS:	4	# TOTAL SHTS:	30

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.):

The calculation was revised because the opening stroke times of 13SJ54 and 14SJ54 valves will be increased. The opening times of 11SJ54 and 12 SJ54 valves will remain the same. The change will be done under DCP's 80017350 and 80017351.

PURPOSE:

The purpose of this calculation is to determine the acceptance criterion for the pressure decay time of the accumulator discharge test in support of the testing of SJ55 and SJ56 check valves.

CONCLUSIONS:

1. The acceptance criterion for the pressure decay time for the 11 and 12 loops that have SJ54 opening stroke time of 12.5 seconds is 27 seconds.

2. The acceptance criterion for the pressure decay time for the 13 and 14 loops that have SJ54 opening stroke time of 22 seconds is 28.1 seconds (reactor head is off).

	Printed Name / Signature	Date
ORIGINATOR/COMPANY NAME:	Vijay Chandra/PSEG Vijay Chandra	May 13, 2004
REVIEWER/COMPANY NAME:	~~James Murphy~~ N/A	May 13, 2004
VERIFIER/COMPANY NAME:	James Murphy	May 13, 2004
PSEG SUPERVISOR APPROVAL:	Paul Lindsay	5/24/04

PSE&G

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST		ID NO. S-1-SJ-MDC-1539				SHEET 2 OF 26
		REFERENCE				
ORIGINATOR	V.CHANDRA	0	V.CHANDRA	1		
DATE	24 JAN 1996		25 FEB 2004			
PEER REVIEW	ART GARCIA		JM			
DATE	cmg 2/2/96		3/18/04			

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FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 3

CALC. NO.: S-1-SJ-MDC-1539			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Feb. 25, 2004	1				
REVIEWER/VERIFIER,DATE		VM 3/18/04					

Revision History

Revision No.	Date	Description
0	February 5, 1996	Original Issue
1	February 25, 2004	Added analysis for the loops whose SJ54 valve opening stroke time was increased to 22 seconds.

Page Revision Index

Page	Revision	Page	Revision	Page	Revision	Page	Revision
1	1	9	0	17	0	25	1
2	1	10	0	18	1	26	1
3	1	11	1	19	0		
4	1	12	0	20	0		
5	1	13	0	21	1		
6	0	14	0	22	1		
7	0	15	0	23	1		
8	0	16	1	24	0		

PSEG CALCULATION CONTINUATION SHEET	TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST		ID NO. S-1-SJ-MDC-1539 REFERENCE				SHEET 4 OF 26
	ORIGINATOR	V.CHANDRA D	V.CHANDRA 1				
	DATE	23JAN1996	03MAR2004				
	PEER REVIEW	Cmag	JM				
	DATE	2-1-96	3/18/04				

1. INTRODUCTION:

ACCUMULATOR DUMP TEST IS DONE IN MODE 6 USING PROCEDURE S1.OP.-ST.SJ-0006(Q) Rev 5 FOR SALEM UNIT 1. THE PURPOSE OF THE TEST IS TO DEMONSTRATE OPERABILITY OF DISCHARGE PIPING CHECK VALVES SJ55 AND SJ56. 1

IN REF. [1] AN ACCEPTANCE CRITERION WAS ESTABLISHED FOR ACCUMULATOR PRESSURE DECAY TIME FOR SALEM UNIT 2. ALSO, THE PRESSURE DECAY TIME WAS CALCULATED FOR A SITUATION WHEN THE REACTOR HEAD IS ON AND THE REACTOR WATER IS DIRECTED TO THE PRESSURIZER.

IN THE PRESENT CALCULATION AN ACCEPTANCE CRITERION FOR PRESSURE DECAY TIME WILL BE GENERATED FOR UNIT 1. BOTH SITUATIONS (REACTOR HEAD ON AND REACTOR HEAD OFF) WILL BE CONSIDERED AS THEY WERE IN REF [1].

THE FLOW LINE UP IS FROM THE ACCUMULATOR TO THE REACTOR VIA VALVE SJ54, SJ55, AND SJ56. INITIALLY THE GAS PRESSURE IN THE ACCUMULATOR IS 70 psig. DURING THE TEST SJ54 IS OPENED AND THE ACCUMULATOR PRESSURE DECAYS. THE TIME FOR THE PRESSURE TO DECAY FROM 70 psig TO 35 psig IS RECORDED. 1

IN THIS CALCULATION, AN ACCEPTANCE CRITERION FOR THIS PRESSURE DECAY TIME HAS BEEN CALCULATED. SEE REF [1] FOR DETAILS.

FORM 2

	CALCULATION CONTINUATION SHEET	SHEET: 5

CALC. NO.: S-1-SJ-MDC-1539			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Feb. 25, 2004	1				
REVIEWER/VERIFIER,DATE							

Originally, the Rev. 0 of this calculation was done with the opening stroke time of valve SJ54 = 12.5 seconds. Therefore, Rev. 0 applies for those loops that still have SJ54 valve opening stroke time of 12.5 seconds (11SJ54 and 12SJ54 valves). The actuators of valves 13SJ54 and 14SJ54 of Salem Unit 1 are being replaced with a longer opening stroke time. All the Salem Unit 2 SJ54 valves have been replaced by longer opening valves. The Salem Unit 2 calculation S-2-SJ-MDC-1394 was revised and the Rev. 2 is the current calculation. This fact is mentioned here because the details of analytical method is presented in the Unit 2 calculation and have not been repeated here. Since the Unit 1 valves have not been replaced yet, there exact opening time is not available. For unit 2, the largest opening stroke time for SJ543 valves is 21.9 seconds. Therefore, 22 seconds opening stroke time will be used for the replacement valves of the unit 1. Please note that the loops that still have the original valves (opening stroke time 12.5 seconds) are unaffected by this revision to the calculation.

This calculation has two sets of results:

1. The original acceptance criterion of 27 seconds [Ref. 8] applies to those loops that have SJ54 stroke time = 12.5 seconds.
2. Since the exact stroke time of valves 13SJ54 and 14SJ54 is not known at this time, a reasonable value for the stroke time was chosen to be 22 sec. As shown in the results section, for the stroke time of 22 seconds for Unit 1, the pressure decay time for units 1 is the same as the value calculated for Unit 2 in Ref. [1]. According to Ref [8], the pressure decay acceptance criterion for Units 1 and 2 is same. Therefore for the increased SJ54 valve stroke time, following the spirit of Ref [8], the Unit 1 pressure decay time criterion will be kept equal to pressure decay time criterion for Unit 2 pressure decay criterion calculated in Ref. [8].

The following note was added after the installation of the DCP's:

After the replacement of actuators of13SJ54 and 14SJ54 valves, the opening stroke times of these valves were measured.
The opening stroke time of 13SJ54 valve is 20.5 sec [Ref. notification 20188810]
The opening stroke time of 14SJ54 valve is 21.3 sec [Ref. notification 20188884]

Therefore, the original estimate of 22 second was quite good and the calculation need not be redone.

2. DESCRIPTION OF CONFIGURATION

CONFIGURATION IS DESCRIBED IN REF [1] AND WILL NOT BE REPEATED HERE.

3. ANALYSIS

IN THIS SECTION A MATHEMATICAL MODEL OF ACCUMULATOR DUMP PROCESS HAS BEEN DEVELOPED. THE DETAILS ARE DESCRIBED IN REF [1].

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CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST	ID NO. S-1-SJ-MDC-1539	SHEET 7 OF 26
	REFERENCE	
ORIGINATOR: V.CHANDRA 0		
DATE: 23 JAN 1996		
PEER REVIEW: AMG		
DATE: 2-1-96		

3.1 ACCUMULATORS

FIGURE 3.1.1 SHOWS THE VARIOUS ACCUMULATOR LEVEL ELEVATIONS. [Ref 2, 3, 4]

AT 100% LEVEL, ELEVATION = 91.4 ft, WATER VOL = 7116 GAL
$= 951.3\ ft^3$

AT 0% LEVEL, ELEVATION = 88.9 ft, WATER VOL = 5325 GAL
$= 711.9\ ft^3$

LET Z_A = ELEVATION OF WATER LEVEL IN THE ACCUMULATOR (ft)

V_{WA} = VOLUME OF WATER IN THE ACCUMULATOR (ft^3)

THEREFORE,

$$V_{WA} = 95.76 Z_A - 7801.2 \quad ; \quad 85.65\ ft \leq Z \leq 91.4\ ft$$

FOR 96% INITIAL WATER LEVEL, $Z_{A,INIT} = 88.9 + 0.96 \times 2.5\ ft$
$= 91.3\ ft$

$V_{WA,INIT} = 941.7\ ft^3$

TOTAL VOLUME OF ACCUMULATOR = $1350\ ft^3$ [Ref 5]

INITIAL NITROGEN VOLUME = $1350 - 941.7\ ft^3$
$= 408.3\ ft^3$

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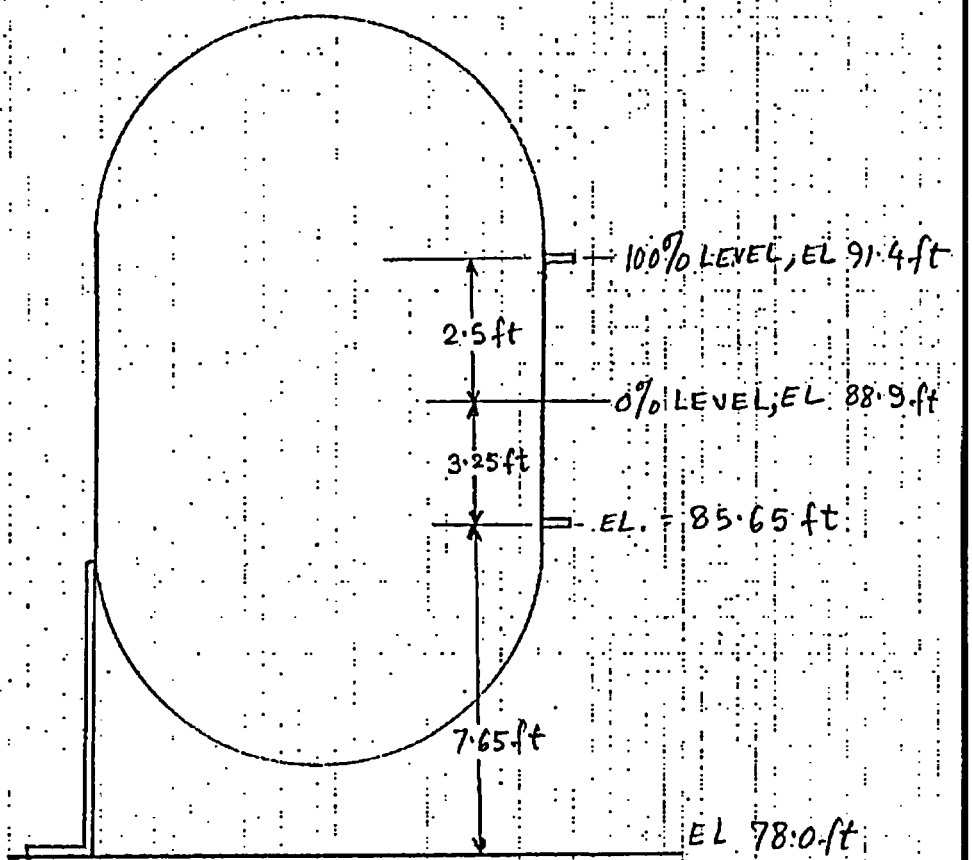
CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.		ID NO. S-1-SJ-MDC-1539	SHEET 8 OF 26
		REFERENCE	
ORIGINATOR	V. CHANDRA	0	
DATE	23 JAN 1996		
PEER REVIEW	ang		
DATE	2-1-96		

FIGURE 3.1.1 ACCUMULATOR WATER LEVEL ELEVATIONS (Ref 2, 3, 4)



PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.	ID NO. S-1-SJ-MDC-1539	SHEET 9 OF 26
	REFERENCE	
ORIGINATOR V.CHANDRA 0		
DATE 23 JAN 1996		
PEER REVIEW DATE 2-1-96		

3.2 PRESSURIZER

PRESSURIZER LEVEL ELEVATIONS VS. VOLUME RELATIONSHIP WAS DEVELOPED IN REF [1]. AT THAT TIME Rev.0 OF CBD DE-CB.RC-0042(Q) WAS CURRENT. HOWEVER, A CBD CHANGE NOTICE FOR FIGURE F17-1 WAS OUTSTANDING AGAINST IT. AT THAT TIME, IT WAS EXPECTED THAT THE CHANGE NOTICE WOULD BE INCORPORATED IN REV. 1. HOWEVER, AT PRESENT THE DMS SYSTEM HAS REV 1. BUT THE CBD CHANGE NOTICE IS NOT INCORPORATED IN IT. TO AVOID THE CONFUSION, THE MARKED COPY OF FIGURE F17-1 IS ATTACHED HERE.

COMPONENT	ELEVATION FEET	INCHES
STEAM GENERATORS		
NARROW RANGE LEVEL TAP (UPPER)	154	7
HI-HI TRIP (67%)	150	2
FULL LOAD (44%)	147	10
NO LOAD (33%)	146	6
FEEDWATER NOZZLE & SPARGER (78% WIDE RANGE)	144	6
LOW LEVEL TRIP (8.5%)	143	7
NARROW RANGE LEVEL TAP (LOWER)	142	7
TOP OF TUBE BUNDLE (70% WIDE RANGE)	140	3
PRIMARY SIDE INLET & OUTLET NOZZLES CENTERLINE	98	7.25
PRIMARY SIDE MANWAY (BOTTOM)	98	7
REACTOR COOLANT PUMPS		
RCP CONNECTIONS (SEAL INJECTION, SEAL RETURN, PRESSURE TAPS)	99	11
PUMP DISCHARGE CENTERLINE	97	0
PUMP INLET NOZZLE	91	2.25
PUMP SUCTION CENTERLINE	86	8.25
PRESSURIZER		
~~100% TOP OF PRESSURIZER~~	~~147~~	~~11~~
~~92% HIGH LEVEL TRIP~~	~~144~~	~~5~~
~~70% HIGH LEVEL ALARM~~	~~134~~	~~9~~
~~60% OPERATING RANGE(UPPER LIMIT)~~	~~130~~	~~4.60~~
~~22% OPERATING RANGE(LOWER LIMIT)~~	~~113~~	~~8.70~~
~~17% LOW LEVEL ALARM~~	~~111~~	~~6.40~~
~~15% HEATERS UNCOVERED~~	~~110~~	~~7.90~~
BASE	104	1
SURGE LINE CENTERLINE	97	0
REACTOR VESSEL		
REACTOR VESSEL FLANGE	104	0
SEAL TABLE	104	0
RCS HOT LEG – TOP OF PIPE	98	2.50
NOZZLE CENTERLINE	97	0
TOP OF ACTIVE FUEL	92	9.60
RHR SYSTEM		
RHR DISCHARGE CONNECTION TO RCS CENTERLINE	97	9.75
RHR SUCTION CONNECTION TO RCS CENTERLINE	96	6
RHR HEAT EXCHANGER OUTLET CENTERLINE	50	6
RHR PUMP SUCTION CENTERLINE	46	10

REVISE

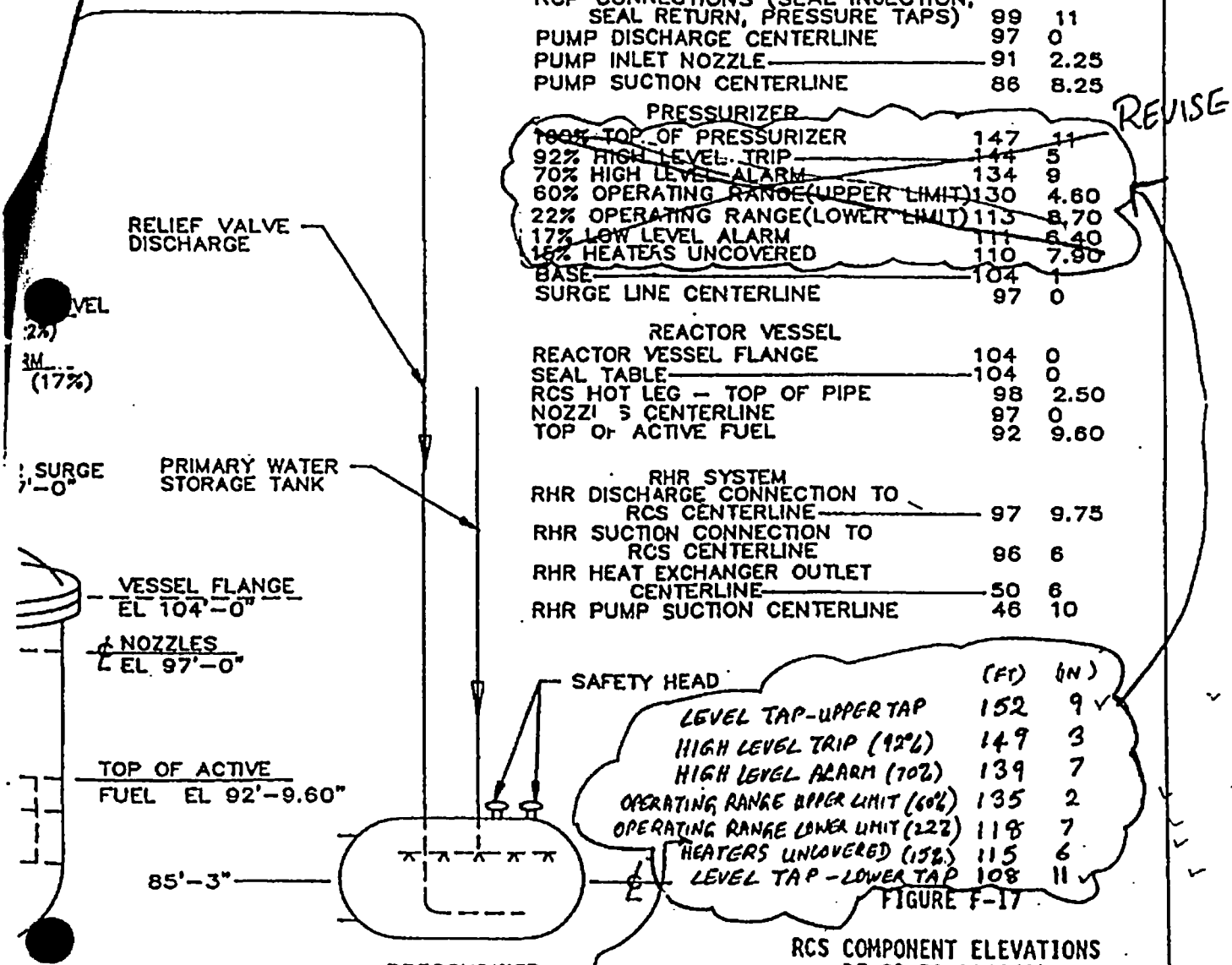


FIGURE F-17

RCS COMPONENT ELEVATIONS
DE-CB.RC-0042(Q)
REV. 0
PAGE F17-1 (LAST)

Low Alarm and Letdown isolated 116-4

PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.		ID NO. S-1-SJ-MDC-1539				SHEET 11 OF 26
		REFERENCE				
ORIGINATOR	V. CHANDRA 0	V. CHANDRA 1				
DATE	24 JAN 1996	25 FEB 2004				
PEER REVIEW	QMG	JM				
DATE	2-2-96	3/18/04				

3.3 CHECK VALVES SJ 55 AND 56

THE PRESSURE DROP VERSUS FLOW RELATIONSHIP FOR THESE CHECK VALVES WAS DEVELOPED IN REF [1] AND WILL NOT BE REPEATED HERE.

3.4 GATE VALVE SJ 54

THE LOSS FACTOR VS. STROKE POSITION TABLE WAS DEVELOPED IN REF [1] AND WILL NOT BE REPEATED HERE. THE MAXIMUM ACCEPTABLE STROKE TIME OF 11 SJ 54, 12 SJ 54, 13 SJ 54, AND 14 SJ 14 VALVE IS 12.5 SEC. [Ref. 6]. THIS VALUE WILL BE USED TO CALCULATE PRESSURE DECAY TIME. THE STROKE TIME OF REPLACEMENT VALVES IS 22 SECONDS. THIS IS BASED ON THE UNIT 2 DATA [Ref. 8] 1

3.5 FRICTION LOSS FACTORS AND INERTIA LENGTHS OF ACCUMULATOR DISCHARGE PIPING

TABLES 3.5.1, 3.5.2, 3.5.3, AND 3.5.4 SHOW THE FRICTION LOSS FACTORS OF DISCHARGE PIPING OF EACH ACCUMULATOR. THE EFFECTIVE $\frac{L}{A}$ IS SHOWN UNDERNEATH EACH TABLE.

EFFECTIVE $\frac{L}{A} = \sum \frac{L_i}{A_i}$

L_i = LENGTH OF EACH PIPE SEGMENT

A_i = FLOW AREA OF EACH PIPE SEGMENT.

(SEE REF 1 p. 26 FOR ITS USE).

PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.

ID NO. S-1-SJ-MDC-1539

REFERENCE

ORIGINATOR V. CHANDRA 0
DATE 24 JAN 1996
PEER REVIEW Cmg
DATE 2-2-96

SHEET 12 OF 26

TABLE 3.5.1

II ACCUMULATOR DISCHARGE LINE FITTINGS

VALVES ARE NOT INCLUDED. REF. STRESS ISO 267241 [Ref. 9]
267246 [Ref. 10]

DESCRIPTION		REF. AREA, A (ft^2)	LOSS FACTOR $K = \frac{\Delta P}{\frac{1}{2}\rho V^2}$	$\frac{K}{A^2}$ (ft^{-4})
29.7 ft LONG PIPE, I.D = 0.835 ft	$\frac{fl}{d} = \frac{0.0146 * 29.7}{0.835} = 0.519$	0.548	0.519	1.73
1 SR ELBOW	$K = 1 * 0.27$	0.548	0.27	0.9
2 LR ELBOW	$K = 2 * 0.18$	0.548	0.36	1.2
79.1 ft LONG PIPE, I.D = 0.7083 ft	$\frac{fl}{d} = \frac{0.0146 * 79.1}{0.7083} = 1.63$	0.394	1.63	10.5
8 LR ELBOWS	$K = 8 * 0.18$	0.394	1.44	9.28
1 SR ELBOW	$K = 1 * 0.27$	0.394	0.27	1.74
2 TEE RUNS	$K = 2 * 0.05$	0.394	0.1	0.64
1 ENTRANCE	$K = 0.5$	0.394	0.5	3.22
1 EXIT	$K = 1.0$	0.394	1.0	6.44

$\sum \frac{K}{A^2} = 35.65\ ft^{-4}$

$\sum \frac{L_i}{A_i} = \frac{29.7}{0.548} + \frac{79.1}{0.394}\ ft^{-1}$

$= 255.0\ ft^{-1}$

PSE&G

CALCULATION CONTINUATION SHEET

TITLE	ID NO.	SHEET
ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.	S-1-SJ-MDC-1539	13 OF 26
	REFERENCE	
ORIGINATOR: V. CHANDRA D		
DATE: 24 JAN 1996		
PEER REVIEW: CMG		
DATE: 2-2-96		

TABLE 3.5.2

12 ACCUMULATOR DISCHARGE LINE FITTINGS

VALVES ARE NOT INCLUDED; Ref STRESS ISO. 26724IC [11] 26724-2 [12]

DESCRIPTION		REF. AREA, A (ft^2)	LOSS FACTOR, $K = \frac{\Delta P}{\frac{1}{2}\rho v^2}$	$\frac{K}{A^2}$ (ft^{-4})
23.9 ft LONG PIPE, ID = 0.835 ft	$\frac{fl}{d} = \frac{0.0146 \times 23.9}{0.835}$	0.548	0.418	1.39
2 LR ELBOWS	K = 2 * 0.18	0.548	0.36	1.2
1 SR ELBOW	K = 1 * 0.27	0.548	0.27	0.9
81.5 ft LONG PIPE, ID = 0.783 ft	$\frac{fl}{d} = \frac{0.0146 * 81.5}{0.783} = 1.52$	0.394	1.52	9.79
7 LR ELBOWS	K = 7 * 0.18	0.394	1.26	8.12
2 SR ELBOWS	K = 2 * 0.27	0.394	0.54	3.48
2 TEE RUNS	K = 2 * 0.05	0.394	0.1	0.644
1 ENTRANCE	K = 0.5	0.394	0.5	3.22
1 EXIT	K = 1.0	0.394	1.0	6.44

$$\sum \frac{L_i}{A_i} = \frac{23.9}{0.548} + \frac{81.5}{0.394}\ ft^{-1}$$

$$= 250.5\ ft^{-1}$$

$$\sum \frac{K}{A^2} = 35.18\ ft^{-4}$$

PSEG

CALCULATION CONTINUATION SHEET

TITLE: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

ID NO. S-1-SJ-MDC-1539

REFERENCE

ORIGINATOR: V. CHANDRA 0
DATE: 24 JAN 1996
PEER REVIEW: amg
DATE: 2-2-96

SHEET 14 OF 26

TABLE 3.5.3

13 ACCUMULATOR DISCHARGE LINE FITTINGS

VALUES ARE NOT INCLUDED, REF. STREE ISO 2C7243 [13] 2C7246 [10]

DESCRIPTION		REF. AREA, A (ft^2)	LOSS FACTOR $K = \frac{\Delta P}{\frac{1}{2}\rho v^2}$	$\frac{K}{A^2}$ (ft^{-4})
13.8 ft LONG PIPE, ID = 0.835 ft	$\frac{fl}{d} = \frac{0.0146 * 13.8}{0.835} = 0.241$	0.548	0.241	0.803
3 SR ELBOW	$K = 3 * 0.27$	0.548	0.81	2.697
1 LR ELBOW	$K = 1 * 0.18$	0.548	0.18	0.599
80.4 ft LONG PIPE, ID = 0.7083 ft	$\frac{fl}{d} = \frac{0.0146 * 80.4}{0.7083} = 1.657$	0.394	1.657	10.674
5 LR ELBOW	$K = 5 * 0.18$	0.394	0.9	5.798
2 SR ELBOW	$K = 2 * 0.27$	0.394	0.54	3.479
2 TEE RUNS	$K = 2 * 0.05$	0.394	0.10	0.644
1 ENTRANCE	$K = 0.5$	0.394	0.5	3.221
1 EXIT	$K = 1.0$	0.394	1.0	6.442

$$\sum \frac{K}{A^2} = 34.357\ ft^{-4}$$

$$\sum \frac{L_i}{A_i} = \frac{13.8}{0.548} + \frac{80.4}{0.394}\ ft^{-1}$$

$$= 229.2\ ft^{-1}$$

PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST	ID NO. S-1-SJ-MDC-1539	SHEET 15 OF 26
	REFERENCE	
ORIGINATOR V.CHANDRA 0		
DATE 24 JAN 1996		
PEER REVIEW ang		
DATE 2-2-96		

TABLE 3.5.4

14 ACCUMULATOR DISCHARGE LINE FITTINGS

VALVES ARE NOT INCLUDED, REF. STRESS ISO. 207244 [Ref. 1.1]

DESCRIPTION		REF. AREA, A (ft^2)	LOSS FACTOR $K = \frac{\Delta P}{\frac{1}{2}\rho V^2}$	$\frac{K}{A^2}$
23.9 ft LONG PIPE ID = 0.835 ft	$\frac{fl}{d} = \frac{0.0146 \times 23.9}{0.835} = 0.42$	0.548	0.42	1.4
1 SR ELBOW	$K = 1 \times 0.27$	0.548	0.27	0.9
2 LR ELBOWS	$K = 2 \times 0.18$	0.548	0.36	1.2
68 ft LONG PIPE ID = 0.7083 ft	$\frac{fl}{d} = \frac{0.0146 \times 68}{0.7083} = 1.40$	0.394	1.40	9.03
6 LR ELBOWS	$K = 6 \times 0.18$	0.394	1.08	6.44
2 SR ELBOWS	$K = 2 \times 0.27$	0.394	0.54	3.5
2 TEE RUNS	$K = 2 \times 0.05$	0.394	0.1	0.64
1 ENTRANCE	$K = 0.5$	0.394	0.5	3.22
1 EXIT	$K = 1.0$	0.394	1.0	6.44

$\sum \frac{K}{A^2} = 32.8\ ft^{-4}$

$$\sum \frac{L_1}{A_1} = \frac{23.9}{0.548} + \frac{68}{0.394}\ ft^{-1}$$

$$= 216.2\ ft^{-1}$$

PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.		ID NO. S-1-SJ-MDC-1539				SHEET 16 OF 26
		REFERENCE				
ORIGINATOR	V.CHANDRA 0	V.CHANDRA 1				
DATE	24 JAN 96	05 MAR 2004				
PEER REVIEW	QMG	JM				
DATE	2-2-96	3/18/04				

11 ACCUMULATOR DISCHARGE LINE HAS THE HIGHEST VALUES OF $\Sigma \frac{L_i}{A_i}$ AND $\Sigma \frac{k}{A^2}$.

THE $\frac{L}{A}$ OF PRESSURIZER SURGE LINE IS $\frac{65}{3.14}$ ft^{-1} [Ref 7]

$= 20.7\ ft^{-1}$

COMBINED $\frac{L}{A}$ OF SURGE LINE AND ACCUMULATOR DISCHARGE LINE $= 255 + 20.7 = 275.7\ ft^{-1}$ [REACTOR HEAD-ON] 1

$\rho\left(\frac{L}{A}\right)_{eff} = 1.94 * 275.7 = 534.8 \frac{SLUG}{ft^4}$ [REACTOR HEAD-ON]

$\frac{1}{2} \Sigma \frac{\rho k}{A^2} = \frac{1}{2} * 1.94 * (35.65 + 0.304) \frac{SLUG}{ft^7}$ [REACTOR HEAD-ON]

($\frac{k}{A^2}$ of SURGE LINE)

$= 34.88 \frac{SLUG}{ft^7}$

WHEN REACTOR HEAD IS OFF

$\rho\left(\frac{L}{A}\right)_{eff} = 1.94 * 255 \frac{slug}{ft^4} = 494.7 \frac{slug}{ft^4}$

$\frac{1}{2} \Sigma \rho \frac{k}{A^2} = \frac{1}{2} * 1.94 * 35.65 \frac{slug}{ft^7}$

$= 34.68 \frac{slug}{ft^7}$

PSEG

CALCULATION CONTINUATION SHEET

TITLE: ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST

ID NO. S-1-SJ-MDC-1539

REFERENCE

SHEET 17 OF 26

ORIGINATOR	V.CHANDRA	0
DATE	24 JAN 1996	
PEER REVIEW	ANG	
DATE	2-2-96	

3.6 EQUATIONS OF MOTION (REACTOR HEADON)

FOLLOWING THE METHOD DESCRIBED ON PAGE 21 OF [REF. 1], WE GET,

$$534.8\frac{dQ}{dt} = (P_A + \rho g Z_A) - (P_P + \rho g Z_P) - 34.88Q^2 - \Delta P_{f,VALVES} \quad (6)$$

$$Z_A = \frac{V_{WA} + 7801.2}{95.76} \quad \text{(FROM SEC. 3.1)} \quad (7)$$

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

$$P_A = P_{A0}\left(\frac{V_{NA0}}{V_{NA}}\right)^n ; \quad n = 1.3 \quad (9)$$

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

$$Z_P = \frac{V_{WP} + 4092.3}{38.34} \quad \text{(FROM REF. 1)} \quad (11)$$

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

INITIAL CONDITIONS

$V_{WA} = 941.7\ ft^3$

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

$P_A = 84.7\ psia$

$Q = 0\ ft^3/s$

$\phi = 0$ RADIAN.

$V_{NA} = 1350 - 941.7\ ft^3 = 408.3\ ft^3$

PSEG

CALCULATION CONTINUATION SHEET

TITLE ACCUMULATOR PRESSURE DECAY DURING DISCHARGE TEST.		ID NO. S1-SJ-MDC-1539			SHEET 18 OF 26
		REFERENCE			
ORIGINATOR	V.CHANDRA 0	V.CHANDRA 1			
DATE	24 JAN 1996	25 FEB 2004			
PEER REVIEW	AMG	JH			
DATE	7-2-96	3/18/04			

EQUATIONS (6) THROUGH (12) WERE SOLVED NUMERICALLY. THE LISTING OF COMPUTER PROGRAM IS SHOWN IN THE FOLLOWING PAGES.

THE REV. 0 OF THIS CALCULATION DEALT WITH THE SITUATION WHEN THE STROKE TIME OF SJ54 VALVE IS 12.5 SEC. SINCE THE STROKE TIME OF 11SJ54 AND 12SJ54 IS NOT BEING CHANGED, THE ACCEPTANCE CRITERION FOR LOOPS 11 AND 12 STILL REMAINS 2.7 Sec.

BY REVISION 1 OF THIS CALCULATION, THE PRESSURE DECAY TIME ANALYSIS FOR SJ54 STROKE TIME OF 22 SECOND HAS BEEN ADDED. 1

THE ACTUAL MEASURED OPENING STROKE TIME OF 13 SJ54 VALVE = 20.5 Sec. [Ref. NOTIFICATION 20188810]

THE ACTUAL MEASURED OPENING STROKE TIME OF 14 SJ54 VALVE = 21.3 Sec. [Ref. NOTIFICATION 20188884]

THESE VALVES ARE CLOSE ENOUGH TO 22 Sec. THAT WAS ORIGINALLY SELECTED BEFORE DCP INSTALLATION.

OUTSTANDING CHANGES MUST BE ATTACHED FOR WORKING COPY
20040706

S-1-SJ-MDC-1539 R-N-0 P 19

COMPUTER PROGRAM LISTING

REACTOR HEAD IS ON

SJ54 STROKE TIME = 12.5 Sec.

```
. type acchon.for
      DIMENSION VVOF(12),CVCV(12)
      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=408.3
      VNA=VNAZ
      PAZ=84.7*144.
      PA=PAZ
      Q=.001
      VWP=758.
      WRITE(*,101)
  101 FORMAT(T19'TIME',  T28'ACCUMULATOR PRESSURE   FLOW RATE')
  103 FORMAT(T19'(SEC.)',T28'         (PSIG)           (GPM)  ',//)
      WRITE(*,103)
   31 NSTEP=NSTEP+1
      TIME=TIME+DT
C  CALCULATE ACCUMULATOR LEVEL ELEVATION
      VWA=1350.-VNA
      ZA=(VWA+7801.2)/95.76
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=12.5
      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-34.88*Q*ABS(Q)
     #       -0.5*GVK*1.94*Q*ABS(Q)/AREA**2 - DPCHK)/534.8
      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(*,102) TIME,+(PA/144.-14.7),
     #    Q*7.48*60.
      ELSE
      IF(MOD((NSTEP+10),100) .EQ. 0)WRITE(*,102) TIME,+(PA/144.-14.7),
     #    Q*7.48*60.
      ENDIF
```

OUTSTANDING CHANGES MUST BE ATTACHED FOR WORKING COPY
20040706

S-1- SJ-MDC-1539 Rev.0 P 20

REACTOR HEAD ISON
SJ 54 STROKE TIME
= 12.5 Sec.

```
  102 FORMAT(F23.3,8F17.2)
C  UPDATE THE OLD VARIABLES
         Q=QQ
         VNA=VVNA
         VWP=VVWP
      IF(TIME .GT. 100.) 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

C:\SALEM\REACTOR\ECCS>
```

S-1-SJ-MDC-1539, Rev 1

COMPUTER PROGRAM LISTING

REACTOR HEAD IS ON
SJ 54 STROKE TIME
= 22 SEC.
CHECK VALVE IS FREE

OUTSTANDING CHANGES MUST BE ATTACHED FOR WORKING COPY
20040706ENSION VVOF(12),CVCV(12)

```
      OPEN(1,FILE='s1Acchon 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=408.3
      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+7801.2)/95.76
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=22.
      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-34.88*Q*ABS(Q)
     #      -0.5*GVK*1.94*Q*ABS(Q)/AREA**2 - DPCHK)/534.8
      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
```

20040706

```
      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
```

□

REACTOR HEAD ISOL
SJ54 STROKE TIME
= 22 Sec.

FORM 2

	CALCULATION CONTINUATION SHEET		SHEET: 23				
CALC. NO.: S-1-SJ-MDC-1539			REFERENCE:				
ORIGINATOR,DATE	REV:	V. Chandra Feb. 25, 2004	1				
REVIEWER/VERIFIER,DATE							

4. RESULTS

Table 4.1 shows the time histories of the accumulator pressure and the discharge flow rate when the SJ54 valve opening stroke time is 12.5 seconds. As suggested by Ref. [8], the acceptance criterion for the pressure decay time was set to 27 seconds. This value was obtained by subtracting 1.5 seconds from the pressure decay time obtained for 6o degree maximum open angle case.

Table 4.2 shows the accumulator pressure and discharge flow rate time histories for the situation when the reactor head is on, check valve is free, and the SJ54 valve stroke time is 22 sec. The 22 second stroke time was selected to reasonable bound the data collected for Unit 2. The pressure decay time for this situation for Unit 1 is nearly the same as it was calculated in Ref. [1] for Unit 2. NRC approved the acceptance criterion for the pressure decay time for Unit 2 on Jan 2, 2004 through relief requests S2-RR-03-V01 and S2-RR-03-V02 (TAC No. MC1102). Following the spirit of Ref. [8], the Unit 1 pressure decay time criterion will be made equal to Unit 1 pressure decay time criterion of 28.1 sec. Please note that the pressure decay time is a relatively weak function of SJ54 stroke time. It is emphasized, that in order to provide some flexibility in data collection, the actual acceptance criterion needs to be slightly greater than the calculated value for the free check valve case.

The following note was added after the installation of the DCP's

After the replacement of actuators of13SJ54 and 14SJ54 valves, the opening stroke times of these valves were measured.
The opening stroke time of 13SJ54 valve is 20.5 sec [Ref. notification 20188810]
The opening stroke time of 14SJ54 valve is 21.3 sec [Ref. notification 20188884]

Therefore, the original estimate of 22 second was quite good and the calculation need not be redone.

5. CONCLUSION

As suggested by Ref. [8], the acceptance criterion for pressure decay time should be made equal to 27 seconds for the situation when the SJ54 opening stroke time is 12.5 seconds. This criterion applies to loops 11 and 12.

Following the rationale provided in Ref [1], the Unit 1 pressure decay time acceptance criterion for 13 and 14 loops will be set equal to 28.1 seconds.

This calculation revision is in support of DCP's 80017350 and 80017351. Therefore, a 50.59 Safety Evaluation is not required.

TABLE 4.1 ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATE TIME HISTORIES

SI-SJ-MDC-1539, Rev.0

TIME (SEC.)	ACCUMULATOR PRESSURE (PSIG)	FLOW RATE (GPM)
.110	70.00	.45
.210	69.99	242.54
.310	69.97	356.39
.410	69.95	468.61
.510	69.92	579.16
.610	69.88	688.20
.710	69.84	824.00
.810	69.78	993.71
.910	69.72	1168.00
1.010	69.64	1341.52
1.110	69.56	1512.76
1.210	69.46	1681.01
1.310	69.36	1841.72
1.410	69.25	1979.86
1.510	69.13	2102.75
1.610	69.00	2216.12
1.710	68.87	2323.05
1.810	68.73	2425.24
1.910	68.58	2523.62
2.010	68.43	2618.72
3.010	66.70	3426.55
4.010	64.66	3977.46
5.010	62.48	4357.61
6.010	60.25	4597.21
7.010	58.05	4707.43
8.010	55.94	4733.72
9.010	53.93	4717.87
10.010	52.03	4669.58
11.010	50.25	4592.14
12.010	48.58	4500.25
13.010	47.02	4398.37
14.010	45.56	4284.26
15.010	44.20	4170.59
16.010	42.92	4060.25
17.010	41.73	3953.51
18.010	40.60	3850.18
19.010	39.55	3750.05
20.010	38.55	3652.87
21.010	37.61	3558.44
22.010	36.73	3460.78
23.010	35.89	3353.02
24.010	35.11	3243.26
25.010	34.37	3134.53
26.010	33.67	3027.76
27.011	33.02	2923.22
28.011	32.40	2820.90
29.011	31.81	2720.75
30.011	31.26	2622.67
31.011	30.74	2526.59
32.011	30.25	2432.44
33.010	29.79	2340.14
34.010	29.35	2249.66
35.010	28.94	2160.95
36.010	28.55	2074.00
37.010	28.18	1988.81
38.010	27.83	1905.40
39.009	27.50	1823.80
40.009	27.19	1744.07
41.009	26.90	1666.29
42.009	26.62	1590.57
43.009	26.36	1517.02

REACTOR HEAD ON CHECK VALVE IS FREE

SJ54 STROKE TIME = 12.5 Sec.

S-1-SJ-MDC-1539, Rev. 1

TABLE 4.2

ACCUMULATOR PRESSURE AND DISCHARGE FLOW RATE TIME HISTORIES.

REACTOR HEAD IS ON
CHECK VALVE IS FREE
SJ 54 STROKE TIME
= 22 Sec.

(SEC.)	(PSIG)	(GPM)
0.110	70.00	0.45
0.210	69.99	144.06
0.310	69.98	212.26
0.410	69.97	280.02
0.510	69.95	347.25
0.610	69.93	413.89
0.710	69.90	479.92
0.810	69.87	545.36
0.910	69.84	610.22
1.010	69.80	674.55
1.110	69.76	738.40
1.210	69.71	829.26
1.310	69.66	935.34
1.410	69.60	1043.46
1.510	69.53	1151.27
1.610	69.46	1258.18
1.710	69.38	1364.00
1.810	69.30	1468.58
1.910	69.21	1571.84
2.010	69.12	1673.67
3.010	67.90	2406.15
4.010	66.40	2915.09
5.010	64.69	3329.83
6.010	62.85	3651.47
7.010	60.96	3878.40
8.010	59.04	4066.45
9.010	57.15	4186.74
10.010	55.29	4273.95
11.010	53.49	4312.81
12.010	51.76	4313.98
13.010	50.11	4287.20
14.010	48.55	4247.92
15.010	47.07	4198.90
16.010	45.66	4138.37
17.010	44.34	4071.83
18.010	43.08	3996.36
19.010	41.89	3915.35
20.010	40.77	3830.78
21.010	39.71	3746.64
22.010	38.71	3661.49
23.010	37.77	3572.18
24.010	36.87	3477.56
25.010	36.03	3371.12
26.010	35.23	3261.53
27.011	34.49	3152.57
28.011	33.79	3045.47
29.011	33.12	2940.55
30.011	32.50	2837.87
31.011	31.91	2737.36
32.011	31.35	2638.94
33.010	30.83	2542.54
34.010	30.33	2448.06
35.010	29.87	2355.46
36.010	29.43	2264.68
37.010	29.01	2175.67
38.010	28.61	2088.43
39.009	28.24	2002.95
40.009	27.89	1919.24