

NORTHEAST NUCLEAR ENERGY COMPANY

SUBJECT Bonnet Pressure of the Containment
Sump Recirculation Valves (2-CS-16.1A/B)

BY P. S. Higgins DATE 7/27/95
CHKD. BY _____ DATE _____
CALC. NO. _____ REV. _____
SHEET NO. 1 OF 8

Independent Review of CCN-2 to 89-078-873FS rev. 0)

QA Category 1

Calculation: 89-078-1206M2 rev. 0

Title: Millstone Unit no 2
Bonnet Pressure of Containment Sump
Recirculation Valves (2-CS-16.1A/B)

Prepared by: _____

Phillip Higgins

Date: 7/27/95

Method of Review:

The ABOVE Calculation Change Notice (CCN) was fully reviewed.
Input & Calc Methodology was reviewed and shown to be
Accurate and Reasonable.

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PDR ADOCK 05000336
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SHEET NO. 2 OF 8

I. Purpose

This calculation determines the the required thrust to open the sump recirculation valves (2-CS-16.1A/B) based upon expected design basis accident conditions seen by the valves. The calculation provides an independent review of the referenced calc using the EPRI Performance Prediction Program Methodology for evaluating Parallel disc gate valve (EPRI TR-103244)

II. Results

Four scerious were reviewed for the valve with most limiting conditions (CS-16.1A). The four cases were: 1) pre-accident conditions; 2) large break loca, 44 minutes into the accident; 3) small break loca 4 hours into the accident w/presssurized bonnet; 4) small break loca 4 hours into accident w/bonnet pressure equal to down stream piping.

Using the "double drag" method which applies forces to both discs on the seat ring, the valves are able to open using design basis limits.

III. References

- (1) Crane Technical Paper # 410
- (2) A. Nusco dwg 25203-26015 sh.
- (3) EPRI TR-103244, "EPRI Performance Prediction Program"

IV. Conditions & Assumptions

See section 1.0, Purpose

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 CHKD. BY _____ DATE _____
 CALC. NO. _____ REV. _____
 SHEET NO. 3 OF 8

Independent Review of CCN-2 to 89-078-873ES rev. 0)

V. Method

1. The sealing force is determined using EPRI PPP guideline for A/D Double Disc valve and info from the as-left static test. This sealing force is compared to force required for the valve to make the valve leak tight.
2. The force required to open the valves during: 1)pre-accident conditions; 2)large break loca, 44 minutes into the accident; 3)small break loca bonnet pressurization; 4)small break loca with bonnet pressure equalized to the downstream pressure.

VI. ANALYSIS

VI.1 Determine the Sealing Force

Step 1: Determine Disk Assembly and Stem Weight

$F_w = 0 \text{ lbf}$...not needed (included in packing/running load)

Step 2: Determine Packing Friction Stem Thrust

$F_{\text{pack}} = 4634 \text{ lbf}$... packing load from CS-16.1A is bounding and used for both valves (see memo MOV-95-391, dated 7/27/95)

Step 3: Determine Piston Effect Stem Thrust

$D_{\text{stem}} = 2.25 \text{ in}$

$P = 37 \text{ psi}$

$$F_p = P \frac{\pi D_{\text{stem}}^2}{4}$$

$$F_p = 147 \text{ lbf}$$

Step 4: Determine Torque Reaction Factor

$B_2 = 24.021 \text{ in}$...seat ring OD

$B_3 = 23.387 \text{ in}$...seat ring ID

$$R_t = 0.5 \frac{B_2 + B_3}{2}$$

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 CALC. NO. _____ REV. _____
 SHEET NO. 4 OF 8

(Independent Review of CCN-2 to 89-078-873ES rev. 0)

$$R_t = 0.988 \cdot ft$$

$$F_S = 0.0226 \cdot ft$$

$$\mu_t = 0.54$$

$$TRF = 1 - \left(\mu_t \cdot \frac{F_S}{R_t} \right) \quad TRF = 0.988$$

Step 5: Determine Actual Sealing Force

$$Adp = \frac{\pi \left(\frac{B_2 + B_3}{2} \right)^2}{4} \quad Adp = 441 \cdot in^2$$

$$R_{static} = 29225 \cdot lbf \quad \dots latest as-left static test TT$$

$$\Delta P_{close} = 0 \cdot psi \quad \dots assumed for static test closure$$

$$R_a = 0.5 \cdot R_{static} + 0.6 \cdot Adp \cdot \Delta P_{close} \quad R_a = 14613 \cdot lbf$$

Contact Force vs. DP Force

$$A_{contact} = \frac{\pi (B_2^2 - B_3^2)}{4} \quad A_{contact} = 23.606 \cdot in^2$$

$$P_{contact} = \frac{R_a}{A_{contact}} \quad P_{contact} = 619 \cdot psi$$

Contact stress required for leak tightness is 4000 psi, thus valve is not considered leak tight.

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CHKD. BY _____

DATE _____

CALC. NO. _____

REV. _____

SHEET NO. 5

OF 8

Step 6: Determine Differential Pressure Stem Thrust(Fdp)

Case 1: Large Break Loca (Time = 0 minutes)

$$P_{\text{bonnet}} = 37 \text{ psi}$$

$$P_{\text{dnstream}} = 37 \text{ psi}$$

$$P_{\text{upstream}} = 2 \text{ psi}$$

$$\Delta P_{\text{upstream}} = P_{\text{bonnet}} - P_{\text{upstream}}$$

$$\Delta P_{\text{dnstream}} = P_{\text{bonnet}} - P_{\text{dnstream}}$$

$$F_{\text{bn}} = 1 \quad \dots \text{bernoulli force correction factor (assumed negligible)}$$

$$F_{\text{dp_upstream}} = A_{\text{dp}} \Delta P_{\text{upstream}} \cdot F_{\text{bn}}$$

$$F_{\text{dp_upstream}} = 8341 \cdot \text{lbf}$$

$$F_{\text{dp_dnstream}} = A_{\text{dp}} \Delta P_{\text{dnstream}} \cdot F_{\text{bn}}$$

$$F_{\text{dp_dnstream}} = 0 \cdot \text{lbf}$$

$$F_{\text{dp}} = F_{\text{dp_upstream}} + F_{\text{dp_dnstream}}$$

$$F_{\text{dp}} = 8341 \cdot \text{lbf}$$

Step 7: Determine Required Thrust for Opening the Valve(Fr)

$$F_r = \frac{F_w + F_{\text{pack}} + F_p + F_{\text{dp}}}{\text{TRF}}$$

...where

$$F_w = 0 \cdot \text{lbf} \quad \dots \text{included in packing load}$$

$$F_{\text{pack}} = 4634 \cdot \text{lbf}$$

$$F_p = 147 \cdot \text{lbf}$$

$$F_{\text{dp}} = 8341 \cdot \text{lbf}$$

$$F_r = 13286 \cdot \text{lbf} < T_{\text{limit}} = 18025 \cdot \text{lbf} \quad \text{Thus, Satisfactory}$$

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 CHKD. BY _____ DATE _____
 CALC. NO. _____ REV. _____
 SHEET NO. 6 OF 8

Step 6: Determine Differential Pressure Stem Thrust (Fdp)

Case 2: Large Break Loca (Time = 44 minutes)

Pbonnet = 37 psi

Pdnstream = 20 psi

Pupstream = 15 psi

$\Delta P_{upstream} = P_{bonnet} - P_{upstream}$

$\Delta P_{dnstream} = P_{bonnet} - P_{dnstream}$

Fbn = 1 ...bernoulli force correction factor (assumed negligible)

$F_{dp_upstream} = A_{dp} \Delta P_{upstream} \cdot F_{bn}$

$F_{dp_upstream} = 5243 \cdot \text{lbf}$

$F_{dp_dnstream} = A_{dp} \Delta P_{dnstream} \cdot F_{bn}$

$F_{dp_dnstream} = 4051 \cdot \text{lbf}$

$F_{dp} = F_{dp_upstream} + F_{dp_dnstream}$

$F_{dp} = 9294 \cdot \text{lbf}$

Step 7: Determine Required Thrust for Opening the Valve (Fr)

$$F_r = \frac{F_w + F_{pack} + F_p + F_{dp}}{TRF}$$

...where

$F_w = 0 \cdot \text{lbf}$...included in packing load

$F_{pack} = 4634 \cdot \text{lbf}$

$F_p = 147 \cdot \text{lbf}$

$F_{dp} = 9294 \cdot \text{lbf}$

$F_r = 14251 \cdot \text{lbf} < T_{limit} = 18025 \cdot \text{lbf}$ Thus, Satisfactory

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BY P. S. Higgins DATE 7/27/95
 CHKD. BY _____ DATE _____
 CALC. NO. _____ REV. _____
 SHEET NO. 7 OF 8

Step 6: Determine Differential Pressure Stem Thrust (Fdp)

Case 3: Small Break Loca (Time = 4 hours, bonnet pressurized)

Pbonnet = 37 psi

Pdnstream = 20 psi

Pupstream = 10 psi

$\Delta P_{upstream} = P_{bonnet} - P_{upstream}$

$\Delta P_{dnstream} = P_{bonnet} - P_{dnstream}$

Fbn = 1 ...bernoulli force correction factor (assumed negligible)

$F_{dp_upstream} = \Delta P_{upstream} \cdot \mu \cdot F_{bn}$

$F_{dp_upstream} = 6434 \cdot \text{lbf}$

$F_{dp_dnstream} = \Delta P_{dnstream} \cdot \mu \cdot F_{bn}$

$F_{dp_dnstream} = 4051 \cdot \text{lbf}$

$F_{dp} = F_{dp_upstream} + F_{dp_dnstream}$

$F_{dp} = 10485 \cdot \text{lbf}$

Step 7: Determine Required Thrust for Opening the Valve (Fr)

$$F_r = \frac{F_w + F_{pack} + F_p + F_{dp}}{TRF}$$

...where

$F_w = 0 \cdot \text{lbf}$...included in packing load

$F_{pack} = 4634 \cdot \text{lbf}$

$F_p = 147 \cdot \text{lbf}$

$F_{dp} = 10485 \cdot \text{lbf}$

$F_r = 15457 \cdot \text{lbf} < T_{limit} = 18025 \cdot \text{lbf}$ Thus, Satisfactory

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 CHKD. BY _____ DATE _____
 CALC. NO. _____ REV. _____
 SHEET NO. 8 OF 8

Step 6: Determine Differential Pressure Stem Thrust(Fdp)

Case 4: Small Break Loca (Time = 4 hours, bonnet pressure = downstream pressure)

Pbonnet := 20-psi

Pdnstream := 20-psi

Pupstream := 10-psi

$\Delta P_{upstream} := P_{bonnet} - P_{upstream}$

$\Delta P_{dnstream} := P_{bonnet} - P_{dnstream}$

Fbn := 1 ...bernoulli force correction factor (assumed negligible)

$Fdp_{upstream} := A_{dp} \Delta P_{upstream} \cdot F_{bn}$

$Fdp_{upstream} = 2383 \cdot lbf$

$Fdp_{dnstream} := A_{dp} \Delta P_{dnstream} \cdot F_{bn}$

$Fdp_{dnstream} = 0 \cdot lbf$

$Fdp := Fdp_{upstream} + Fdp_{dnstream}$

$Fdp = 2383 \cdot lbf$

Step 7: Determine Required Thrust for Opening the Valve(Fr)

$$Fr := \frac{F_w + F_{pack} + F_p + F_{dp}}{TRF}$$

...where

$F_w = 0 \cdot lbf$...included in packing load

$F_{pack} = 4634 \cdot lbf$

$F_p = 147 \cdot lbf$

$F_{dp} = 2383 \cdot lbf$

$Fr = 7254 \cdot lbf$ < $T_{limit} = 18025 \cdot lbf$ Thus, Satisfactory

MP-2

Portions from SP 21136, Rev. 9

Procedure to monitor and fill containment sump piping to prevent
pressure locking of 2-CS-16.1 A/B

TABLE OF CONTENTS

<u>PROCEDURE SECTION</u>	<u>SECTION TITLE</u>	<u>PAGE NO.</u>
7.13	Failure Mode Testing of Valve 2 - SI - 312 (Eng. Form 21136-1G)	42
7.14	Full Stroke Testing and Stroke Time Testing of Valve 2 - CS - 13.1B (Eng. Form 21136-1G)	43
7.15	Full Stroke Testing (OPEN) the "A" LPSI Pump Minimum Flow Recirculation Line Check Valve 2 - SI - 448 (Eng. Form 21136-1H)	45
7.16	Full Stroke and Stroke Time Testing of Valves 2 - SI - 615, 2 - SI - 625, and Stroke Testing of 2 - SI - 400 (Eng. Form 21136-1H)	45
7.17	Full Stroke Testing (OPEN) the "B" LPSI Pump Minimum Flow Recirculation Line Check Valve 2 - SI - 451 (Eng. Form 21136-1D)	48
7.18	Full Stroke and Stroke Time Testing of Valves 2 - SI - 635 and 2 - SI - 645 (Eng. Form 21136-1D)	49
7.19	Full Stroke Testing (OPEN) the "A" Containment Spray Pump Discharge Check Valve 2 - CS - 2A and the "A" Containment Spray Pump Minimum Flow Recirculation Line Check Valve 2 - CS - 6A and the Recirculation (Eng. Form 21136-1E) Check Valve 2-65-26	51
7.20	Part Stroke Testing (OPEN) the Containment Sump Outlet Check Valve 2 - CS - 15A and verifying CTMT Sump (Eng. Form 21136-1E) Suction Piping is Full	53
7.21	Part Stroke Testing (OPEN) the Containment Sump Outlet Check Valve 2 - CS - 15B and verifying CTMT Sump (Eng. Form 21136-1E) Suction Piping is Full	55
7.22	Full Stroke and Stroke Time Testing of Valve 2 - CS - 4.1A (Eng. Form 21136-1E)	57
7.23	Full Stroke and Stroke Time Testing of Valve 2 - CS - 16.1A (Eng. Form 21136-1E)	59
7.24	Full Stroke Testing (OPEN) the "B" Containment Spray Pump Discharge Check Valve 2 - CS - 2B and the "B" Containment Spray Pump Minimum Flow Recirculation Line Check Valve 2 - CS - 6B (Eng. Form 21136-1F)	61

ch 15

ch 14
ch 15 change 4
ch 15

ch 14