Callaway Plant
Post Office Box 620
Fulton, Missouri 65251

UNION ELECTRIC

April 8, 1994

U.S. Nuclear Regulatory Commission
Mr. Thomas Scarbrough
Mail Stop 7E23 OWFN
Washington, DC 20555-0001

Enclosed are the following documents requested during the April 7, 1994 conference call regarding Callaway's GL 89-10 closure document.

1) RFR-8746I - Verify the Thrust Requirements for MOV's Using Grouping. Reference Question No. 8

2) Graph titled "Measured Coefficients of Friction for Rising Steam Valves". Reference Question No. 5.3

We are also gathering further information to support discussions regarding questions numbers 3, 7 and 12.

Please contact me if you need additional information.

Mark Reidmeyer
QA Engineer
314-676-4306

MAR/tmw

Enclosures

cc: NRCI 94002
S. H. Reed, UENE MOV Engineer
314-676-8540
D. E. Shafer, UE Licensing

140043

9406160059 940408
PDR ADOCK 05000483
P PDR

DF01

REPORT: NERP8171
PAGE : 1

UNION ELECTRIC COMPANY
REQUESTS FOR RESOLUTION SYSTEM
RFR TRAVELER SHEET

DATE: 01/21/94
TIME: 15:47

RFR NUMBER: 8746 I

RFR SUMMARY: VERIFY THE THRUST REQ'T FOR MOV'S USING GROUPING

DRAWING CHANGES REQUIRED: N
TEXT CHANGES REQUIRED: N

LIR: Y
DIR: N
NSE: N

ATTACHMENT	PAGES	ATTACHMENT	PAGES
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ATTACHMENT 2	2	ATTACHMENT 3	2
ATTACHMENT 4	4	ATTACHMENT 5	11
ATTACHMENT 6	3	ATTACHMENT 7	13
ATTACHMENT 8	74	ATTACHMENT 9	4

TO:	DATE:	FROM:
SHR	1-21-94	Raw
DEH	1-22-94	SHR

NOTES: No remaining action 1-24-94 deh

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REPORT: NERP8161                     UNION ELECTRIC COMPANY                          DATE: 04/06/94
PAGE  : 1                         REQUESTS FOR RESOLUTION SYSTEM                     TIME: 10:05
                                        RFR PRINT            RFR#:   8746 REV: I     FILE CODE: E170.0102


                                  STATUS          PRIORITY
RFR NUMBER   REV   STATUS          DATE      PRI   DATE       CATEGORY                         SYSTEMS
----------   ---   ------        --------    ---  --------    --------     ------------------------------------------------
   8746       I      90          19940124    10   19931213    M V          AL  BB  BG  EN  LF  EJ  BN  EG  EM  EP
                                                                           KA  KC

ALARA:          N               NPDES:  N     PERSONNEL SAFETY CONCERN: N

BUILDINGS:

PLAN  PGMS:     MV

COMPONENTS :    ALHV0034         ALHV0035         ALHV0036         BBHV0013         BBHV0014
                BBHV0015         BBHV0016         BBHV8000A        BBHV8000B        BBHV8037A
                BBHV8037B        BBHV8351A        BBHV8351B        BBHV8351C        BBHV8351D
                BBPV8702A        BBPV8702B        EJHV8701A        EJHV8701B        BGHV8100
                BGHV8112         BGHV8109         BGLCV0112B       BGLCV0112C       BNHV0003
                BNHV0004         BNHV8812A        BNHV8812B        EGHV0011         EGHV0012
                EGHV0013         EGHV0014         EGHV0062         EGHV0132         EJHV8811A
                EJHV8811B        EMHV8807A        EMHV8807B        ENHV0001         ENHV0006
                ENHV0007         ENHV0012         ENHV0015         ENHV0016         EPHV8808A


KEYWORDS    :   SETPOINTS


REFERENCES :    RFR  010324A             RFR  005353I            CORR ULNRC 1755          RFR  008746C
                RFR  008746G             CALC ZZ-117
SUPPLEMENTS:         0          0          0

SUPPLEMENTED BY:
SUPERSEDES:       9878 A    9878 B        0

SUPERSEDED BY:

RFR SUMMARY:    VERIFY THE THRUST REQ'T FOR MOV'S USING GROUPING

FULL DESC:      THE MOV'S REFERENCED ARE MOV'S THAT HAVE HAD THRUST REQUIREMENTS TO
                ENSURE OPERABILITY UNDER DESIGN BASIS CONDITIONS DETERMINED USING
                INFORMATION FROM SIMILAR VALVES, THAT HAVE BEEN DP TESTED.  THE THRUST
                REQUIREMENTS FOR THE MOV'S THAT HAVE NOT BEEN DP TESTED MAY NEED TO BE
                REVISED AS THE THRUST REQUIREMENTS FOR THE VALVES THAT HAVE BEEN DP
                TESTED HAVE RECENTLY BEEN RECALCULATED USING CLOSE CALIBRATION
                TECHNIQUES.



  *R337008746I*
 *008746 I*
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PROPOSED RES: DETERMINE REVISED THRUST REQUIREMENTS FOR THOSE MOV'S THAT HAVE BEEN SET UP USING INFORMATION FROM OTHER MOV'S THAT HAVE BEEN DP TESTED. ALSO, DETERMINE IF THERE ARE OTHER MOV'S THAT SHOULD HAVE THRUST REQUIRMENTS DETERMINED USING THIS METHOD VERSUS THE MOVATS DP DATA BASE.

CLOSURE DESC: The scope of this rfr has been expanded from what was first requested in this rfr. Instead of only evaluating those mov's whose thrust requirements were previously determined from the grouping of other mov's dp tested at callaway the thrust requirements for all mov's not dp tested to the criteria of edp-zz-01114 were re-evalauted. Some of these mov's previously had thrust requirements based on the movats dp data base, calculations or grouping of mov's dp tested at callaway. It is intended that this rfr will supercede all of these other evaluations and provide the final thrust requirements that will be used for generic letter 89-10. The dp thrust values previously provided by the movats dp data base (calc zz-117) will be voided (CATS 41501 will track this action). The revised thrust values from this RFR are summarized on Attachment 4. Note that some of these thrust requirements are commercial values. In addition, the present minimum available thrust from the most recent MOVATS test was compared with the new thrust requirements being developed in this RFR and also RFR 8746G. This was also done for rev G but was not documented. For traceability this review is being included with this RFR. No operability concerns have been identified with the present setup of any safety related MOV with an active safety function.

COMMENTS: also covered in this rfr are the following mov's
emhv8924
ephv8808b,c,d
kahv0030
kchv0253
lffv0095 and lfhv0105&106
efpdv0019 and 20

***** APPROVALS/SIGNATURES SECTION *****

ORIGINATOR: WINK ROGER C ORIG DATE: 19931210 ORIG. DEPT: NESM
ORIG SUPERVISOR: HEINLEIN DAVID E APPROV DATE: 19931213
ORIG DEPT HEAD: MCGRAW JOHN A APPROV DATE: 19931213
DES. SUPV. ENG: MAXWELL DANIEL J
RESP SUPV. ENG: HEINLEIN DAVID E DEPT: NESM
RESP INDIVIDUAL DISP: WINK ROGER C FORECAST DATE: 19940107
QUALIFIED REVIEWER: REED STEVEN H QR DATE: 19940122
SUPV ENG REVIEW: HEINLEIN DAVID E REVIEW DATE: 19940124
PLANT MGR MINOR MOD: APPROVAL DATE: 0
ORC MEETING NBR: ORC ACCEPTABLE:

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                    ***** ATTACHMENTS SECTION *****

NUCLEAR SAFETY EVALUATION: N
LICENSING IMPACT REVIEW:   Y
DESIGN IMPACT REPORT:      N

        ATTACHMENT              PAGES           ATTACHMENT            PAGES           ATTACHMENT            PAGES
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DETERMINATION OF THRUST VALUES    14   ATTACHMENT 1                       2  ATTACHMENT 2                       2
ATTACHMENT 3                       2   ATTACHMENT 4                       4  ATTACHMENT 5                      11
ATTACHMENT 6                       3   ATTACHMENT 7                      13  ATTACHMENT 8                      74
ATTACHMENT 9                       4                                      0                                     0
                       CLASS     VALID   UPDATE    NOT./
DRAW/DOC NUMBER          1      DOCCNTL   RESP    RECEIPT     UPDATED         RESPONSIBLE INDIVIDUAL
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                          **** END OF REPORT ***
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LICENSING IMPACT REVIEW

(1) This review is applicable to RFR 8746I

IN ANSWERING THE FOLLOWING QUESTIONS, REFER TO ATTACHMENT 4 OF APA-ZZ-00140.

(2) 10CFR 50.59 APPLICABILITY

(2.1) ☐ No Formal Safety Evaluation Required.
(Refer to Attachment 4 of APA-ZZ-00140, justify your findings in Section 7, and proceed to Section 3)

(2.2) ☐ Outside Safety Evaluation
(Attach CA-#1340 and proceed to Section 3)

(2.3) SAFETY EVALUATION SCREENING

(2.3.1) Yes ___ No ✓ A proposed change to the facility as described in the FSAR?

(2.3.2) Yes ___ No ✓ A change to procedures as described in the FSAR?

(2.3.3) Yes ___ No ✓ A test or experiment not described in the FSAR?

(2.3.4) Yes ___ No ✓ A change to the Technical Specifications?

If any question in this section is answered "Yes", complete a Formal Safety Evaluation per APA-ZZ-00140. If the answers are all "No", use Section 7.0 to provide a written evaluation why an Unreviewed Safety Question does not exist.

NOTE *Changes to the FSAR or Technical Specifications require additional processing in accordance with APA-ZZ-00108.*

(3) EQUIPMENT QUALIFICATION IMPACT REVIEW

Does this modification/change involve:

(3.1) Yes ✓ No ___ An activity which involves any safety-related structure, system, equipment, or component?

If no, then mark questions 3.2 through 3.8 "N/A" and proceed to question 3.9.

(3.2) Yes ___ No ✓ N/A ___ Installation of a new or modification to an existing system, subsystem, equipment or component involving the issuance of a new design specification and/or the assignment of new equipment tag numbers?

If yes, then mark question 3.3 "N/A" and proceed to question 3.4.

(3.3) Yes ___ No ✓ N/A ___ An activity which will modify or change any system, equipment or component which must function in a harsh post accident environment? (LOCA, MSLB or HELB Category A or B in FSAR Table 3.11(B)-3)

If no, then mark questions 3.4 through 3.6 "N/A" and proceed to question 3.7.

This review is applicable to RFR 8746I

(3.4) Yes ___ No ___ N/A ✓ For equipment or component changes to items identified as being required to function in a harsh post accident environment (i.e., LOCA, MSLB, or HELB Category A or B in FSAR Table 3.11(B)-3), a change in organic (soft) parts from those specified for the existing equipment or component (e.g., O-rings, packing, gaskets, active or pressure boundary rubber/plastic parts, insulation, etc.)?

(3.5) Yes ___ No ___ N/A ✓ Relocation of existing equipment or installation of new equipment such that submergence after an accident is an issue (compare intended location against FSAR Table 3.6-6)?

(3.6) Yes ___ No ___ N/A ✓ For equipment or component changes, a change in performance characteristics that could impact safety functions (e.g., changes in instrument accuracy)?

(3.7) Yes ___ No ✓ N/A ___ For equipment or component changes, a significant change in size, mass, orientation, mounting, or center of gravity from that of the existing configuration (e.g., a valve mass change of more than 20% or 20 lbs., per the guidance of EPRI-NP-5639)?

(3.8) Yes ___ No ✓ N/A ___ For equipment or component changes, a change to internal parts that may impact Seismic Qualification?

(3.9) Yes ___ No ✓ A change such that the containment spray system could cause the pH of the delivered spray to be outside the range of 4.0 to 11.0?

(3.10) Yes ___ No ✓ An activity which will cause any safety-related system, equipment or component to be moved from its currently installed location to another room?

(3.11) Yes ___ No ✓ The possibility of environmental changes to rooms or areas containing safety-related structures, systems, equipment or components (i.e., changes in radiation level, or source terms, temperature profiles, pressure profiles, humidity profiles, flood levels or relocation of a high energy line)?

(3.12) Yes ___ No ✓ An activity which will modify or change any system, equipment or component listed as LOCA, MSLB, or HELB Category C or D in FSAR Table 3.11(B)-3 such that Seismic Qualification may be impacted?

(3.13) Yes ___ No ✓ Does the modification, change, or review involve a possible Seismic II/I question or affect Seismic Category I Stress Problems?

2933 (3.14) Yes ___ No ✓ The possibility of adding an unqualified coating (paint) to the Reactor Building or on items capable of blocking the containment sump?

40922 If any of questions 3.2 through 3.12 are marked "Yes", then the environmental and/or seismic qualification impact shall be verified per APA-ZZ-00390. Such verification must be performed by the EQ/Materials Support group or Licensing and documented in Section 8. This verification shall be coordinated with Design Control prior to affected equipment being released to service.

40922 Requests for Resolution (RFRs) that deal with material equivalency and affect Category A and B equipment (see question 3.3) must be considered for inclusion into the EQ files. If the files are impacted, an EQ Change Notice shall be generated IAW APA-ZZ-00390.

If question 3.13 is marked "Yes", address the notes/questions listed in Attachment 4, Para. 3.13. Appropriate records (Example - Formal Safety Evaluation, DIR, etc.) will be generated by the Evaluating Engineer to document the evaluation. In addition, complete CA-#1077, "Seismic II/I Hazards Analysis Review". The original CA-#1077 is to be attached to the "LIR" and a copy forwarded to the Supervising Engineer - Civil/Fire Protection/Design Bases.

If Question 3.13 is marked "NO", a Seismic II/I question does not exist due to the nature of the modification, change, or review.

If Question 3.14 is marked "YES", the Civil/Fire Protection/Design Bases Design Control group should be contacted for assistance on reviews.

This review is applicable to RFR 8746I

4497 (4) ENVIRONMENTAL EVALUATION

This modification/change involves:

(4.1) Yes ____ No ✓ An increase in thermal power above the currently licensed level?

(4.2) Yes ____ No ✓ An increase in noise level?

(4.3) Yes ____ No ✓ A physical change to site grounds or plant layout ?

(4.4) Yes ____ No ✓ An adverse impact on area wildlife and/or vegetation?

(4.5) Yes ____ No ✓ A change in the rate, quantity, concentration, or composition, or temperature of liquid effluents or any NPDES permitted outfall?

(4.6) Yes ____ No ✓ A change in the rate, quantity, concentration, or composition of gaseous effluents?

(4.7) Yes ____ No ✓ A change in particulate emissions rate, concentration, or composition?

42916 (4.8) Yes ____ No ✓ Any excavation on UE property outside of the Owner Controlled Area fence or any excavation disturbing five acres or more on UE property?

42427 (4.9) Yes ____ No ✓ A possible change to the facility's potential for the discharge of oil into or upon the navigable waters of the U.S.?

(4.10) Yes ____ No ✓ A significant increase in any adverse environmental impact <u>previously</u> evaluated in NUREG 0813 (FES-OL)?

(4.11) Yes ____ No ✓ A matter which has <u>not</u> been previously evaluated in NUREG 0813 (FES-OL) which may have a significant adverse environmental impact?

If the answer to any of the above questions is "Yes", a Final Environmental Evaluation must be performed by Radiological Engineering Department. If all of the questions in this section are marked "No", an unreviewed environmental question does not exist and a Final Environmental Evaluation is not required.

(5) 10 CFR 50.54 APPLICABILITY DETERMINATION

This modification/change involves:

(5.1) Yes ____ No ✓ A change to the Radiological Emergency Response Plan (RERP?)

(5.2) If yes, forward to the Supervisor, Emergency Preparedness to answer the following question:

Is RERP effectiveness reduced? ☐ Yes ☐ No

(Provide basis for this response in Section 8 of this form and sign below.)

________________________ ____/____/____

Supervisor, Emergency Preparedness

(5.3) Yes ____ No ✓ A change to the Physical Security or Contingency Plan?

(5.4) If yes, forward to the Superintendent, Security to answer the following question:

Is Security effectiveness reduced? ☐ Yes ☐ No

(Provide basis for this response in Section 8 of this form and sign below.)

________________________ ____/____/____

Superintendent, Security

This review is applicable to RFR 8746I

(5.5) Yes ____ No ✓ A change to the Operating Quality Assurance Manual (OQAM) including the Supplemental QA Programs?

(5.6) If yes, forward to the Supervising Engineer, Quality Assurance for completion of a Quality Assurance evaluation.

Is Quality Assurance reduced? ☐ Yes ☐ No

(Provide basis for this response in Section 8 of this form and sign below.)

______________________________ ____/____/____

Supervising Engineer, Quality Assurance

(6) CERTIFICATIONS

(6.1) FIRE PROTECTION REVIEW

(6.1.1) Yes ____ No ✓ This modification/change/review may involve a change to one or more aspects of the approved Fire Protection Program as defined in the checklists of EDP-ZZ-04044, Fire Protection Reviews.

If yes, document areas of concern and resolution in Section 8 of the LIR or on a Design Input Report (DIR) and have a Fire Protection Engineer perform a cross-disciplinary review of the LIR or DIR per EDP-ZZ-04044.

(6.1.2) Yes ____ No ✓ This modification/change/review involves an addition of combustible or flammable material.

If yes, evaluate the need for a "Combustible/Flammable Material Addition" form IAW EDP-ZZ-04044. Proceed to question 6.1.3.

(6.1.3) Yes ____ N/R ✓ CA-#1855 from EDP-ZZ-04044 attached to LIR and copy sent to Supervising Engineer - Civil/Fire Protection/Design Bases.

621 (6.2) ALARA REVIEW (complete one section: EITHER Sect. 6.2.1 OR 6.2.2)

(6.2.1) Modification - Specific(applicable for CMPs, RMPs, EMPs and Minor Modifications)

Yes ____ No ____ Will this modification require work within the Radiological Controlled Area (RCA)?

Yes ____ No ____ Will this modification require work on a system containing or potentially containing radioactive material?

Yes ____ No ____ Will this modification involve work on a system which connects to or interfaces with a system or component storing, transferring, or handling radioactive material?

Yes ____ No ____ Will this modification or associated implementation or operation involve modification, removal, or installation of shielding?

Yes ____ No ____ Will this modification involve radioactive waste generation?

If the answer to any of the questions above is "yes", an ALARA design review is required per Nuclear Engineering Design Guide ZZ-003-00. If ZZ-003-00 requirements cannot be met, an ALARA review must be performed by Radiological Engineering.

☐ Documentation detailing the results of this review is included in Section 8 of the LIR.

☐ All answers to the above questions are "No" and it is certified that the proposed change does not increase potential radiation exposures beyond the exposures that already exist.

(6.2.2) GENERIC

☑ I hereby certify that the proposed change does not increase potential radiation exposures beyond the exposures that already exist.

This review is applicable to RFR 8746I

☐ This change required further evaluation by a qualified ALARA reviewer per Nuclear Engineering Design Guide ZZ-003-00. Documentation of this review is included in Section 8 of the LIR.

(6.3) ODCM/PCP REVIEW

(6.3.1) Yes ____ No ✓ This modification/change/review may impact the Process Control Program (PCP) as detailed in APA-ZZ-01011.

(6.3.1.1) If yes, forward to the Superintendent, Chemistry & Radwaste to answer the following two questions in accordance with Administrative Technical Specification 6.13.

Is the overall conformance of the solidified waste product to existing criteria for solid wastes reduced?

☐ Yes ☐ No

2814 Does this modification/change/review require a change to the PCP?

☐ Yes ☐ No

(Provide basis for this response in Section 8 of this form and sign below)

______________________ ____________ ____/____/____

Superintendent, Chemistry and Radwaste

(6.3.2) Yes ____ No ✓ This modification/change/review may impact the Off-site Dose Calculation Manual (ODCM) as detailed in APA-ZZ-01003.

(6.3.2.1) If yes, forward to the Superintendent, Health Physics to answer the following two questions in accordance with Administrative Technical Specification 6.14.

Is the accuracy of effluent release calculations, dose calculations or setpoints determinations reduced?

☐ Yes ☐ No

2815 Does this modification/change/review require a change to the ODCM?

☐ Yes ☐ No

(Provide basis for this response in Section 8 of this form and sign below)

______________________________ ____/____/____

Superintendent, Health Physics

This review is applicable to RFR 8746 I

(6.4) HUMAN FACTOR EVALUATION

This Modification/Change involves:

(6.4.1) Yes ____ No ✓ A change to the Main Control Board (RL001 through RL028) or Auxiliary Shutdown Panel (RP118)?

(6.4.2) Yes ____ No ✓ A change to the Plant Annunciator Window location, engraving, etc.?

(6.4.3) Yes ____ No ✓ A change to the Control Room temperature, air velocity, lighting, ambient sound level, etc.?

(6.4.4) Yes ____ No ✓ A change to the Auxiliary Shutdown Panel Room lighting?

If the answer to any of the above is "YES", prepare a brief description of the modification/change and forward to the Human Factors Design Review Engineer. If all of the above are "NO", a Human Factor Review is not required. However, if controls, instrumentation, etc. change to other locations, a Human Factor Review should be requested.

N/R ____ / ____ / ____
Human Factors Design Review Engineer

(6.5) STATION BLACKOUT (SBO) EVALUATION

This Modification/Change involves:

(6.5.1) Yes ____ No ✓ Placing additional electrical load on the Station Batteries

(6.5.2) Yes ____ No ✓ Adding sources of heat in the Control Room (3601) or Equipment Cabinet Area (3605)

(6.5.3) Yes ____ No ✓ A change in the source of supplied power for any Containment Isolation Valve or its position indicators

(6.5.4) Yes ____ No ✓ A change in the source of supplied power for any safety-related or Station Blackout instrumentation or controls

(6.5.5) Yes ____ No ✓ A change that will increase the rate of Reactor Coolant inventory loss?

(6.5.6) Yes ____ No ✓ A reduction in the required Condensate Storage Tank volume

(6.5.7) Yes ____ No ✓ A reduction in the volume of backup nitrogen for the Auxiliary Feedwater Control or Steam Generator Atmospheric Relief valves

(6.5.8) Yes ____ No ✓ The addition of heat generating sources, that will be present after a loss of AC power, to any of the following rooms

1202	Access Area B & Chiller Surge Tank Area
1304	Auxiliary Feedwater Pipe Chase
1305	Auxiliary Feedwater Pipe Chase
1322	Piping Penetration Room B
1323	Piping Penetration Room A
1327	Auxiliary Feedwater Pump Valve Compartment No 2
1330	Auxiliary Feedwater Pump Valve Compartment No 4
1331	Turbine Driven Auxiliary Feedwater Pump Room
1408	Corridor No 2
1409	Electrical Penetration Room B
1411	Main Feedwater/Steam Tunnel
1412	Main Feedwater/Steam Tunnel
1501	Control Room A/C & Filtration Units Room B
—	Condensate Storage Tank Valve House
1508	Main Feedwater/Steam Tunnel
1509	Main Feedwater/Steam Tunnel
1512	Control Room A/C & Filtration Units Room A
3302	Engineered Safety Features Switchgear Room No. 2
3404	Switchboard Room No. 4
3405	Battery Room No. 4
3407	Battery Room No. 1
3408	Switchboard Room No. 1
3410	Switchboard Room No. 2
3411	Battery Room No. 2
3413	Battery Room No. 3
3414	Switchboard Room No. 3
4201	Condenser Pit

If the answer to any of the above is "YES", prepare a brief description of the modification/change and forward to the Station Blackout Review Engineer. If all of the above are "NO", then no Station Blackout Review is required.

N/R ____ / ____ / ____
Station Blackout Review Engineer

This review is applicable to RFR 8746T

(6.6) PROBABILISTIC RISK ASSESSMENT (PRA) REVIEW

This modification/change involves

(6.6.1) Yes ____ No ✓ A potentially PRA-significant change to a plant system.

(6.6.2) Yes ____ No ✓ A change to plant Technical Specifications.

(6.6.3) Yes ____ No ✓ A change to emergency operating procedures.

If the answer to any of the above is "Yes", prepare a PRA Evaluation Request (PRAER) Form (CA-#2237; ref. FDP-ZZ-04004, Performance of PRA Evaluations), and forward to the Supervising Engineer, Safety Analysis & Reactor Design. If all of the above are "No", a probabilistic risk assessment is not required.

N/R ____/____/____

PRA Engineer

(7) JUSTIFICATION FOR NO UNREVIEWED SAFETY QUESTION

Briefly state why this modification does not require a Formal Safety Evaluation; use guidelines in Attachment 4 of APA-ZZ-00140; attach extra sheets if necessary)

This RFR determines the thrust requirements for MOVs that have not been DP tested in accordance with EDP-ZZ-01114 and/or Generic Letter 89-10. A review has been performed comparing the present thrust setting vs the requirements provided in this RFR. No operability concerns were identified (refer to ATT 9) thus, no formal safety evaluation is required.

This review is applicable to RFR 8746I

(8) COMMENTS

List any special conditions or comments pertaining to these evaluations and certifications

(8) APPROVALS

Responsible Engineer Date 1-21-94

Qualified Reviewer Steven H. Reed Date 1-22-94

RFR 8746I DETERMINATION OF THRUST VALUES

INTRODUCTION

Generic Letter 89-10 requires that utilities differential pressure (DP) test safety related MOV's when practical in order to verify that these components will be capable of performing their intended safety function. RFR 10324A has been dispositioned and provides the reasoning why it is impractical to DP test selected safety related MOV's at Callaway[1]. It has been the Callaway Plants philosophy to DP test all safety related MOV's when practical , however, because of situations where an MOV cannot be adequately DP tested alternate methods are needed to determine how the thrust requirements for these MOV's can be established in order to satisfy GL 89-10 requirements. The purpose of this RFR is to describe for each safety related rising stem valve MOV that has not been DP tested to the criteria described in EDP-ZZ-01114, Motor Operated Valve Predictive Performance Program, how the thrust requirements are being established in order to satisfy Generic Letter 89-10 requirements. Note that RFR 10324A addressed both safety related rising stem and butterfly valve MOV's. This RFR is only addressing safety related rising stem MOV's as all safety related butterfly MOV's have already been evaluated[2].

Several attachments are provided with this RFR as summarized below:

Attachment 1:	Provides a comparison of actual DP test results vs. calculated thrust values. When DP test results are referred to they originate from this attachment.
Attachment 2:	Determines the calculated thrust values for valves discussed in this RFR that have not been DP tested.
Attachment 3:	Provides information regarding the Rate of Loading Factors used in this RFR.
Attachment 4:	Provides a summary of the final thrust values for values being evaluated in this RFR.
Attachment 5:	Provides seat ring dimensions for Westinghouse supplied MOV's.
Attachment 6:	Provides DP test information for ENHV0006 and 12 from Wolf Creek.
Attachmetnt 7:	Provides PRA information for MOV's discussed in this RFR
Attachment 8:	Provides the latest information from the EPRI MOV Predictive Performance Program.
Attachment 9:	Operability verification for the revised thrust requirements provided by RFR 8746I and G.

PRIMARY METHOD OF DETERMINING DP REQUIREMENTS FOR VALVES NOT DP TESTED

For those valves that cannot be DP tested the preferred method for determining thrust requirements has been to group similar MOV's that have been DP tested at Callaway and either using that data directly or demonstrating that the thrust requirements can be conservatively predicted using calculations.

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[1] Note that RFR 10324A stated that EFHV23,39,40,41,42 could not be DP tested to the criteria of EDP-ZZ-01114. These valves have been DP tested greater than 50% of the design DP per RFR 8746H. In addition, RFR 10324A did not refer to LFFV0095 and LFHV00105,106. These valves were DP tested but not to the criteria of EDP-ZZ-01114. EFPDV0019 and 20 thrust values are also determined in this RFR even through they are routinely DP tested near the design DP of 134 psid.

[2] RFR 8746H

noting

if VF ↓ as ΔP ↑ then this would not work

Before this method is considered reliable several conditions should be met. First the valves being used for comparison purposes must be of the same manufacturer and type. Secondly, the valves being used for comparison must meet the criteria listed below before the test results can be directly applied. If the test DP for valves being used for comparison are above the design DP of the valve(s) being evaluated the thrust values are reduced proportionately. Flow rates should also be considered when using similar valves to determine thrust requirements. Additionally, the similar valve(s) should be the same nominal size or larger. If these conditions are not satisfied the secondary method is employed.

Test DP must be 80% of design DP for valve not DP tested if design DP is > 260 psid
Test DP must be 50% of design DP for valve not DP tested if design DP is < 260 psid

SECONDARY METHOD OF DETERMINING DP REQUIREMENTS FOR VALVES NOT DP TESTED

The secondary method used to determine thrust requirements for MOV's not DP tested is use of a modified standard industry equation[3]. Listed below is the modified industry equation being used for gate and globe valves.

OPEN THRUST REQUIREMENTS = ROL x (DAxDPxVF)

CLOSED THRUST REQUIREMENT = ROL x ((DAxDPx VF) + SAx LP)

where: ROL= Rate of Loading ; set dependent on actuator size[4] (ranges from 15% to 22%)
DA = Mean Seat Area sq. inches
DP = Differential Pressure psid
VF = Valve Factor = .4 to 1.0 for flex wedge gate valves, 1.1 to 2.2 for globe valves and .4 for parallel disc/slide gate valves[5]
SA = Stem Area sq. inches
LP = Line Pressure

For example, refer to the information provided on Attachment 2 for ALHV0034:

ROL = 1.15
DA = 44.92 sq. in
DP = 135 psid in closed direction
VF = .5
SA = 1.22718 sq. in

Using the information above the closing thrsut requirements become:

CLOSED THRUST = (1.15) * ((44.92 *135 *.5) + (1.22718 * 135)) = 3677 lbs

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[3] Refer to EPRI NP-6660-D, Application Guideline for Motor Operated Valves in Nuclear Power Plants eqn 5-13

[4] Refer to Attachment 3

[5] Other valve factors may be used if supported by the results of EPRI Predictive Performance Program. If other valve factors are used they will be discussed in the individual section of this RFR.

Note that the open thrust equation is the same as the closing thrust equation with the exception of the SAxLP term. This term, commonly referred to as the piston effect would actually be negative in the open direction thus reducing the calculated thrust requirements further. This term is set equal to zero for conservatism. Also note that neither term includes a value for stem packing loads. This term is included during field testing where the packing loads are measured rather than being provided here based on generic guidelines.

In summary, the discussion above was intended to demonstrate the methodology being used at Callaway to satisfy GL 89-10 requirements with regards to establishing thrust requirements. Each of the 54 rising stem MOV's at Callaway that have not been DP tested to the criteria of EDP-ZZ-01114 and the basis for the thrust requirements to allow close-out of GL 89-10 is provided in this RFR. Note that some thrust requirements are being changed from that previously established in the Callaway Equipment List (CEL) to provide added conservatism while some MOV's have had thrust requirements relaxed because of unrealistic thrust requirements that were overly conservative. Finally, it will be noted that the weighting each MOV has on the Callaway Plant PRA is included on Attachment 7. No MOV's that are of high priority with respect to the Independent Plant Evaluation (IPE) have had there thrust requirements determined using the methods described in this RFR. Thus, any rising stem MOV that is considered to have high priority with respect to the IPE has been DP tested to the criteria of EDP-ZZ-01114.

ALHV0034,35,36: CST TO AFP SUCTION ISOLATION VALVES

These MOV's were partially DP tested during the IE Bulletin 85-03 program. However, the test DP (14 psid) was inadequate to satisfy the criteria of EDP-ZZ-01114 for extrapolation purposes. The present closing thrust requirements for ALHV0034,35,36 originated from RFR 8746D based on comparison of the thrust requirements from EGHV0058,59,60,71,126,127,130 and 131. However, in reviewing the valve design for these valves it became apparent that some of these valves should not be considered suitable for comparison as similar valves. ALHV0034,35,36 are Anchor Darling flex wedge gate (FWG) valves. EGHV0058,59,60,127,130 and 131 are also Anchor Darling valves but are of the parallel disc gate (PDG) design. The difference in the two designs are that the FWG valve discs are wedged downward into the sloped seating surface of the valve body whereas the PDG valves are thrust outward by a wedge assembly. The flex wedge design will have a higher valve factor assuming an equal disc friction coefficient because of the sloped seating surface. This still leaves EGHV0071 and 126 which are of the same design as ALHV0034,35,36 but of different sizes as described below.

VALVE ID	MANUFACTURER	TYPE	SIZE
ALHV0034	ANCHOR DARLING	FWG	8"
ALHV0034	ANCHOR DARLING	FWG	8"
ALHV0036	ANCHOR DARLING	FWG	10"
EGHV0071	ANCHOR DARLING	FWG	12"
EGHV0126	ANCHOR DARLING	FWG	12"

For ALHV0034,35,36 it is desired , since the valves sizes are different, to demonstrate that the thrust requirements for EGHV0071 and 126 can be approximated using calculations and a valve factor of .5 when compared with the actual DP test results. Once this has been shown the thrust requirements for ALHV0034,35,36 will be determined using calculations and a .5 valve factor. Attachment 1 provides the results of the DP test measurements for EGHV0071 and 126 and the calculations using the equations described in the Introduction section. The information from Attachment 1 is repeated here for reference.

VALVE ID	CALC CLOSED THRUST	MEASURED CLOSED THRUST
EGHV0071	5054 LBS	5267 LBS
EGHV0126	4951 LBS	4220 LBS

As can be seen the calculational method would have provided a good approximation of the closing thrust requirements for EGHV0071 and 126. Note that the thrust values listed above inherently include conservatism with respect to measured thrust due to the methods in which DP testing is performed at Callaway, i.e. include spring pack apparent spring pack preload.

ALHV0034,35 and 36 are installed in a system with basically the same fluid medium as EGHV0071 and 126, i.e. sub cooled liquid with a normal temperature less than 100 degrees Fahrenheit. The fluid velocity through EGHV0071 and 126 during the DP testing (~3300 GPM or 11.13 ft/sec[6]) is much greater than the worst case velocity for ALHV0034,35,36 (575 GPM or 3.7 ft/sec for ALHV0034,35 and 1145 GPM or 4.7 ft/sec through ALHV0036[7]).

Based on the discussion above the closing thrust requirements for ALHV0034,35,36 can be established using calculational methods. The revised closing thrust requirements for ALHV0034,35,36 are provided below. Note that the opening thrust requirements for ALHV0034,35,36 as provided in RFR 8746D remain unchanged.

ALHV0034,35 CLOSING THRUST REQUIREMENTS = 3677 LBS
ALHV0036 CLOSING THRUST REQUIREMENT = 4993 LBS

BBHV0013,14,15,16 RCP THERMAL BARRIER RETURN FLOW ISOLATION VALVES

These MOV's have been DP tested but did not satisfy the criteria for extrapolation provided in EDP-ZZ-01114 in the closed direction. These are MOV's that have no similar valves tested to a high enough pressure to compare DP test data with at Callaway. In referring to the EPRI Performance Prediction Program a 2.5" Velan FWG has been tested under blowdown conditions at 530 degrees F and 2660 psid. Under these conditions the disc friction coefficient is recorded as .328. Assuming a 5 degree wedge angle this corresponds to a valve factor of .340. The disc friction coefficient is converted to valve factor using the following equation[8].

$$\text{VALVE FACTOR} = \frac{\mu}{\text{COS } \Phi - \mu * \text{SIN } \Phi}$$

WHERE μ = APPARENT FRICTION COEFFICIENT
Φ = WEDGE ANGEL (ASSUMED 5 DEGREES)

The design basis conditions for BBHV0013,14,15,16, i.e. isolate under a thermal barrier break, are similar to the test conditions for the 2.5" Velan FWG valve. BBHV0013,14,15 and 16 are 3 inch Velan FWG valves. Since the design of these valves are the same and only the size is slightly different (2.5" vs. 3") the disc friction coefficient information provided above is considered valid for determining the thrust requirements for BBHV0013,14,15 and 16. For added conservatism a valve factor of .4 will be used in place of the .34 valve factor determined above.

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[6] Refer to Special Test Report for ETP-EG-ST002.

[7] Refer to FSAR Chapter 10.4

[8] Refer to EPRI MOV Program Review Meeting Minutes 12/1/93 included in Attachment 8.

Using the calculational method described previously with a .4 valve factor a closing thrust requirement of 8482 lbs closing thrust is obtained[9]. The opening thrust requirements provided by RFR 14359A should continue to be used as they are based on in situ DP testing within the criteria of EDP-ZZ-01114.

CLOSING THRUST REQUIREMENT FOR BBHV0013,14,15,16: 8482 LBS

BBHV8000A/B PORV BLOCK VALVES

The present opening and closing thrust requirements for BBHV8000A/B originate from RFR 5353I and are based on a comparison with other Westinghouse flex wedge gate valves that have been DP tested at Callaway. The design DP for these valves is 2485 psid open and 2335 psid closed. The test DP's for the valves used for comparison in RFR 5353I and their revised thrust measurements[10] to overcome the test DP is repeated below.

VALVE ID	SIZE	TEST DP	MEASURED OPEN THRUST	MEASURED CLOSED THRUST
BGHV8105	3"	2572 PSID	2490 LBS	10373 LBS
BGHV8106	3"	2572 PSID	4540 LBS	12127 LBS
EMHV8801A	4"	2677 PSID	4458 LBS	4221 LBS
EMHV8801B	4"	2677 PSID	6062 LBS	2815 LBS
EMHV8803A	4"	2727 PSID	10586 LBS	4632 LBS
EMHV8803B	4"	2702 PSID	3760 LBS	1567 LBS
EMHV8821A	4"	1595 PSID	4299 LBS	3934 LBS
EMHV8821B	4"	1540 PSID	4249 LBS	2709 LBS
EMHV8835	4"	1595 PSID	3650 LBS	N/A

BGHV8105 and BGHV8106 are the same size and type valve, have the largest measured closing thrust requirements and were DP tested at a pressure in excess of the design DP for BBHV8000A/B. Using the calculational method a closing thrust of 11630 lbs is obtained for comparison with the test DP thrust requirements on BGHV8105/8106. The calculations are comparable with the test results.

However, before using the DP test results from BGHV8105/8106 to predict bounding thrust requirements for BBHV8000A/B the differences between the DP test of BGHV8110&8111 and design conditions for BBHV8000A&B should be addressed. BGHV8105 & 8106 were tested under pumped flow, cold water conditions under relatively low flowrates (<120 GPM or less than 7.2 ft/sec) compared with what BBHV8000A/B would be expected to see. Under a design basis accident BBHV8000A/B would be expected to isolate under 2 phase blowdown conditions.

In referring to the EPRI MOV Predictive Performance Program a Westinghouse 3" FWG valve is being tested under high DP conditions at a nominal velocity of 15 ft/sec. Under these conditions an opening apparent friction coefficient of .313 is recorded. For the 7 degree wedge angle for this model valve this corresponds to a valve factor of .328 (refer to the discussion for BBHV0013,14,15 & 16 on how to calculate valve factor). In reviewing the EPRI study it is found that the opening apparent friction coefficients tend to bound or closely approximate the closing apparent friction coefficients in the high pressure cold/hot water test loop data. Thus, for non blowdown conditions it appears that a valve factor of below .5 could be justified. However, since these valves have not been DP tested under blowdown conditions the use of a .6 valve factor is recommended for BBHV8000A/B. Using the a valve factor of .6 the revised closing thrust becomes 11355 lbs.

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[9] Refer to Attachment 2

[10] Refer to RFR's 8746F&G

In the open direction using a .6 valve factor the thrust requirements for BBHV8000A/B become 9244 lbs.

It should also be noted that these are limit closed MOV's that will develop the torque/thrust necessary to overcome DP conditions up to locked rotor conditions. The capabilities of these MOV's to develop this amount of torque/thrust is provided by calculation ZZ-224.

BBHV8000A/B CLOSED THRUST REQUIREMENT = 11355 LBS
OPEN THRUST REQUIREMENT = 9244 LBS

BBHV8037A/B PRESSURIZER RELIEF TANK ISOLATION VALVES

These valves have had their thrust requirements determined using calculations as described in RFR 9878B. The thrust requirements using this method were determined to be 1100 lbs both open and closed for a design DP of 104 psid. The method used in RFR 9878B is slightly different than that used in this RFR disposition.

BBHV8037A/B are 4 inch Westinghouse FWG valves. There have been several 4" valves of this design DP tested under more severe conditions that BBHV8037A/B would be subjected to and well in excess of the design DP for BBHV8037A/B (refer to BBHV8000A/B section above). If one takes the largest measured closing thrust from the 4" valves that have been DP tested (EMHV8803A) and compares it to what would be determined using calculations and a 1.0 valve factor it is evident that the calculational method provides conservative results.

Based on this discussion the thrust requirements for BBHV8037A/B can be determined very conservatively using calculations. For consistency the thrust requirements are being recalculated via the method described in this RFR. For additional conservatism the thrust requirements have been calculated using a valve factor of 1.0.

BBHV8037A/B CLOSING THRUST REQUIREMENTS 1337 LBS
OPENING THRUST REQUIREMENTS 1190 LBS

BBHV8351A,B,C,D RCP SEAL INJECTION ISOLATION VALVES

MOV's BGHV8110 and 8111 are identical MOV's that have been DP tested at 2582 and 2824 psid respectively. BGHV8110 and 8111 are the same size globe valve and were tested under higher flowrates (~ 60 GPM) than what BBHV8351A,B,C and D provide. BGHV8110 and 8111 are the CCP minflow line isolation valves that have flowrates limited to 60 GPM by use of an upstream orifice. BHV8351A,B,C and D normally have a combined flow rate of ~32 GPM (or ~ 8 GPM each) to supply the RCP seals. These valves are 2" Velan globe valves with flow under the seat. These valves have been determined to not have an active safety function but for commercial considerations it is desired to have their thrust requirements established to overcome a DP of 2813 psid[11]. In reviewing the DP data for BGHV8110 and BGHV8111 it is discovered that the amount of thrust to overcome the test DP was less than the apparent preload of the spring packs. Thus, the amount of thrust to overcome those test DP's had to have been less than the apparent preload of the spring packs. Since BGHV8111 was tested at a DP above the commercial DP for BBHV8351A,B,C,D the closed apparent preload from BGHV8111 will be used for the open and closed thrust requirements for BBHV8351A,B,C,D.

BBHV8351A,B,C,D OPEN AND CLOSING THRUST REQUIREMENT = 7039 LBS

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[11] Based on the disposition of RFR 5353G and SOS 90-1584 it was determined that these valves have no active safety function to open or close. RFR 5353X provides a commercial DP.

BBPV8702A,B EJHV8701A,B RHR PUMP SUCTION ISOLATION VALVES FROM RCS LOOPS 1 & 4

There are no other valves of the same size at Callaway that have been adequately DP tested for comparison. BBPV8701A/B & EJHV8702A/B are 12" Westinghouse FWG valves. Additionally, there is limited information available in the EPRI Performance Prediction Program for this size and type of valve. What is provided in the EPRI program is an apparent friction coefficient for the 3" Westinghouse FWG valve discussed earlier in the section for BBHV8000A/B. The valve factor for this 3" valve is .328. Because of the limited information with regard to this size of valve it is recommended that the .5 valve factor continue to be used. Using calculations and a .5 valve factor the thrust requirements for these valves become:

BBPV8702A/B EJHV8701A/B OPENING THRUST REQUIREMENTS 19761 LBS
CLOSING THRUST REQUIREMENTS 28065 LBS

BGHV8100 & 8112 RCP SEAL WATER RETURN ISOLATION VALVES

A review of valves DP tested at Callaway indicates that BGHV8110 & 8111 are identical valves that have been DP tested. These valves are 2" Velan globe valves with flow under the seat. The DP testing for BGHV8110/8111 was at significantly higher DP's and flowrates (~60 GPM and ~2600 psid) than the design DP and nominal flowrate for BGHV8100/8112 (155 psid and <32 GPM). Refer to the previous discussion for BBHV8351A,B,C,D. BGHV8100/8112 will experience lower flowrates than the BBHV8351's since a portion of RCP seal injection goes into the RCS.

Both BGHV8110 and 8111 had thrust requirements to overcome the test DP less than spring pack preload so a determination of the actual thrust requirements for these valves is unknown. Calculations indicate that the thrust required to open/close against 155 psid is 541 lbs and 736 lbs respectively.

It is known that BGHV8111 was tested at a DP significantly higher than the design DP for BGHV8100/8112 and it is known that the thrust requirement for BGHV8111 was less than the measured apparent spring pack preload from BGHV8111. Therefore, the thrust requirements for BGHV8100/8112 must be less than the apparent spring pack preload for BGHV8111. For extreme conservatism the thrust requirements for BGHV8110/8111 will be set equal to the apparent spring pack preload from BGHV8111 (7039 lbs).

BGHV8100 & 8112 OPEN & CLOSING THRUST REQUIREMENT = 7039 LBS

BGHV8109 NORMAL CHARGING PUMP MINIFLOW ISOLATION VALVE

This valve is identical to those discussed above for BGHV8110 & 8112. Based on the closing design DP for BGHV8109 (2818 psid) being near the test DP for BGHV8111 (2842 psid) the closing test data for BGHV8111 will be used as the closing thrust requirements for BGHV8109.

As stated previously the closing thrust requirements to overcome the test DP for BGHV8111 were less than spring pack preload so a determination of the actual thrust requirements is unknown. The spring pack preload for BGHV8111 is 7039 lbs. It is known that the thrust required to overcome DP for BGHV8111 is below this value.

In the open direction it is known that this valve requires no assistance from the motor operator to open[12]. This valve has been known to open by itself with line pressure as the operator is de clutched. For conservatism the opening thrust requirements will be established based on calculations.

BGHV8109 CLOSING THRUST REQUIREMENTS 7039 LBS

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[12] refer to RFR 7263A

OPENING THRUST REQUIREMENTS 328 LBS

BGLCV0112B,C CHARGING PUMPS SUCTION ISOLATION VALVES FROM VCT

These MOV's were included in the response to NRC I.E. Bulletin 85-03. Because these valves could not be adequately DP tested as discussed in RFR 10324A and ULNRC 1755 the thrust requirements for these valves were determined using valves of the same design but different sizes. In preparing for and testing MOV's in accordance with GL 89-10, additional Westinghouse FWG valves of the same type and size have been DP tested at significantly higher DP's and flowrates than the design DP of 100 psid for BGLCV0112B/C. Refer to the table below.

VALVE ID	SIZE	TEST DP	MEASURED OPEN THRUST	MEASURED CLOSED THRUST
EMHV8801A	4"	2677 PSID	4458 LBS	4221 LBS
EMHV8801B	4"	2677 PSID	6062 LBS	2815 LBS
EMHV8821A	4"	1595 PSID	4299 LBS	3934 LBS
EMHV8821B	4"	1540 PSID	4249 LBS	2709 LBS
EMHV8835	4"	1595 PSID	3650 LBS	N/A

If one calculated the thrust requirements for BGLCV0112B/C a thrust requirement of 1286 lbs closed and 1145 lbs open would be obtained using valve factor of 1.0. These valves were previously set up for 3110 lbs open and 1965 lbs closed. Since these MOV's are capable of providing significantly higher thrust and for added conservatism it is recommended that the thrust values for BGLCV0112B/C be set up to the largest open and closed thrust measurement listed in the table above.

BGLCV0112B/C CLOSING THRUST REQUIREMENT: 4221 LBS
OPENING THRUST REQUIREMENT 6062 LBS

BNHV0003,4 RWST TO CTMT SPRAY PUMP ISOLATION VALVES

These valves presently have thrust requirements established using calculations in accordance with RFR 9878A. The method used in RFR 9878A is slightly different than that used in this RFR. For consistency the thrust requirements are being recalculated in this RFR. As shown on Attachment 2 the re-calculated values become 3356 lbs closed and 3301 lbs open using a valve factor of 1.0 to overcome the design DP of 32 psid.

In referring to the DP tests performed at Callaway the only valves comparable are EGHV0071 and 126. The only significant difference between these valves types are that BNHV0003/4 are stainless while EGHV0071/126 are carbon steel valves. Listed below are the measured thrust requirements from EGHV0071/126. The DP test for EGHV0071 was at 94 psid and the test for EGHV0126 at 92 psid.

VALVE ID	MEASURED OPEN THRUST	MEASURED CLOSED THRUST
EGHV0071	4885 LBS	5267 LBS
EGHV0126	1982 LBS	4220 LBS

As can be seen with the data above, if the thrust values for EGHV0071 is derated to the design DP for BNHV0003&4 lower values than that calculated above would be obtained. For added conservatism the thrust requirements for BNHV0003&4 will be based on a valve factor of 1.0

BNHV0003&4 OPENING THRUST REQUIREMENT 3301 LBS
CLOSING THRUST REQUIREMENT 3356 LBS

BNHV8812A,B RWST TO RHR PUMP SUCTION ISOLATION VALVES

There are no other valves of the same size at Callaway that have been adequately DP tested for comparison. These are 14" Westinghouse FWG valves. Additionally, there is limited information available in the EPRI Performance Prediction Program for this size and type of valve. What is provided in the EPRI program is an apparent friction coefficient for the 3" Westinghouse FWG valve discussed in the section for BBHV8000A/B. The valve factor for this 3" valve is .328. Because of the limited information with regard to this size of valve and the thrust margin available it is recommended that a 1.0 valve factor be used. Using calculations the thrust requirements for these valves become:

BNHV8812A&B **OPENING THRUST REQUIREMENTS 4482 LBS**
CLOSING THRUST REQUIREMENTS 4607 LBS

EFPDV0019, 20 ESW SELF CLEANING STRAINER DRAIN DP CONTROL VALVE

These valves are routinely operated under DP conditions during ESW pump runs. However, the MOVATS test equipment has not been installed on these valves so measured thrust requirements to overcome DP conditions is unknown. EFHV0097 and 98 are identical valves which are also routinely DP tested during ESW pump operation and have been diagnostically tested under DP conditions. The DP data for EFHV0097 and 98 however, is not being used for comparison purposes because the thrust requirements can be more conservatively determined using calculations. The DP data for EFHV0097 was less than spring pack preload and the required thrust analysis for EFHV0098 is based on a very conservative spring pack displacement value not attributable to DP effect[13]. In addition, EFPDV0019 and 20 have been determined to not have an active safety function to close per RFR 5353S so closing thrust requirements are not critical and can be determined conservatively using analytical methods. Referring to Attachment 2 the thrust requirements for EFPDV0019 and 20 are calculated using a valve factor of 1.0 as follows:

EFPDV0019 & 20 **OPENING THRUST REQUIREMENTS 834 LBS**
CLOSING THRUST REQUIREMENTS 1023 LBS

EGHV0011,12,13,14 ESW TO CCW EMERGENCY MAKEUP ISOLATION VALVES

These valves are Yarway 1.5 inch globe valves with flow under the seat. The only safety function for these valves is to open[14]. The purpose of these valves is to open as an emergency makeup water supply for the CCW system. Since the safety function for these valves is to open and flow is under the seat the opening thrust requirements for these valves will be minimal and can be conservatively calculated. Referring to Attachment 2 an opening thrust of 462 lbs and a closing thrust of 560 lbs is obtained using a valve factor of 2.2. The operators for these valves are equipped with heavy spring packs are capable of providing well in excess of these thrust values. For additional conservatism an open and closed thrust requirement of 1500 lbs will be specified.

EGHV00011,12,13,14; OPEN & CLOSED THRUST REQUIREMENT = 1500 LBS:

EGHV0062 RCP THERMAL BARRIER RETURN CCW SYSTEM ISOLATION VALVE

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[13] Refer to RFR 8746G

[14] Reference RFR 5353S

This MOV has an active safety function to close against 2335 psid and a commercial function to open against 112 psid. The thrust requirements to open are determined below in the discussion for EGHV0132. The thrust requirements to close against 2335 psid were previously calculated in RFR 9878A using slightly different methods. For consistency the thrust requirements for EGHV0062 have been re-calculated to be 12984 lbs using a valve factor of .6. This valve factor is considered conservative for this style of valve. This is a Velan parallel slide gate valve that is position closed. This type of valve is designed to operate with lower thrust requirements than their FWG counterparts. In reviewing the EPRI Performance Program no valves were available for comparison. There have been similar valves DP tested at Callaway, i.e. EGHV0061 and 133. However, they were tested at too low a DP to be considered for determining the thrust requirements for EGHV0062.

EGHV0062 OPENING THRUST REQUIREMENT 1220 LBS
CLOSING THRUST REQUIREMENT 12984 LBS

EGHV0132 CCW RETURN FROM RCP THERMAL BARRIER EGHV0062 BYPASS ISOLATION VALVE

The DP that these valves may be expected to operate against is 112 psid for commercial considerations[15]. Previously these valves had their thrust requirements determined using calculational methods from RFR 9878A. For consistency these thrust requirements are being re-calculated in this RFR. Valves EGHV0061 and 133 are identical MOV's that have been DP tested to 94 and 90.5 psid respectively. Referring to Attachment 1 the thrust requirements to overcome these test conditions are as follows:

VALVE ID	TEST DP	CLOSING THRUST	OPENING THRUST
EGHV0061	94 PSID	812 LBS	829 LBS
EGHV0133	90.5 PSID	1609 LBS	983 LBS

Using calculations the thrust requirements for EGHV0133 are 379 lbs closed and 247 lbs open using a DP of 112 psid. Thus, it is apparent that it would be most conservative to use the thrust requirements for EGHV0133 extrapolated to 112 psid to determine the thrust requirements for EGHV0132 (and EGHV0062 in the open direction). Using this method the following thrust values are obtained:

OPEN THRUST VALUE = (983 LBS)(112/90.5) = 1216.5 LBS SAY 1220 LBS
CLOSED THRUST VALUE = (1609 LBS)(112/90.5) = 1991 LBS SAY 2000 LBS

EGHV0132 OPEN THRUST REQUIREMENT = 1220 LBS
CLOSED THRUST REQUIREMENT = 2000 LBS

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[15] Reference RFR 5353X

EJHV8811A,B RHR PUMP SUCTION ISOLATION VALVES FROM EMERGENCY SUMPS

There are no other valves of the same size at Callaway that have been adequately DP tested for comparison. These are 14" Westinghouse FWG valves. Additionally, there is limited information available in the EPRI Performance Prediction Program for this size and type of valve. What is provided in the EPRI program is an apparent friction coefficient for the 3" Westinghouse FWG valve discussed earlier in the section for BBHV8000A/B. The valve factor for this 3" valve is .328. Because of the limited information with regard to this size of valve and the thrust margin available it is recommended that a 1.0 valve factor be used. Using calculations the thrust requirements for these valves become:

EJHV8811A/B	**OPEN THRUST REQUIREMENT**	**7199 LBS**
	CLOSING THRUST REQUIREMENT	**7399 LBS**

EMHV8807A,B

Because of how the system is aligned when these valve are manipulated there is no DP across these valves when they are required to be operated[16]. These valves presently have their thrust requirements established to overcome the stem rejection load (930 lbs per RFR 9878A). However, for commercial considerations these valves should be set up to overcome a DP of 252 psid per RFR 5353X.

Valves EMHV8923A/B are identical valves which have been DP tested against 178 and 180 psid respectively. From RFR 8746G the thrust required to overcome these DP's are as follows:

VALVE ID	THRUST TO OPEN	THRUST TO CLOSE
EMHV8923A	1573 LBS	1929 LBS
EMHV8923B	2148 LBS	3186 LBS

Since these are identical valves that have been DP tested it is recommended that for commercial reasons the thrust requirements for EMHV8807A/B be determined by extrapolating the thrust requirements from EMHV8923B to the commercial DP of 252 psid. Using this method the thrust requirements for EMHV8807A/B are as follows:

(2148 lbs) * (252/180) = 3007.2 lbs SAY 3110 lbs open

(3186 lbs) * (252/180) = 4660.4 lbs SAY 4665 lbs closed

Based on the above the commercial thrust requirements for EMHV8807A/B should be established as follows. These commercial requirements bound all safety related thrust requirements.

EMHV8807A/B	**CLOSED THRUST REQUIREMENT**	**4665 LBS**
	OPEN THRUST REQUIREMENT	**3110 LBS**

EMHV8924

This MOV has no active safety function and is used solely as a maintenance isolation valve. During normal power operation this valve is maintained open with a locking device installed and with electrical power isolated at the breaker. Additionally, this MOV has input into the ESF status panel which would alert operators should it become mispositioned. Based on the above discussion this MOV has been removed from the GL 89-10 program and no thrust requirements are being provided via this RFR.

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[16] Reference RFR 5353X

ENHV0001,7 CONTAINMENT SPRAY PUMP SUCTION ISOLATION FROM EMERGENCY SUMPS

These valves presently have thrust requirements established using calculations in accordance with RFR 9878A. For consistency the thrust requirements have been recalculated on Attachment 2. This resulted in predicted thrust requirements of 2878 lbs closed and 2786 lbs open.

In referring to the DP tests performed at Callaway the only valves comparable are EGHV0071 and 126. The only significant difference between these models are that ENHV0001/7 are stainless while EGHV0071/126 are carbon steel valves. These are all 12" Anchor Darling FWG models. Listed below are the measured thrust requirements from EGHV0071/126. The DP test for EGHV0071 was at 94 psid and the test for EGHV0126 at 92 psid. The design DP for ENHV0001/7 is 54 psid.

VALVE ID	MEASURED OPEN THRUST	MEASURED CLOSED THRUST
EGHV0071	4885 LBS	5267 LBS
EGHV0126	1982 LBS	4220 LBS

If the DP test thrust measurements for EGHV0071 are de-rated to the design DP of ENHV0001/7 slightly more conservative numbers vs. calculated numbers are obtained for ENHV0001/7. Since ENHV0001/7 are stainless valves it is believed that the valve factor for these valves is lower and requires less thrust than EGHV0071. Based on the discussion above the thrust requirements for ENHV0001&7 are being conservatively established as follows:

OPEN THRUST REQUIREMENT = (4885 LBS)(54/94) = 2806 say 3000 lbs
CLOSE THRUST REQUIREMENT (5267 LBS)(54/94) = 3026 say 3100 lbs

ENHV0001 & 7 OPEN THRUST REQUIREMENT = 3000 LBS
CLOSED THRUST REQUIREMENT = 3100 LBS

ENHV0006,12 CONTAINMENT SPRAY PUMP DISCHARGE ISOLATION VALVES

These valves are 10" Anchor Darling stainless steel FWG valves. There have been no other valves at Callaway that have been adequately DP tested that can be considered similar. However, these valves have been DP tested at Wolf Creek. The data sheets from the DP test at Wolf Creek have been provided as Attachment 6.

The DP test at Wolf Creek was under maximum system flow and DP conditions obtainable (232 psid). Under these conditions the thrust required to open against these test conditions (including VOTES equipment accuracy) are documented as 3027 lbs for ENHV0006 and 4848 lbs for ENHV0012. No closing thrust requirements were provided since this valve has no safety function in the closed direction. Note that these thrust numbers are direct stem thrust measurements during the DP test.

Wolf Creek then calculated the disc/seat coefficient of friction for these valves to be .17 and .28 for ENHV0006 and 12 respectively. Using the method described in the discussion for BBHV0013,14,15 & 16 this corresponds to valve factors of .173 and .288 for a 5 degree disc wedge angle. These coefficients of friction validated the .35 value that was assumed at Wolf Creek prior to performing this DP test. Thus, they successfully demonstrated that the .35 friction coefficient was conservative for these valves at Wolf Creek.

Because of the differences in the MOV programs at Wolf Creek and Callaway it is not recommended that DP test thrust measurements be applied directly at Callaway. Instead it is recommended that a conservative valve factor based on the Wolf Creek testing and rate of loading factor be assumed to determine the thrust requirements . Since the Wolf Creek testing validated a coefficient of friction of .35 it is recommended that a .4 valve factor be used with a rate of loading factor of 1.20. Using these numbers the thrust requirements are as follows:

ENHV0006 & 12 OPEN THRUST REQUIREMENT = 8970 LBS
CLOSED THRUST REQUIREMENT = 9487 LBS

ENHV0015,16 CONTAINMENT SPRAY ADDITIVE TANK TO CONTAINMENT SPRAY PUMP SUCTION

The present thrust requirements for ENHV0015 and 16 originate from RFR 8746C and is based on the thrust requirements of similar valves. The design DP for these valves is 18 psid. RFR 8746C conservatively determines the thrust requirements for these valves to be as follows;

VALVE ID	CLOSING THRUST REQUIREMENT	OPENING THRUST REQUIREMENT
ENHV0015	4234 LBS	2801 LBS
ENHV0016	1938 LBS	1557 LBS

These valves are being removed from the plant with the implementation of modification MP 92-1053. This modification is eliminating the containment spray additive tank and thus the need for these valves. This modification is scheduled for implementation spring, 1995.

Based on the conservatism of the present thrust requirements, the low design DP, and the fact that these valves are scheduled for removal from the plant no further action is required for these valves. The thrust requirements presently imposed should continue to be used until these MOV's are eliminated.

EPHV8808A,B,C,D

These valves are listed as having no active safety function to open with an active safety function to close but at zero differential pressure[17]. Based on the above it is apparent that the thrust requirements for these valves can be adequately determined using conservative engineering analysis. Using calculational methods and a .5 valve factor the thrust requirements become 26223 lbs open and 30500 lbs closed for a DP of 726 psid. Note that these thrust requirements are for commercial considerations only. As the thrust rating of the operators on these valves is 140,000 lbs it is evident that these thrust requirements can be easily satisfied. For safety considerations these valves must be able to overcome piston effect associated with a line pressure of 726 psid. This value is calculated below:

PISTON EFFECT CALCULATION FOR EPHV8808A,B,C,D

Piston effect = (line pressure)(stem area)(rate of loading factor)
= (726 psid)(4.9087 lbs)(1.20)
= 4277 lbs SAY 4300 lbs

Based on the above discussion EPHV8808A,B,C,D have commercial and safety thrust requirements as provided below.

EPHV8808A,B,C & D COMMERCIAL OPENING THRUST REQUIREMENT 26223 LBS
COMMERCIAL CLOSING THRUST REQUIREMENT 30500 LBS
SAFETY OPEN & CLOSED THRUST REQUIREMENT 4300 LBS

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[17] Reference RFR 5353X

KAHV0030

The purpose of this MOV is to provide additional redundancy to the hydrogen recombiners in the event makeup air is needed to purge hydrogen from containment following an accident. This valve was installed in accordance with Reg. Guide 1.7. This valve is not considered to have an active safety function.[18]

No other valves of this type have been DP tested at Callaway. Since this valve has no active safety function its thrust requirements can be conservatively determined using calculations. Using this methodology a closing thrust of 276 lbs and an opening thrust of 173 lbs is provided for a design DP of 149 psid assuming a valve factor of 1.0.

KAHV0030 OPENING THRUST REQUIREMENT = 347 LBS
CLOSING THRUST REQUIREMENT = 450 LBS

KCHV0253

The valve is a 4 inch VELAN parallel slide gate valve with a design DP of 189 psid open and closed. Two other valves of this size and model (EGHV0061/133) were DP tested 94 and 90.5 psid respectively. However, these test DP's are not within 50% of the design DP of KCHV0253 and thus are not being considered. KCHV0253 is a 4" Velan parallel slide gate valve that typically requires less thrust than the FWG counterparts. No valve of this type is being tested in the EPRI Performance Prediction Program. For conservatism the thrust requirements for this valve will be calculated using a valve factor of 1.0.

KCHV0253 CLOSED THRUST REQUIREMENT = 1507 LBS
OPEN THRUST REQUIREMENT = 1291 LBS

LFFV0095,LFHV0105&106 CONTAINMENT NORMAL SUMP AND AUXILIARY BUILDING SUMP DISCHARGE ISOLATION VALVES

All three of these MOV's were DP tested. However, for LFFV0095 in the closed direction and LFHV0105&106 in both directions they were not tested at a high enough DP to satisfy the criteria of EDP-ZZ-01114. Because of the thrust margin available with these valves the thrust requirements are most easily determined by assuming a valve factor of 1.0 and calculating the thrust requirements. Using this method the thrust requirements become:

LFFV0095 CLOSING THRUST REQUIREMENT = 1766 LBS
OPENING THRUST REQUIREMENT = 295 LBS

LFHV0105/106 CLOSING THRUST REQUIREMENT = 548 LBS
OPENING THRUST REQUIREMENT = 532 LBS

Reference RFR 10320A.

1/21/94

ATTACHMENT 1 TO RFR 8746I
COMPARISON OF CALCULATED VS MEASURED THRUST VALUES FOR MOV'S DP TESTED AT CALLAWAY

VALVE ID	CALCULATED THRUST CLOSED	CALCULATED THRUST OPEN	MEASURED THRUST CLOSED (note 1)	MEASURED THRUST OPEN (note 1)	TEST DP CLOSED (note 1)	TEST DP OPEN (note 1)	VALVE MFGR (note 2)	TYPE (note 3)	MODEL (note 3)	SIZE (note 3)	TYPE (note 2)	SIZE (note 2)	STEM DIA (note 2)	STEM AREA	DISC DIA (note 4)	DISC AREA	RATE OF LOADING (note 5)	VALVE FACTOR (note 6)	PRELOAD
ALHV0005	6950	6374	3259	2430	1604	1604	MASON	GLOBE	90-207X1	4	SMB	OO	0.625	0.3068	2.0000	3.14	1.15	1.1	379
ALHV0007	6928	6355	8282	2535	1599	1599	MASON	GLOBE	90-207X1	4	SMB	OO	0.625	0.3068	2.0000	3.14	1.15	1.1	691
ALHV0009	7036	6454	7059	3057	1624	1624	MASON	GLOBE	90-207X1	4	SMB	OO	0.625	0.3068	2.0000	3.14	1.15	1.1	450
ALHV0011	7036	6454	7324	1622	1624	1624	MASON	GLOBE	90-207X1	4	SMB	OO	0.625	0.3068	2.0000	3.14	1.15	1.1	258
ALHV0034	381	362	979	3466	14	14	A/D	FW GATE	E6207-5	8	SMB	OO	1.25	1.22718	7.5625	44.92	1.15	0.5	150
ALHV0035	381	362	1139	3053	14	14	A/D	FW GATE	E6207-5	8	SMB	OO	1.25	1.22718	7.5625	44.92	1.15	0.5	332
ALHV0036	518	498	510	2501	14	14	A/D	FW GATE	E6207-4	10	SMB	OO	1.25	1.22718	8.8750	61.86	1.15	0.5	281
BBHV0013	458	321	N/A	1290	103	103	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	0.99402	2.6250	5.41	1.15	0.5	1290
BBHV0014	489	352	N/A	1278	113	113	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	0.99402	2.6250	5.41	1.15	0.5	1278
BBHV0015	458	321	N/A	1625	103	103	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	0.99402	2.6250	5.41	1.15	0.5	1625
BBHV0016	458	321	N/A	1381	103	103	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	0.99402	2.6250	5.41	1.15	0.5	1381
BGHV8104	347	255	7968	7793	73	73	VELAN	GLOBE	2TM78FNA	2	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	1.1	7968
BGHV8105	11630	7973	10373	2490	2572	2572	WEST	FW GATE	3-GM78FNA	3	SB	OO	1.25	1.22718	2.6200	5.39	1.15	0.5	269
BGHV8106	11630	7973	12127	4540	2572	2572	WEST	FW GATE	3-GM78FNA	3	SB	OO	1.25	1.22718	2.6200	5.39	1.15	0.5	226
BGHV8110	12267	9020	8162	6910	2582	2582	VELAN	GLOBE	P2-6303-N2	2	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	1.1	8162
BGHV8111	13414	9864	7039	6185	2824	2824	VELAN	GLOBE	P2-6303-N2	2	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	1.1	7039
BGHV8357A	354	0	952	472	2531	0	A/D	GLOBE	70-18-9	1	SMB	OOO	0.625	0.3068	0.3750	0.11	1.15	1.1	952
BGHV8357B	365	0	847	586	2611	0	A/D	GLOBE	70-18-9	1	SMB	OOO	0.625	0.3068	0.3750	0.11	1.15	1.1	847
BNHV8806A	4072	3765	1921	4219	197	197	WEST	FW GATE	8GM72FBA	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	102
BNHV8806B	4072	3765	1592	2654	197	197	WEST	FW GATE	8-GM72FBA	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	1129
BNHV8813	7223	5311	3230	8036	1520	1520	VELAN	GLOBE	2TM78FNC	2	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	1.1	3230
BNLCV0112D	3998	3690	3025	4529	193	193	WEST	FW GATE	8GM72FBA	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	313
BNLCV0112E	4038	3730	2026	4963	195	195	WEST	FW GATE	8GM72FBA	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	1110
EFHV0097	553	405	1138	N/A	130	130	VELAN	SW GATE	B10-0054B-02	3	SMB	OOO	1.125	0.99402	2.6250	5.41	1.15	0.5	1138
EFHV0098	532	389	1515	N/A	125	125	VELAN	SW GATE	B10-0054B-02	3	SMB	OOO	1.125	0.99402	2.6250	5.41	1.15	0.5	523
EGHV0058	5175	4891	5545	5420	95	95	A/D	DBL DISC	E6207-1	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	3767
EGHV0059	5332	5045	5105	5458	98	98	A/D	DBL DISC	E6207-1	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	1314
EGHV0060	5121	4840	9682	5394	94	94	A/D	DBL DISC	E6207-1	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	
EGHV0061	394	257	812	829	94	94	VELAN	PDG	B12-0144B-02	4	SMB	OOO	1.125	0.99402	2.7500	5.94	1.15	0.4	812
EGHV0071	5054	4849	5267	4885	94	94	A/D	FW GATE	E6207-3	12	SMB	OO	1.373	1.48489	10.6875	89.71	1.15	0.5	276
EGHV0072	340	250	N/A	1233	103	103	YARWAY	GLOBE	5515B-SA105M	2	SMB	OOO	0.937	0.68956	1.5625	1.92	1.15	1.1	1233
EGHV0073	340	250	N/A	1497	103	103	YARWAY	GLOBE	5515B-SA105M	2	SMB	OOO	0.937	0.68956	1.5625	1.92	1.15	1.1	1497
EGHV0074	340	250	N/A	2259	103	103	YARWAY	GLOBE	5515B-SA105M	2	SMB	OOO	0.937	0.68956	1.5625	1.92	1.15	1.1	2259
EGHV0075	340	250	N/A	2466	103	103	YARWAY	GLOBE	5515B-SA105M	2	SMB	OOO	0.937	0.68956	1.5625	1.92	1.15	1.1	2466
EGHV0126	4951	4746	4220	1982	92	92	A/D	FW GATE	E6207-3	12	SMB	OO	1.375	1.48489	10.6875	89.71	1.15	0.5	556
EGHV0127	5381	5097	8539	3448	99	99	A/D	DBL DISC	E6207-1	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	150
EGHV0130	4798	4531	4564	2165	88	88	A/D	DBL DISC	E6207-2	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	230
EGHV0131	5332	5045	6311	4321	98	98	A/D	DBL DISK	E6207-21	12	SMB	OO	1.625	2.07394	11.9375	111.92	1.15	0.4	391
EGHV0133	379	247	1609	983	91	91	VELAN	PDG	B10-0144B-02	4	SMB	OOO	1.125	0.99402	2.7500	5.94	1.15	0.4	309
EJFCV0610	896	645	809	816	208	208	WEST	FW GATE	3-GM88FNB	3	SMB	OOO	1.125	0.99402	2.6200	5.39	1.15	0.5	134
EJFCV0611	881	623	857	507	201	201	WEST	FW GATE	3-GM88FNB	3	SMB	OOO	1.125	0.99402	2.6200	5.39	1.15	0.5	330
EJHV8716B	10064	8951	N.A	10611	189	189	WEST	FW GATE	10000GM84FEB	10	SB	1	2.5	4.90874	10.0250	78.93	1.20	0.5	0
EJHV8804A	3077	2446	7314	2733	161	128	WEST	FW GATE	08000GM84FEB	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	472
EJHV8804B	3169	2923	4070	3522	153	153	WEST	FW GATE	08000GM84FEB	8	SB	OO	1.25	1.22718	6.5050	33.23	1.15	0.5	349
EJHV8809A	7730	6646	29983	38350	184	184	WEST	FW GATE	10GM78FNC	10	SBD	3	2.5	4.90874	8.7550	60.20	1.20	0.5	29983
EJHV8809B	7940	6827	20466	13337	189	189	WEST	FW GATE	10GM78FNC	10	SBD	3	2.5	4.90874	8.7550	60.20	1.20	0.5	12006
EJHV8840	7940	6827	17170	14363	189	189	WEST	FW GATE	10GM78FNC	10	SBD	3	2.5	4.90874	8.7550	60.20	1.20	0.5	17170
EMHV8801A	18113	14309	4221	4458	2677	2677	WEST	FW GATE	04000GM88FNA	4	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	443
EMHV8801B	18113	14309	2815	6062	2677	2677	WEST	FW GATE	04000GM88FNB	4	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	255
EMHV8802A	4648	3677	3767	1357	688	688	WEST	FW GATE	04000GM88FNB	3	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	551
EMHV8802B	4445	3516	2787	2009	658	658	WEST	FW GATE	04000GM88FNB	3	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	541
EMHV8803A	18424	14575	4632	10586	2727	2727	WEST	FW GATE	04000GM88FNB	4	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	235
EMHV8803B	18253	14440	1567	3760	2702	2702	WEST	FW GATE	04000GM88FNB	4	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	599

Notes:

1. From RFR 8746G
2. From CEL
3. From valve drawings.
4. Anchor Darling values from RFR 5353 , Westinghouse values from attachment 5. Rest from valve drawings
5. From Attachment 3.
6. Refer to RFR text.

1/21/94

ATTACHMENT 1 TO RFR 8746I

COMPARISON OF CALCULATED VS MEASURED THRUST VALUES FOR MOV'S DP TESTED AT CALLAWAY

VALVE ID	CALCULATED THRUST CLOSED	CALCULATED THRUST OPEN	MEASURED THRUST CLOSED (note 1)	MEASURED THRUST OPEN (note 1)	TEST DP CLOSED (note 1)	TEST DP OPEN (note 1)	VALVE MFGR (note 2)	TYPE (note 3)	MODEL (note 3)	SIZE (note 3)	TYPE (note 2)	SIZE (note 2)	STEM DIA (note 2)	STEM AREA	DISC DIA (note 4)	DISC AREA	RATE OF LOADING (note 5)	VALVE FACTOR (note 6)	PRELOAD
EMHV8814A	7199	5293	6754	8055	1515	1515	VELAN	GLOBE	1-1/2-TM78FN	1.5	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	1.1	6754
EMHV8814B	3282	2413	6697	7200	1520	1520	VELAN	GLOBE	-1/2-TM78FN	1.5	SMB	OO	1.125	0.99402	1.8750	2.76	1.15	0.5	6697
EMHV8821A	11117	8824	3934	4299	1595	1595	WEST	FW GATE	04000GM87FHB	4	SB	OO	1.25	1.22718	3.5000	9.62	1.15	0.5	486
EMHV8821B	10735	8520	2709	4249	1540	1540	WEST	FW GATE	04000GM87FHB	4	SB	OO	1.25	1.22718	3.5000	9.62	1.15	0.5	447
EMHV8835	10802	8524	N/A	3650	1595	1595	WEST	FW GATE	04000GM88FNB	4	SBD	OO	1.25	1.22718	3.4400	9.29	1.15	0.5	480
EMHV8923A	3239	2957	1573	1929	178	178	WEST	FW GATE	06001GM92FBB	6	SMB	OO	1.25	1.22718	6.0650	28.89	1.15	0.5	820
EMHV8923B	3272	2990	2148	3186	180	180	WEST	FW GATE	06001GM92FBB	6	SMB	OO	1.25	1.22718	6.0650	28.89	1.15	0.5	815
FCHV0312	N/A	2387	N/A	1921	1075	1075	GIMPEL	GLOBE	82-14097A	4	SMB	OOO	1.125	0.99402	1.4950	1.76	1.15	1.1	971
LFFV0095	89	81	283	645	6	6	A/D	FW GATE	E6118-5	6	SMB	OO	1	0.7854	5.7188	25.69	1.15	0.5	420
LFHV0105	127	114	543	1409	8	8	A/D	FW GATE	E6118-10	6	SMB	OOO	1	0.7854	5.7188	25.69	1.15	0.5	543
LFHV0106	127	114	831	1242	8	8	A/D	FW GATE	E6118-10	6	SMB	OOO	1	0.7854	5.7188	25.69	1.15	0.5	831

Notes:

1. From RFR 8746G
2. From CEL
3. From valve drawings.
4. Anchor Darling values from RFR 5353 , Westinghouse values from attachment 5. Rest from valve drawings.
5. From Attachment 3.
6. Refer to RFR text.

ATTACHMENT 2 TO RFR 8746I

CALCULATED THRUST VALUES FOR VALVES EVALUATED IN RFR 8746I

VALVE ID	DESIGN DP OPEN (note 1)	DESIGN DP CLOSED (note 1)	CALCULATED THRUST CLOSED W/O ERROR AND STEM LOAD	CALCULATED THRUST OPEN W/O ERROR AND STEM LOAD	RATE OF LOADING (note 2)	VALVE FACTOR (note 5)	STEM AREA	DISC AREA	VALVE MFGR (note 1)	TYPE (note 4)	MODEL (note 4)	SIZE (note 4)	TYPE (note 1)	SIZE (note 1)	STEM DIA (note 1)	DISC DIA (note 3)
ALHV0034	25	135	3877	646	1.15	0.50	1.22718	44.92	A/D	FW GATE	E6207-5	8	SMB	OO	1.25	7.5625
ALHV0035	25	135	3877	646	1.15	0.50	1.22718	44.92	A/D	FW GATE	E6207-5	8	SMB	OO	1.25	7.5625
ALHV0036	25 [illegible]	135	4993	889	1.15	0.50	1.22718	61.88	A/D	FW GATE	E6207-4	10	SMB	OO	1.25	8.8750
BBHV0013	145 [illegible]	2335	8482	361	1.15	0.40	0.99402	5.41	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	2.6250
BBHV0014	~~145~~ 156	2335	8482	361	1.15	0.40	0.99402	5.41	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	2.6250
BBHV0015	145	2335	8482	361	1.15	0.40	0.99402	5.41	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	2.6250
BBHV0016	145	2335	8482	361	1.15	0.40	0.99402	5.41	VELAN	FW GATE	B10-3054P-02	3	SMB	OO	1.125	2.6250
BBHV8000A	2485	2335	11355	9244	1.15	0.80	0.99402	5.39	WEST	FW GATE	3-GM88FNB	3	SB	OO	1.125	2.6200
BBHV8000B	2485	2335	11355	9244	1.15	0.60	0.99402	5.39	WEST	FW GATE	3-GM88FNB	3	SB	OO	1.125	2.6200
BBHV8037A	104	104	1337	1190	1.15	1.00	1.22718	9.95	WEST	FW GATE	040000GM-82F	4	SB	OO	1.25	3.5600
BBHV8037B	104	104	1337	1190	1.15	1.00	1.22718	9.95	WEST	FW GATE	040000GM-82F	4	SB	OO	1.25	3.5600
BBHV8351A	2813	2813	13363	9825	1.15	1.10	0.99402	2.76	VELAN	GLOBE	2TM78FNA	2	SMB	OO	1.125	1.8750
BBHV8351B	2813	2813	13363	9825	1.15	1.10	0.99402	2.76	VELAN	GLOBE	2TM78FNA	2	SMB	OO	1.125	1.8750
BBHV8351C	2813	2813	13363	9825	1.15	1.10	0.99402	2.76	VELAN	GLOBE	2TM78FNA	2	SMB	OO	1.125	1.8750
BBHV8351D	2813	2813	13363	9825	1.15	1.10	0.99402	2.76	VELAN	GLOBE	2TM78FNA	2	SMB	OO	1.125	1.8750
BBPV8702A	380	484	28065	19761	1.20	0.50	7.06858	88.67	WEST	FW GATE	12002GM885EH	12	SMB	2	3	10.5050
BBPV8702B	380	484	28065	19761	1.20	0.50	7.06858	88.67	WEST	FW GATE	12002GM885EH	12	SMB	2	3	10.5050
BGHV8100	155	155	738	541	1.15	1.10	0.99402	2.76	VELAN	GLOBE	P2-6303-N2	2	SMB	OO	1.125	1.8750
BGHV8109	94	2818	13388	328	1.15	1.10	0.99402	2.76	VELAN	GLOBE	P2-6303-N2	2	SMB	OO	1.125	1.8750
BGHV8112	155	155	738	541	1.15	1.10	0.99402	2.76	VELAN	GLOBE	P2-6303-N2	2	SMB	OO	1.125	1.8750
BGLCV0112B	100	100	1288	1145	1.15	1.00	1.22718	9.95	WEST	SW GATE	040000GM82FB	4	SB	OO	1.25	3.5600
BGLCV0112C	100	100	1288	1145	1.15	1.00	1.22718	9.95	WEST	SW GATE	04000GM82FBB	4	SB	OO	1.25	3.5600
BNHV0003	32	32	3358	3301	1.15	1.00	1.48489	89.71	A/D	FW GATE	E6118-3	12	SMB	OO	1.375	10.6875
BNHV0004	32	32	3358	3301	1.15	1.00	1.48489	89.71	A/D	FW GATE	E6118-3	12	SMB	OO	1.375	10.6875
BNHV8812A	33	33	4807	4482	1.20	1.00	3.14159	113.19	WEST	FW GATE	14GM74FEC	14	SB	1	2	12.0050
BNHV8812B	33	33	4807	4482	1.20	1.00	3.14159	113.19	WEST	FW GATE	14GM74FEC	14	SB	1	2	12.0050
EFPDV0019	134	134	1023	834	1.15	1.00	1.22718	5.41	VELAN	SW GATE	B10-0054B-02	3	SMB	0	1.25	2.6250
EFPDV0020	134	134	1023	834	1.15	1.00	1.22718	5.41	VELAN	SW GATE	B10-0054B-3	4	SMB	1	1.25	2.6250
EGHV0011	123	123	580	482	1.15	2.20	0.68956	1.48	YARWAY	GLOBE	55158	1.5	SMB	OOO	0.937	1.3750
EGHV0012	122	122	555	458	1.15	2.20	0.68956	1.48	YARWAY	GLOBE	55158	1.5	SMB	OOO	0.937	1.3750
EGHV0013	123	123	580	482	1.15	2.20	0.68956	1.48	YARWAY	GLOBE	55158	1.5	SMB	OOO	0.937	1.3750
EGHV0014	122	122	555	458	1.15	2.20	0.68956	1.48	YARWAY	GLOBE	55158	1.5	SMB	OOO	0.937	1.3750
EGHV0062	112	2335	12984	487	1.22	0.60	0.99402	5.94	VELAN	PDG	B12-0144B-02	4	SMB	O	1.125	2.7500
EGHV0132	112	112	434	308	1.15	0.40	0.99402	5.94	VELAN	PDG	B12-3144P	4	SMB	OO	1.125	2.7500
EJHV8701A	380	484	28065	19761	1.20	0.30	7.06858	88.67	WEST	FW GATE	12002GM88SEH	12	SMB	2	3	10.5050
EJHV8701B	380	484	28065	19761	1.20	0.50	7.06858	88.67	WEST	FW GATE	12GM88SEF	12	SMB	2	3	10.5050
EJHV8811A	53	53	7399	7199	1.20	1.00	3.14159	113.19	WEST	FW GATE	14000GM84FEH	14	SB	1	2	12.0050
EJHV8811B	53	53	7399	7199	1.20	1.00	3.14159	113.19	WEST	FW GATE	14000GM84FEH	14	SB	1	2	12.0050
EMHV8807A	252	252	4542	4186	1.15	0.50	1.22718	28.89	WEST	FW GATE	060001GM92FB	6	SMB	OO	1.25	6.0650
EMHV8807B	252	252	4542	4186	1.15	0.50	1.22718	28.89	WEST	FW GATE	060001GM92FB	6	SMB	OO	1.25	6.0650
ENHV0001	54	54	2878	2786	1.15	0.50	1.48489	89.71	A/D	FW GATE	E6118-4	12	SMB	OO	1.375	10.6875
ENHV0006	244	244	9487	8970	1.20	0.40	1.76715	76.59	A/D	FW GATE	E6118-1	10	SMB	OO	1.5	9.8750
ENHV0007	54	54	2878	2786	1.15	0.50	1.48489	89.71	A/D	FW GATE	E6118-4	12	SMB	OO	1.375	10.6875
ENHV0012	244	244	9487	8970	1.20	0.40	1.76715	78.59	A/D	FW GATE	E6118-1	10	SMB	OO	1.5	9.8750
ENHV0015	18	18	86	77	1.15	0.50	0.44179	7.39	A/D	FW GATE	E6118-2	3	SMB	OO	0.75	3.0680
ENHV0016	18	18	86	77	1.15	0.50	0.44179	7.39	A/D	FW GATE	E6118-2	3	SMB	OO	0.75	3.0680
EPHV8808A	728	728	30500	26223	1.20	0.50	4.90874	60.20	WEST	FW GATE	10000GM88FNH	10	SBD	3	2.5	8.7550
EPHV8808B	728	728	30500	26223	1.20	0.50	4.90874	60.20	WEST	FW GATE	10000GM88FNH	10	SBD	3	2.5	8.7550
EPHV8808C	728	728	30500	26223	1.20	0.50	4.90874	60.20	WEST	FW GATE	10000GM88FNH	10	SBD	3	2.5	8.7550

Notes:

1. Some design DP's are for commercial reasons. CEL has design basis DP's.
2. From Att 3
3. A/D valves seat dia from 5353 analysis, West. valves from Att 5. Rest from drawings.
4. From drawings
5. Refer to RFR text.

ATTACHMENT 2 TO RFR 8746I

CALCULATED THRUST VALUES FOR VALVES EVALUATED IN RFR 8746I

VALVE ID	DESIGN DP OPEN (note 1)	DESIGN DP CLOSED (note 1)	CALCULATED THRUST CLOSED W/O ERROR AND STEM LOAD	CALCULATED THRUST OPEN W/O ERROR AND STEM LOAD	RATE OF LOADING (note 2)	VALVE FACTOR (note 5)	STEM AREA	DISC AREA	VALVE MFGR (note 1)	TYPE (note 4)	MODEL (note 4)	SIZE (note 4)	TYPE (note 1)	SIZE (note 1)	STEM DIA (note 1)	DISC DIA (note 3)
EPHV8808D	728	728	30500	26223	1.20	0.50	4.90874	60.20	WEST	FW GATE	10000GM88FSH	10	SBD	3	2.5	8.7550
KAHV0030	149	149	450	347	1.15	1.00	0.60132	2.02	WARNER	SW GATE		1.5	SMB	000	0.875	1.6030
KCHV0253	189	189	1507	1291	1.15	1.00	0.99402	5.94	VELAN	PDG	1015	4	SMB	000	1.125	2.7500
LFFV0095	10	58	1788	295	1.15	1.00	0.7854	25.69	A/D	FW GATE	E6118-5	8	SMB	00	1	5.7188
LFHV0105	18	18	548	532	1.15	1.00	0.7854	25.69	A/D	FW GATE	E6118-10	8	SMB	000	1	5.7188
LFHV0108	18	18	548	532	1.15	1.00	0.7854	25.69	A/D	FW GATE	E6118-10	8	SMB	000	1	5.7188

Notes:

1. Some design DP's are for commercial reasons. CEL has design basis DP's.
2. From Att 3
3. A/D valves seat dia from 5353 analysis, West. valves from Att 5. Rest from drawings.
4. From drawings
5. Refer to RFR text.

ATTACHMENT 3

RATE OF LOADING FACTORS USED IN RFR 87461

The following rate of loading factors are used in RFR 87461. These rate of loading factors are based on information contained in MOVATS Engineering Report 5.0 Rev 6 page 20 of 20 attached..

ACTUATOR SIZE	ROL FACTOR
SMB-000	1.15
SMB-00 SBD-00 SB-00	1.15
SMB-0	1.22
SMB-1 SBD-1 SB-1 SMB-2 SB-2 SMB-3 SBD-3	1.20

RFR 8746I
ATT 3
Pg 2 of 2

TABLE 3
Load Rate Testing Summary
Belleville Spring Testing

LOAD RATE

Actuator	Overall Actuator Ratio	Force (#/Sec)		Disp (in/Sec)		% Difference*		
		Max	Min	Max	Min	.08"	0.16"	0.28"
SMB-1	27.2:1	250,000	22,000	1.3	0.13	18	14	14
SMB-1	88.4:1	82,000	9,000	0.5	0.04	12	11	11
SMB-1	72.42:1	99,000	10,000	0.52	0.09	17	14	14
SB-0	39.11:1	500,000	75,000	5.5	0.8	18	15	10
SB-0	96.2:1	220,000	26,000	2.7	0.4	25	26	18
SMB-0	69.59:1	110,000	15,000	1.1	0.2	22	21	21
SMB-00	72.0:1	48,000	4,500	0.83	0.07	14	12	12
SMB-00	23.0:1	130,000	12,000	2.30	0.21	13	13	10
SMB-00	72.0:1	45,000	5,000	0.8	0.1	-5	-5	-5
SMB-00	41.0:1	88,000	9,000	1.6	0.17	-5	-6	-7
SMB-00	23.0:1	108,000	15,000	4	0.7	8	5	-11
SMB-00	72.0:1	35,000	5,000	1.8	0.3	4	2	-5
SMB-000	33.5:1	13,500	4,000	1.6	0.5	10	7	5
SMB-000	36.0:1	15,000	4,000	1.7	0.5	9	11	11
SMB-000	75.0:1	6,700	1,700	0.75	0.2	13	10	9

Max 20%

Max 27%

Max 15%

*Percent difference between force at fast-load-rate and force at slow-load-rate at a given spring pack displacement.

i.e., At .08" of spring pack displacement: ~~ROL~~

for SmB-00s 000's
SB
SBD } Max .15

Thrust at maximum load rate = 15,000 lbs
Thrust at minimum load rate = 12,300 lbs

% difference = $\frac{15,000-12,300}{15,000}$ x 100 = 18

SmB-0 Max .22

1's & above .20

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ATTACHMENT 4
SUMMARY OF THE THRUST VALUES DETERMINED IN RFR 8746I

VALVE ID	CLOSED THRUST REQUIREMENT	OPEN THRUST REQUIREMENT	PRA SIGNIFICANCE	METHOD USED FOR DETERMINING THRUST REQUIREMENT	NOTES
ALHV0034	3677	UNCHANGED	LOW	SIMILAR VALVES DP TESTED. VALIDATED CALULATIONS VS DP TEST RESULTS THEN USED CALCUALTIONS FOR ALHV0034	OPEN THRUST REQUIREMENT BASED ON DP TESTING
ALHV0035	3677	UNCHANGED	LOW	SIMILAR VALVES DP TESTED. VALIDATED CALULATIONS VS DP TEST RESULTS THEN USED CALCUALTIONS FOR ALHV0035	OPEN THRUST REQUIREMENT BASED ON DP TESTING
ALHV0036	4993	UNCHANGED	LOW	SIMILAR VALVES DP TESTED. VALIDATED CALULATIONS VS DP TEST RESULTS THEN USED CALCUALTIONS FOR ALHV0036	OPEN THRUST REQUIREMENT BASED ON DP TESTING
BBHV0013	8482	UNCHANGED	NONE	USED CALCULATION WITH A .4 VALVE FACTOR BASED ON EPRI PERFORMANCE PREDICTION PROGRAM RESULTS	OPEN THRUST REQUIREMENT BASED ON DP TESTING
BBHV0014	8482	UNCHANGED	NONE	USED CALCULATION WITH A .4 VALVE FACTOR BASED ON EPRI PERFORMANCE PREDICTION PROGRAM RESULTS	OPEN THRUST REQUIREMENT BASED ON DP TESTING
BBHV0015	8482	UNCHANGED	NONE	USED CALCULATION WITH A .4 VALVE FACTOR BASED ON EPRI PERFORMANCE PREDICTION PROGRAM RESULTS	OPEN THRUST REQUIREMENT BASED ON DP TESTING
BBHV0016	8482	UNCHANGED	NONE	USED CALCULATION WITH A .4 VALVE FACTOR BASED ON EPRI PERFORMANCE PREDICTION PROGRAM RESULTS	OPEN THRUST REQUIREMENT BASED ON DP TESTING
BBHV8000A	11355	9244	MEDIUM	COMPARED DP DATA WITH SIMILAR VALVES. USED CALCULATIONS WITH A.6 VALVE FACTOR TO DETERMINE FINAL THRUST NUMBERS	
BBHV8000B	11355	9244	LOW	COMPARED DP DATA WITH SIMILAR VALVES. USED CALCULATIONS WITH A.6 VALVE FACTOR TO DETERMINE FINAL THRUST NUMBERS	
BBHV8037A	1337	1190	NONE	COMPARED SIMILAR VALVES THAT WERE DP TESTED. USED CALCULATIONS WITH A 1.0 VALVE FACTOR TO DETERMINE FINAL THRUST NUMBERS BECAUSE OF MARGIN AVAILABLE.	
BBHV8037B	1337	1190	NONE	COMPARED SIMILAR VALVES THAT WERE DP TESTED. USED CALCULATIONS WITH A 1.0 VALVE FACTOR TO DETERMINE FINAL THRUST NUMBERS BECAUSE OF MARGIN AVAILABLE.	
BBHV8351A	7039	7039	NONE	USED THRUST REQUIREMENTS FROM AN IDENTICAL VALVE TESTED UNDER LARGER DP AND FLOWRATE.	OPEN AND CLOSED THRUST REQUIREMENTS PROVIDED ARE FOR COMMERCIAL CONCERNS

ATTACHMENT 4
SUMMARY OF THE THRUST VALUES DETERMINED IN RFR 8746I

VALVE ID	CLOSED THRUST REQUIREMENT	OPEN THRUST REQUIREMENT	PRA SIGNIFICANCE	METHOD USED FOR DETERMINING THRUST REQUIREMENT	NOTES
BBHV8351B	7039	7039	NONE	USED THRUST REQUIREMENTS FROM AN IDENTICAL VALVE TESTED UNDER LARGER DP AND FLOWRATE.	OPEN AND CLOSED THRUST REQUIREMENTS PROVIDED ARE FOR COMMERCIAL CONCERNS
BBHV8351C	7039	7039	NONE	USED THRUST REQUIREMENTS FROM AN IDENTICAL VALVE TESTED UNDER LARGER DP AND FLOWRATE.	OPEN AND CLOSED THRUST REQUIREMENTS PROVIDED ARE FOR COMMERCIAL CONCERNS
BBHV8351D	7039	7039	NONE	USED THRUST REQUIREMENTS FROM AN IDENTICAL VALVE TESTED UNDER LARGER DP AND FLOWRATE.	OPEN AND CLOSED THRUST REQUIREMENTS PROVIDED ARE FOR COMMERCIAL CONCERNS
BBPV8702A	28065	19761	LOW	USED CALCULATIONS WITH A .5 VALVE FACTOR	
BBPV8702B	28065	19761	LOW	USED CALCULATIONS WITH A .5 VALVE FACTOR	
BGHV8100	7039	7039	NONE	BASED ON THRUST REQUIREMENTS OF IDENTICAL VALVE TESTED AT HIGHER DP AND FLOWRATE	
BGHV8109	7039	328	NONE	CLOSED THRUST BASED ON REQUIREMENTS OF IDENTICAL VALVE TESTED AT HIGHER DP AND FLOWRATE. OPEN THRUST BASED ON CALCS.	
BGHV8112	7039	7039	NONE	BASED ON THRUST REQUIREMENTS OF IDENTICAL VALVE TESTED AT HIGHER DP AND FLOWRATE	
BGLCV0112B	4221	6062	LOW	BASED ON THRUST REQUIREMENTS OF IDENTICAL VALVE TESTED AT HIGHER DP AND FLOWRATE	
BGLCV0112C	4221	6062	LOW	BASED ON THRUST REQUIREMENTS OF IDENTICAL VALVE TESTED AT HIGHER DP AND FLOWRATE	
BNHV0003	3356	3301	LOW	COMPARED THRUST REQUIREMENT OF SIMILAR VALVES THEN DETERMINED REQUIREMENTS BASED ON CALCS AND A VALVE FACTOR OF 1.0 FOR CONSERVATISM	
BNHV0004	3356	3301	LOW	COMPARED THRUST REQUIREMENT OF SIMILAR VALVES THEN DETERMINED REQUIREMENTS BASED ON CALCS AND A VALVE FACTOR OF 1.0 FOR CONSERVATISM	
BNHV8812A	4607	4482	LOW	CALCULATIONS WITH A VALVE FACTOR OF 1.0	
BNHV8812B	4607	4482	LOW	CALCULATIONS WITH A VALVE FACTOR OF 1.0	
EFPDV0019	1023	834		CALCULATIONS WITH A VALVE FACTOR OF 1.0	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EFPDV0020	1023	834		CALCULATIONS WITH A VALVE FACTOR OF 1.0	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EGHV0011	1500	1500	NONE	THRUST REQUIREMENTS BOUND CALCULATIONS USING A VALVE FACTOR OF 2.2	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS

ATTACHMENT 4
SUMMARY OF THE THRUST VALUES DETERMINED IN RFR 8746I

VALVE ID	CLOSED THRUST REQUIREMENT	OPEN THRUST REQUIREMENT	PRA SIGNIFICANCE	METHOD USED FOR DETERMINING THRUST REQUIREMENT	NOTES
EGHV0012	1500	1500	NONE	THRUST REQUIREMENTS BOUND CALCULATIONS USING A VALVE FACTOR OF 2.2.	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EGHV0013	1500	1500	NONE	THRUST REQUIREMENTS BOUND CALCULATIONS USING A VALVE FACTOR OF 2.2.	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EGHV0014	1500	1500	NONE	THRUST REQUIREMENTS BOUND CALCULATIONS USING A VALVE FACTOR OF 2.2.	CLOSE THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EGHV0062	12984	1220	NONE	CALCULATIONS WITH A VALVE FACTOR OF .6 CLOSED AND SIMILAR VALVES THAT WERE DP TESTED IN THE OPEN DIRECTION	OPEN THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS
EGHV0132	2000	1220	NONE	SIMILAR VALVES THAT WERE DP TESTED	THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS. VALVE HAS NO ACTIVE SAFETY FUNCTION.
EJHV8701A	28065	19761	LOW	USED CALCULATIONS WITH A .5 VALVE FACTOR	
EJHV8701B	28065	19761	LOW	USED CALCULATIONS WITH A .5 VALVE FACTOR	
EJHV8811A	7399	7199	MEDIUM	CALCULATIONS WITH A VALVE FACTOR OF 1.0	
EJHV8811B	7399	7199	MEDIUM	CALCULATIONS WITH A VALVE FACTOR OF 1.0	
EMHV8807A	4665	3110	LOW	SIMILAR VALVES THAT WERE DP TESTED	THRUST REQUIREMENTS FOR COMMERCIAL CONCERNS. SAFETY RELATED DP IS 0 PSID. NUMBERS BASED ON 252 PSID.
EMHV8807B	4665	3110	LOW	SIMILAR VALVES THAT WERE DP TESTED	THRUST REQUIREMENTS FOR COMMERCIAL CONCERNS. SAFETY RELATED DP IS 0 PSID. NUMBERS BASED ON 252 PSID.
ENHV0001	3100	3000	LOW	SIMILAR VALVES THAT WERE DP TESTED	
ENHV0006	9487	8970	LOW	USED CALCULATION WITH A .5 VALVE FACTOR. VALVE FACTOR CONSISTENT WITH EPRI PREDICTIVE PROGRAM RESULTS	CLOSED THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS. NO ACTIVE CLOSE FUNCTION.
ENHV0007	3100	3000	LOW	SIMILAR VALVES THAT WERE DP TESTED	
ENHV0012	9487	8970	LOW	USED CALCULATION WITH A .5 VALVE FACTOR. VALVE FACTOR CONSISTENT WITH EPRI PREDICTIVE PROGRAM RESULTS	CLOSED THRUST REQUIREMENTS ARE FOR COMMERCIAL CONCERNS. NO ACTIVE CLOSE FUNCTION.
ENHV0015	NO CHANGE	NO CHANGE	NONE	SIMILAR VALVES DP TESTED UNDER BOUNDING CONDITIONS	VALVES BEING ELIMINATED IN 1995
ENHV0016	NO CHANGE	NO CHANGE	NONE	SIMILAR VALVES DP TESTED UNDER BOUNDING CONDITIONS	VALVES BEING ELIMINATED IN 1996

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ATTACHMENT 4

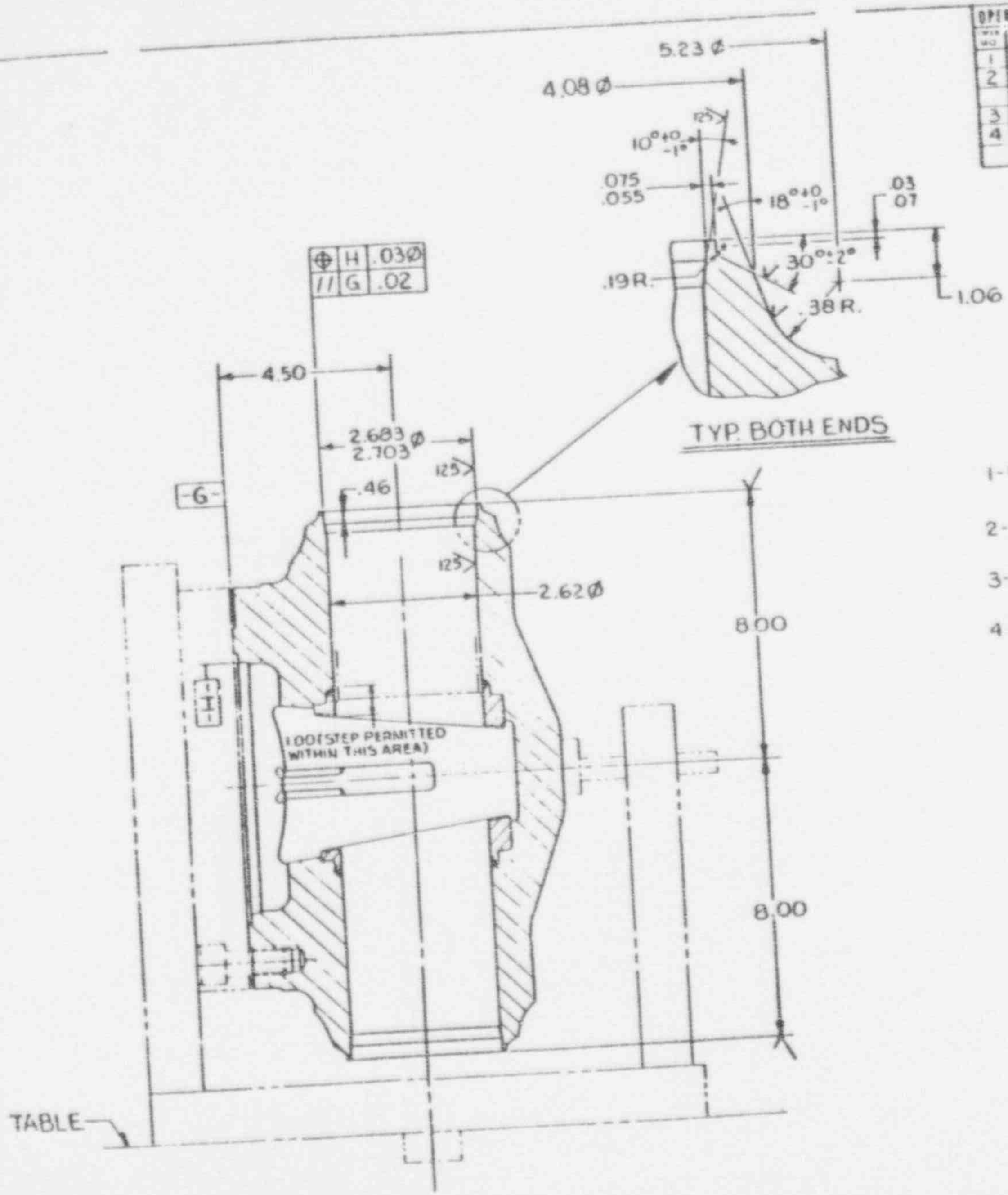
SUMMARY OF THE THRUST VALUES DETERMINED IN RFR 8746I

VALVE ID	CLOSED THRUST REQUIREMENT	OPEN THRUST REQUIREMENT	PRA SIGNIFICANCE	METHOD USED FOR DETERMINING THRUST REQUIREMENT	NOTES
EPHV8808A	30500 4300	26223 4300	NONE	CALCULATIONS WITH A .5 VALVE FACTOR	COMMERCIAL THRUST VALUES PROVIDED FIRST WITH SAFETY THRUST VALUES (4300 LBS) PROVIDED NEXT.
EPHV8808B	30500 4300	26223 4300	NONE	CALCULATIONS WITH A .5 VALVE FACTOR	COMMERCIAL THRUST VALUES BASED ON DP OF 726 PSID. VALVE HAS SAFETY RELATED DP OF 0 PSID.
EPHV8808C	30500 4300	26223 4300	NONE	CALCULATIONS WITH A .5 VALVE FACTOR	COMMERCIAL THRUST VALUES BASED ON DP OF 726 PSID. VALVE HAS SAFETY RELATED DP OF 0 PSID.
EPHV8808D	30500 4300	26223 4300	NONE	CALCULATIONS WITH A .5 VALVE FACTOR	COMMERCIAL THRUST VALUES BASED ON DP OF 726 PSID. VALVE HAS SAFETY RELATED DP OF 0 PSID.
KAHV0030	450	347	NONE	CALCULATIONS WITH A VALVE FACTOR OF 1.0	VALVE INSTALLED IN AN AIR SYSTEM
KCHV0253	1507	1291	NONE	CALCULATIONS WITH A VALVE FACTOR OF 1.0	
LFFV0095	1766	295		CALCULATIONS WITH A VALVE FACTOR OF 1.1	VALVES DP TESTED UNDER LOW DP'S
LFHV0105	548	532		CALCULATIONS WITH A VALVE FACTOR OF 1.2	VALVES DP TESTED UNDER LOW DP'S
LFHV0106	548	532		CALCULATIONS WITH A VALVE FACTOR OF 1.3	VALVES DP TESTED UNDER LOW DP'S

ATTACHMENT 5 TO RFR 8746I

THE ATTACHED DRAWINGS WERE OBTAINED FROM THE WESTINGHOUSE STRESS REPORTS IN THE QA VAULT OF THE CALLAWAY NUCLEAR PLANT. THESE DRAWINGS SHOW THE MEAN SEAT AREA OF WESTINGHOUSE FLEX WEDGE GATE VALVES.

OPERATION WELD PREP AND BORE CONFIGURATION		
OPER NO	OPERATION DESCRIPTION	APPLICABLE TOOL OR SPECIFICATION
1	SET-UP FIXTURE	114E951TIK
2	MACHINE WELD PREP AND BORE	114E555TIA
	CONFIGURATION (PORT "A").	
3	ROTATE BODY 180° IN FIXTURE.	
4	MACHINE WELD PREP AND BORE	
	CONFIGURATION (PORT "B")	



TYP. BOTH ENDS

NOTES

1- MAX. MACHINED SURFACE ROUGHNESS OF 250 μ IN (V) TO BE HELD, UNLESS OTHERWISE SPECIFIED.

2- ALL UNTOLERANCED DIMENSIONS TO BE ± .02 UNLESS OTHERWISE SPECIFIED.

3- ALL ANGULAR TOLERANCES TO BE ± 2° UNLESS OTHERWISE SPECIFIED.

4- ALL RADII TO BE .04 ± .02 UNLESS OTHERWISE SPECIFIED.

RFR 8746I

EJFCV0610, 611
BGHV8105, 8106
BBHV8000A,B

40° DELETED
3.23 WAS 3.48
3.24 WAS 5.09 2

1 VALVES 1

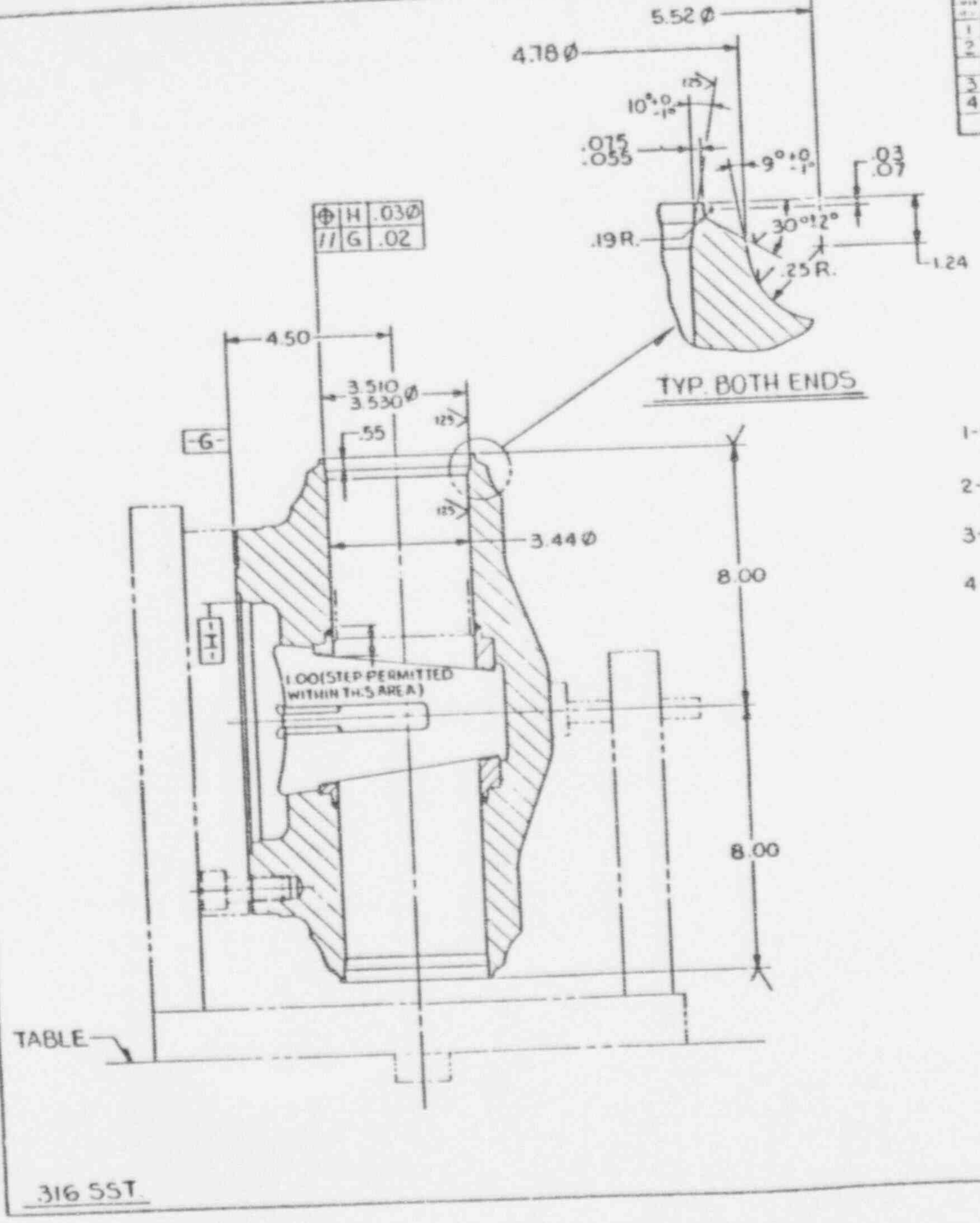
Westinghouse Electric Corporation
ELECTRO MECHANICAL DIVISION CHESWICK, PA
BODY (3 IN - 1525 LB)
1166E46M07
OPERATION NO 0900

316 SST.

ATTACHMENT 5

2 of ~~16~~ 11 RD 1-20-84

	OPERATION WELD PREP AND BORE CONFIGURATION						...472
	OPERATION DESCRIPTION						
1	SET - UP FIXTURE	114E551TIK					
2	MACHINE WELD PREP AND BORE CONFIGURATION (PORT "A").	114E955T1A					
3	ROTATE BODY 180° IN FIXTURE						
4	MACHINE WELD PREP AND BORE CONFIGURATION (PORT "B")						



NOTES

1- MAX. MACHINED SURFACE ROUGHNESS OF 250 μIN (√) TO BE HELD, UNLESS OTHERWISE SPECIFIED.
2- ALL UNTOLERANCED DIMENSIONS TO BE ±.02 UNLESS OTHERWISE SPECIFIED.
3- ALL ANGULAR TOLERANCES TO BE ± 2° UNLESS OTHERWISE SPECIFIED.
4- ALL RADII TO BE .04 ±.02 UNLESS OTHERWISE SPECIFIED.

EMHV 8801A, B
8803A, B
8802A, B
8835

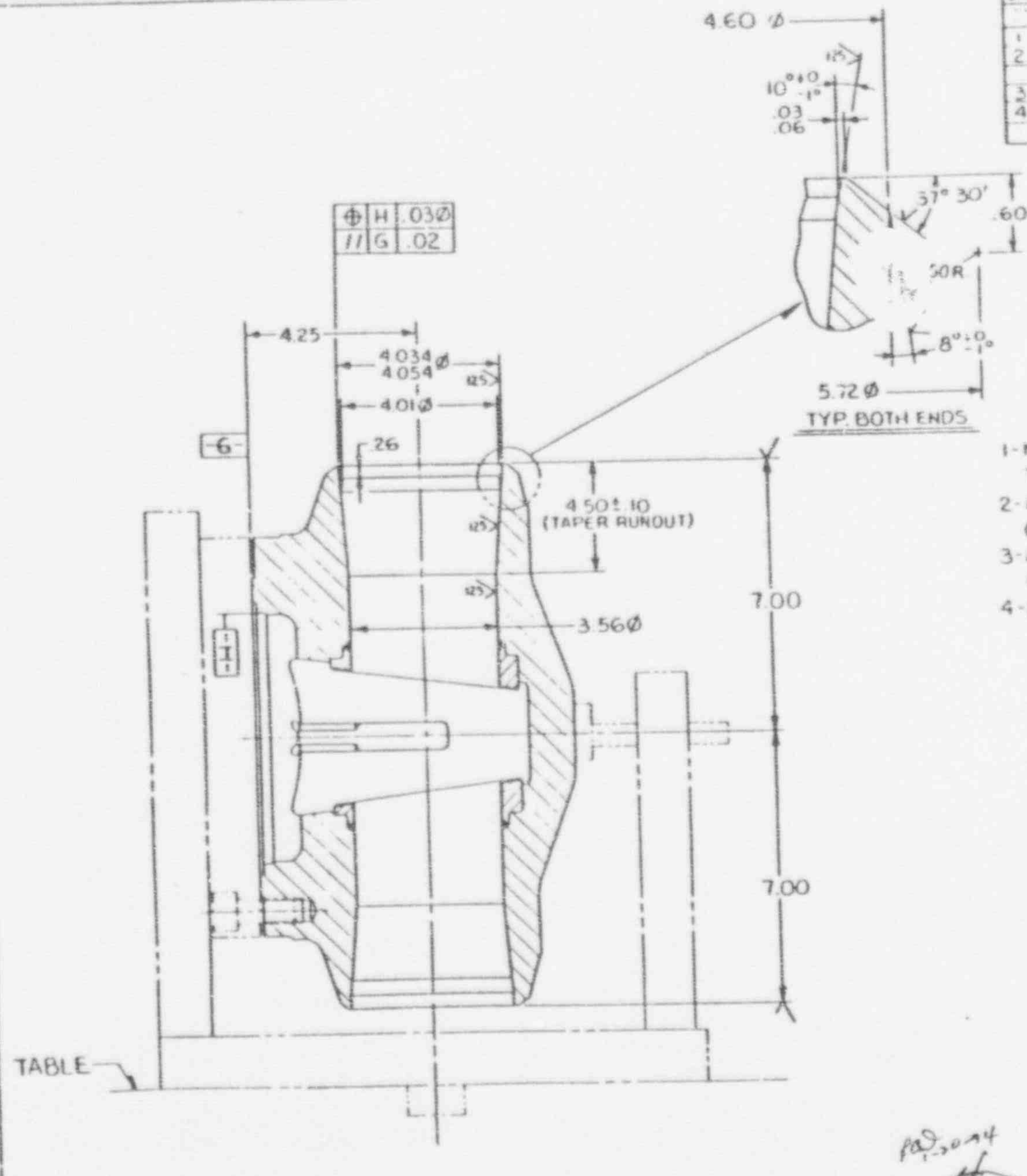
5.52 Ø WAS 6.00 Ø
.25 R WAS .50R
2

18 VALVES 1

Westinghouse Electric Corporation
ELECTRO MECHANICAL DIVISION CHESWICK PA
BODY (4IN - 1525LB)
1166E52M07
0900
SHEET 1 OF 1

ATTACHMENT 5 3 8/16 11 RAW 1-30-84

	OPERATION WELD PREP AND BORE CONFIGURATION		470
1	SET-UP FIXTURE	114F951TIK	
2	MACHINE WELD PREP AND BORE CONFIGURATION (PORT "A")	114E955TIA	
3	ROTATE BODY 180° IN FIXTURE		
4	MACHINE WELD PREP AND BORE CONFIGURATION (PORT "B")		



NOTES

1- MAX MACHINED SURFACE ROUGHNESS OF 250 μ IN (√) TO BE HELD, UNLESS OTHERWISE SPECIFIED.

2- ALL UNTOLERANCED DIMENSIONS TO BE ± .02 UNLESS OTHERWISE SPECIFIED.

3- ALL ANGULAR TOLERANCES TO BE ± 2° UNLESS OTHERWISE SPECIFIED.

4- ALL RADII TO BE .04 ± .02 UNLESS OTHERWISE SPECIFIED.

RFR 8746 I

BGLCV0112B/C

BBHV8037A/B

1# VALVES 1

Westinghouse Electric Corporation

ELECTRO MECHANICAL DIVISION CHESWICK, PA.

BODY (4" - 150 LB.)

1186F49M08

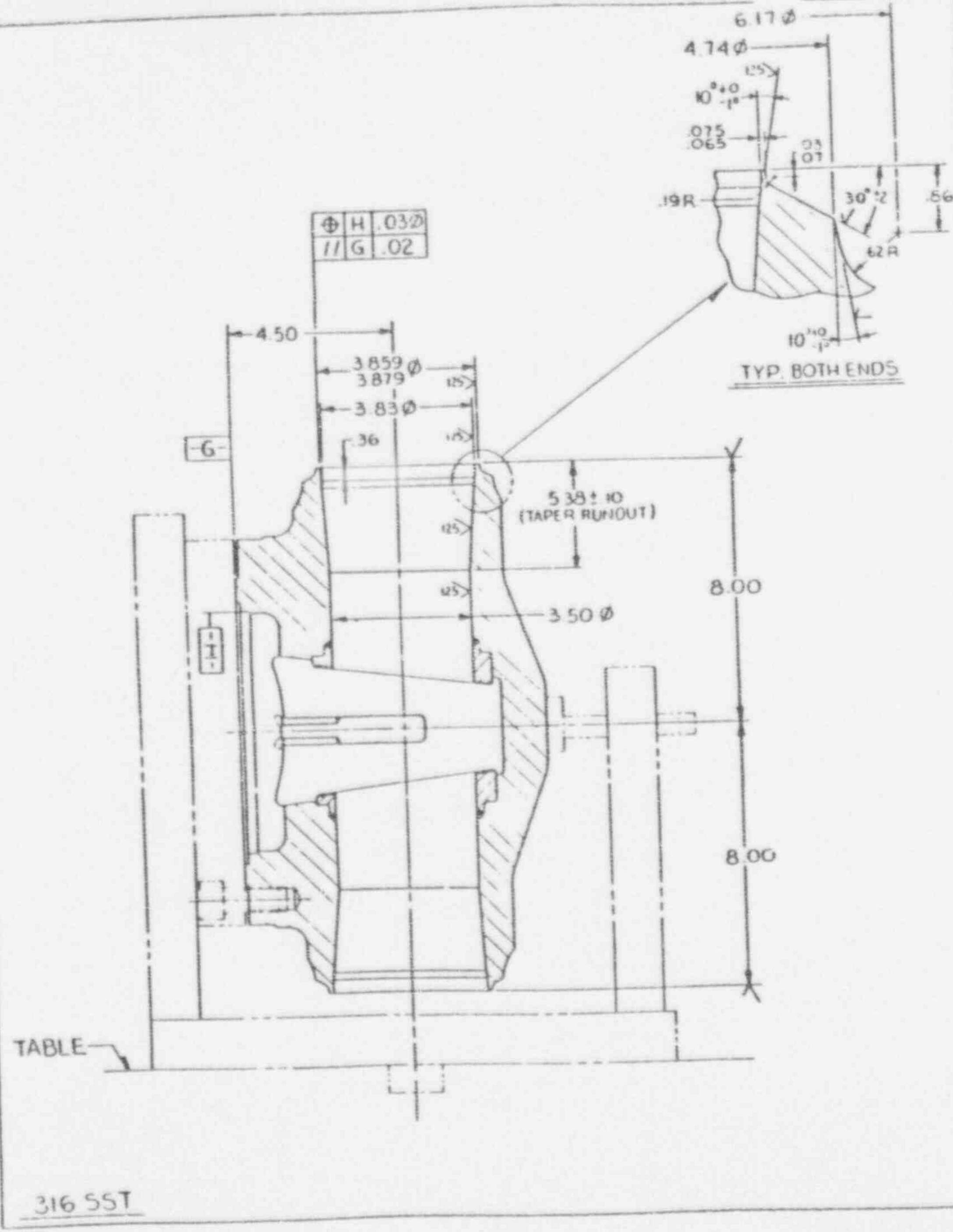
OPERATION NO. 0900

RAD 1-20-94

RAD 1-11-94

ATT 5 ~~3B R~~ 4B 11

OPERATION WELD PREP AND BORE CONFIGURATION							
	[illegible]	[illegible]					
1	SET-UP FIXTURE	114E951TIK					
2	MACHINE WELD PREP AND BORE	114E955TIA					
	CONFIGURATION (PORT "A").						
3	ROTATE BODY 180° IN FIXTURE						
4	MACHINE WELD PREP AND BORE						
	CONFIGURATION (PORT "B")						



NOTES

1- MAX. MACHINED SURFACE ROUGHNESS OF 250 μ IN (√) TO BE HELD, UNLESS OTHERWISE SPECIFIED.

2- ALL UNTOLERANCED DIMENSIONS TO BE ± .02 UNLESS OTHERWISE SPECIFIED.

3- ALL ANGULAR TOLERANCES TO BE ± 2° UNLESS OTHERWISE SPECIFIED.

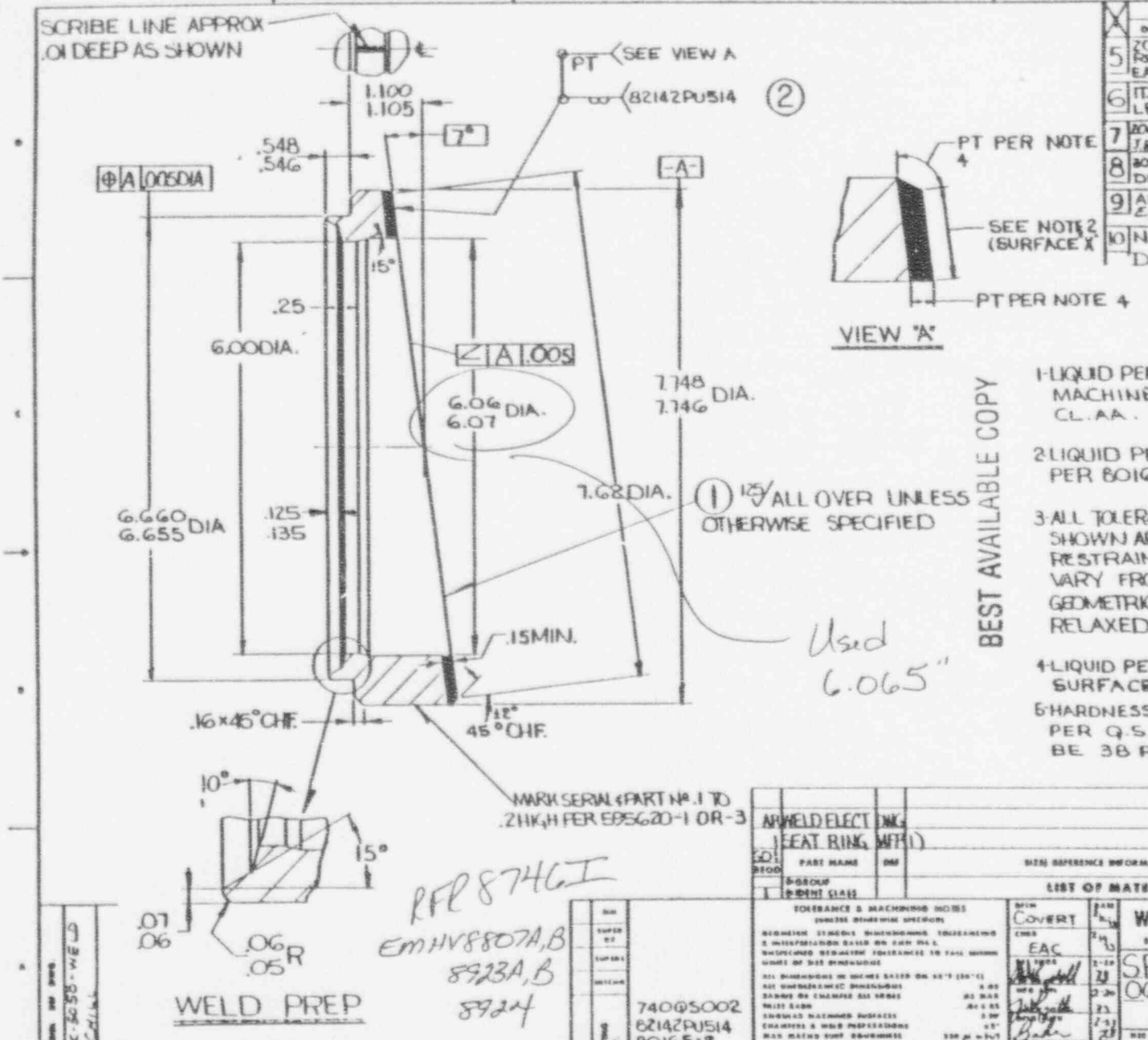
4- ALL RADII TO BE .04 ± .02 UNLESS OTHERWISE SPECIFIED.

EMHV8821A,B

II VALVES | 1

Westinghouse Electric Corporation
ELECTRO-MECHANICAL DIVISION CHESWICK PA
BODY (4" - 900 LB.)
1166E52M08
OPERATION NO. 0300
SHEET 1 of 1

ATT 5 ~~4 of 10~~ 5 RAW 1-11-94 5 of 11 RAW 1-20-94



Used 6.065"

BEST AVAILABLE COPY

RFR 8746I

EMHV8807A,B
8923A,B
8924

	REVISIONS
	ORIGINAL RELEASE ON E.O
5	ZONE B-4 .15MIN. WAS .20MIN REVISED NOTE 1 EAC/wa/JSZ NEW 12/5/75
6	IT. 1 955B810H03 WAS 955B810H01 LRC/EAC/JSZ 1-30-76
7	ZONE B-5 28°CHF. WAS 45°CHF.
8	ZONE B-B, 45°CHF WAS 28°CHF DMF
9	ADDED "595620-3" TO MARKING NOTE
10	NOTE 5 ADDED DAN

NOTES

1-LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER 80165-2, CL.AA.

2-LIQUID PENETRANT EXAMINE SURFACE "X" PER 80165-2, CL.OA.

3-ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D. WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D. TOLERANCES & GEOMETRIC SYMBOLS WITHIN .01 IN RELAXED CONDITION.

4-LIQUID PENETRANT EXAMINE INDICATED SURFACES PER 80165-2. CL.OOK.

5-HARDNESS OF STELLITE TO BE CHECKED PER Q.S. 740QS002. HARDNESS TO BE 38 Rc MIN.

AR	WELD ELECT	DWG		308A772	H01		2
1	SEAT RING	MFR(1)		955B810	H03	1	1
	PART NAME	DWG	SIZE REFERENCE INFORMATION	MAIN SUB CODE PART NUMBER OR SEE DWG	IDENT CLASS	NOTE	ITEM
1	GROUP IDENT CLASS		LIST OF MATERIALS				

740QS002
82142PU514
80165-2

SPECIFICATION LIST

TOLERANCE & MACHINING NOTES

DSGN Covert
CHKD EAC

Westinghouse Electric Corporation

ELECTRO-MECHANICAL DIV. – CHESWICK PA. U.S.A.

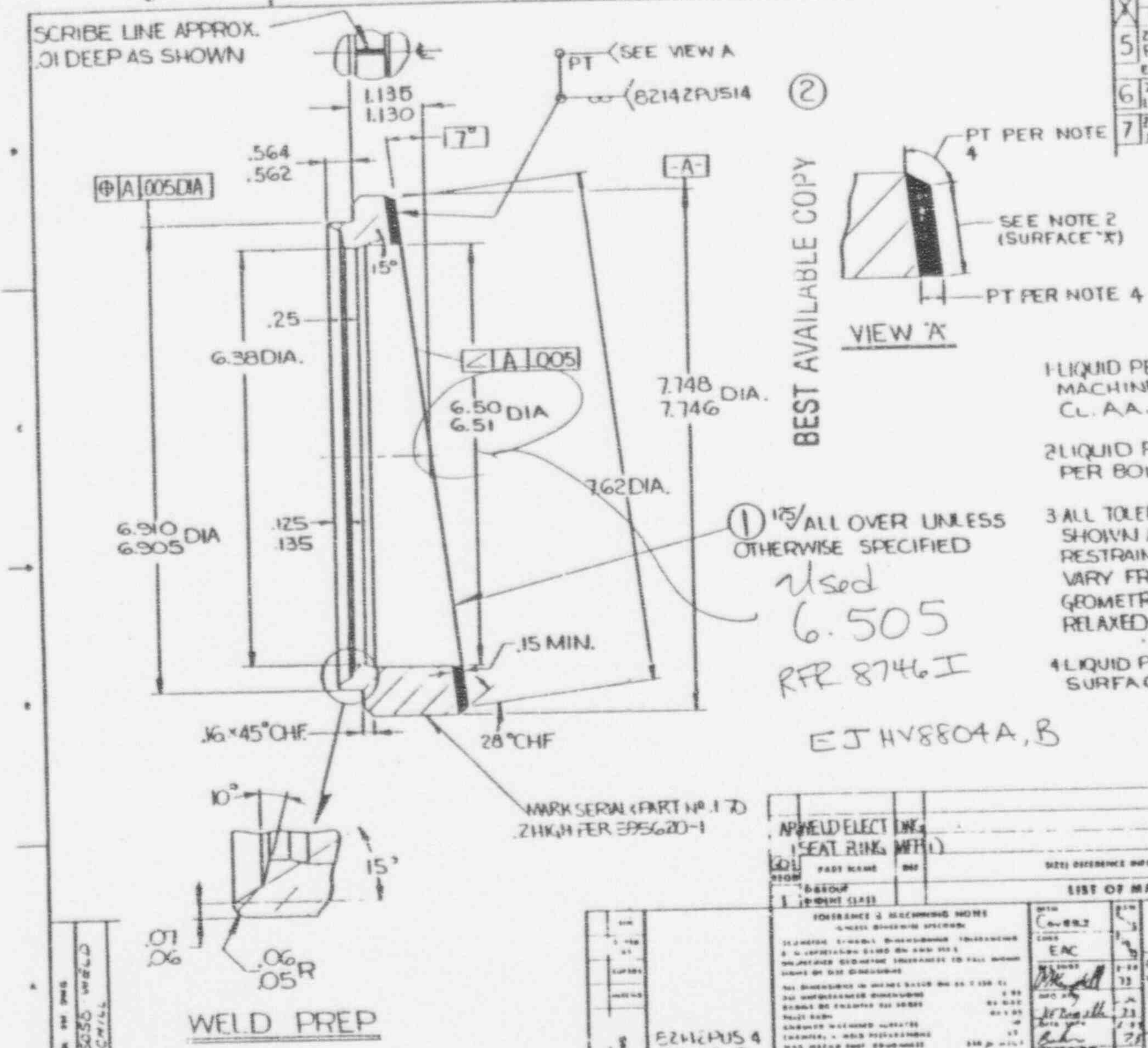
SEAT RING-08-1500LB, 06-150LB, 300LB
SEAT RING

SIZE C | CAGE IDENT NO. 04808 | DWG NO. 130E 7

SCALE N.T.S.

RCD 1-11-94

ATT 5 ~~6 of 10~~ RCD 1-30-94 6 of 11



Used
6.505
RFR 8746 I

EJ HV8804A,B

NOTES

1. LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER 80165-2, CL. AA.
2. LIQUID PENETRANT EXAMINE SURFACE "X" PER 80165-2, CL.OA.
3. ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D. WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D. TOLERANCES & GEOMETRIC SYMBOLS WITHIN .01 IN RELAXED CONDITION.
4. LIQUID PENETRANT EXAMINE INDICATED SURFACES PER 80165-2. CL. OOK.

REVISIONS

ORIGINAL RELEASE ON 1 0

5	ZONE B-4 .15MIN. WAS .20MIN. REVISED NOTE 1 EAC/W10/WK/13E MGW 12/5/75
6	ZONE D5 - 1.135/1.130 WAS 1.125/1.120 1 RC/EAC/13Z 1-30-76
7	ZONE B-5 28°CHF. WAS 45°CHF

	AP WELD ELECT DWG			208A112 H01			2
	1 SEAT RING MFR 1)			955B810 H01	1		1

LIST OF MATERIALS

E2142PUS 4
80165-2

Covert
EAC

Westinghouse Electric Corporation
ELECTRO-MECHANICAL DIV. - CHESWICK PA. U.S.A.

SEAT RING-08 0150LB,
0300LB

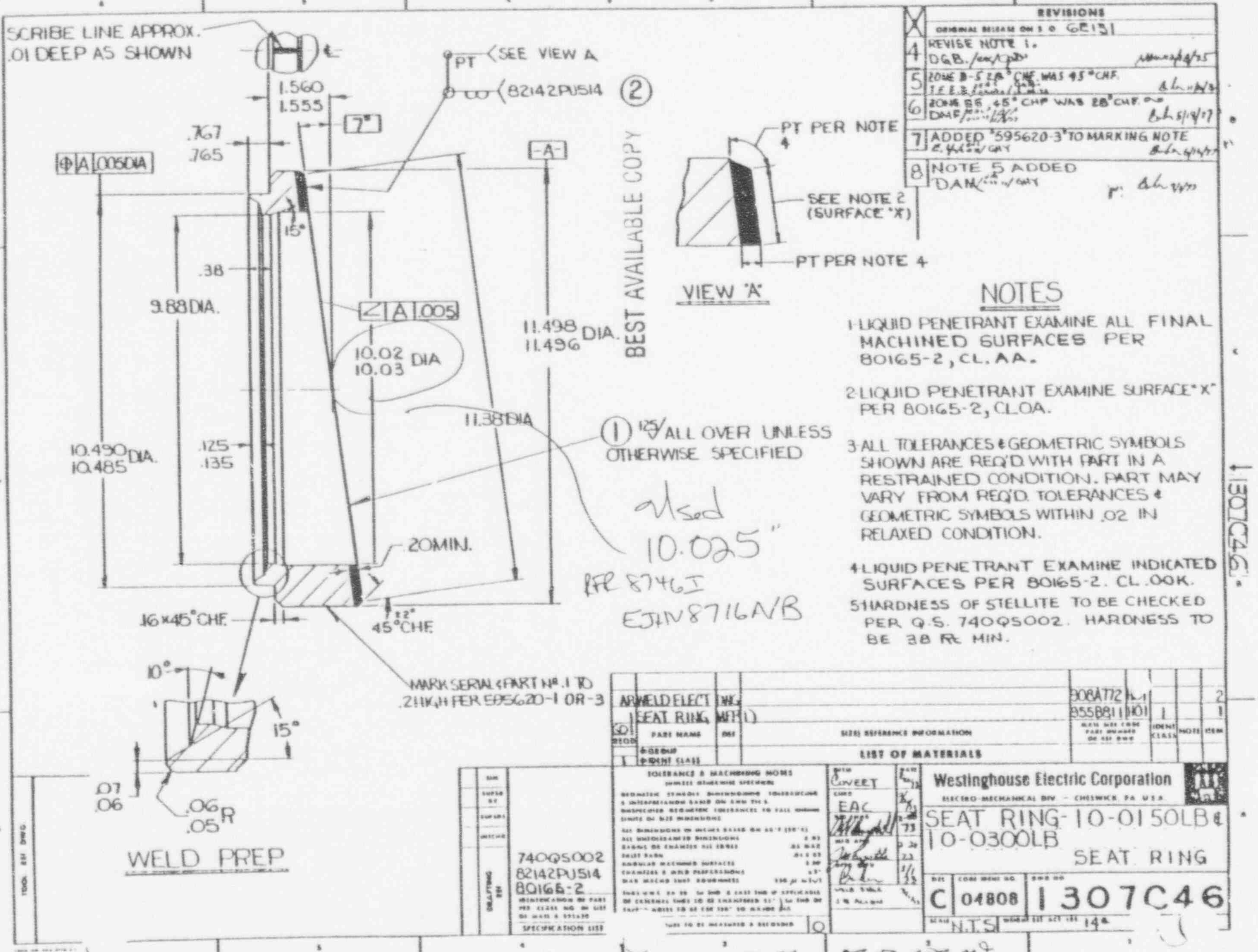
SEAT RING

C 04808 1306C68

N.T.S. 5

ATT 5 ~~6 of 10~~ 11 RAW 1-11-94

7 of 11 RAD 1-20-94



Used 10.025"
Per 8746I
EJ#N8716N/B

NOTES

1. LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER 80165-2, CL. AA.
2. LIQUID PENETRANT EXAMINE SURFACE "X" PER 80165-2, CL. OA.
3. ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D TOLERANCES & GEOMETRIC SYMBOLS WITHIN .02 IN RELAXED CONDITION.
4. LIQUID PENETRANT EXAMINE INDICATED SURFACES PER 80165-2. CL. OOK.
5. HARDNESS OF STELLITE TO BE CHECKED PER Q.S. 740QS002. HARDNESS TO BE 38 Rc MIN.

	REVISIONS
	ORIGINAL RELEASE ON S.O. GE131
4	REVISE NOTE 1. DGB. [illegible]
5	ZONE B-5 28° CHF. WAS 45° CHF. [illegible]
6	ZONE B6, 45° CHF WAS 28° CHF. DAF [illegible]
7	ADDED "595620-3" TO MARKING NOTE E. [illegible]/GAY
8	NOTE 5 ADDED DAM [illegible]/GAY

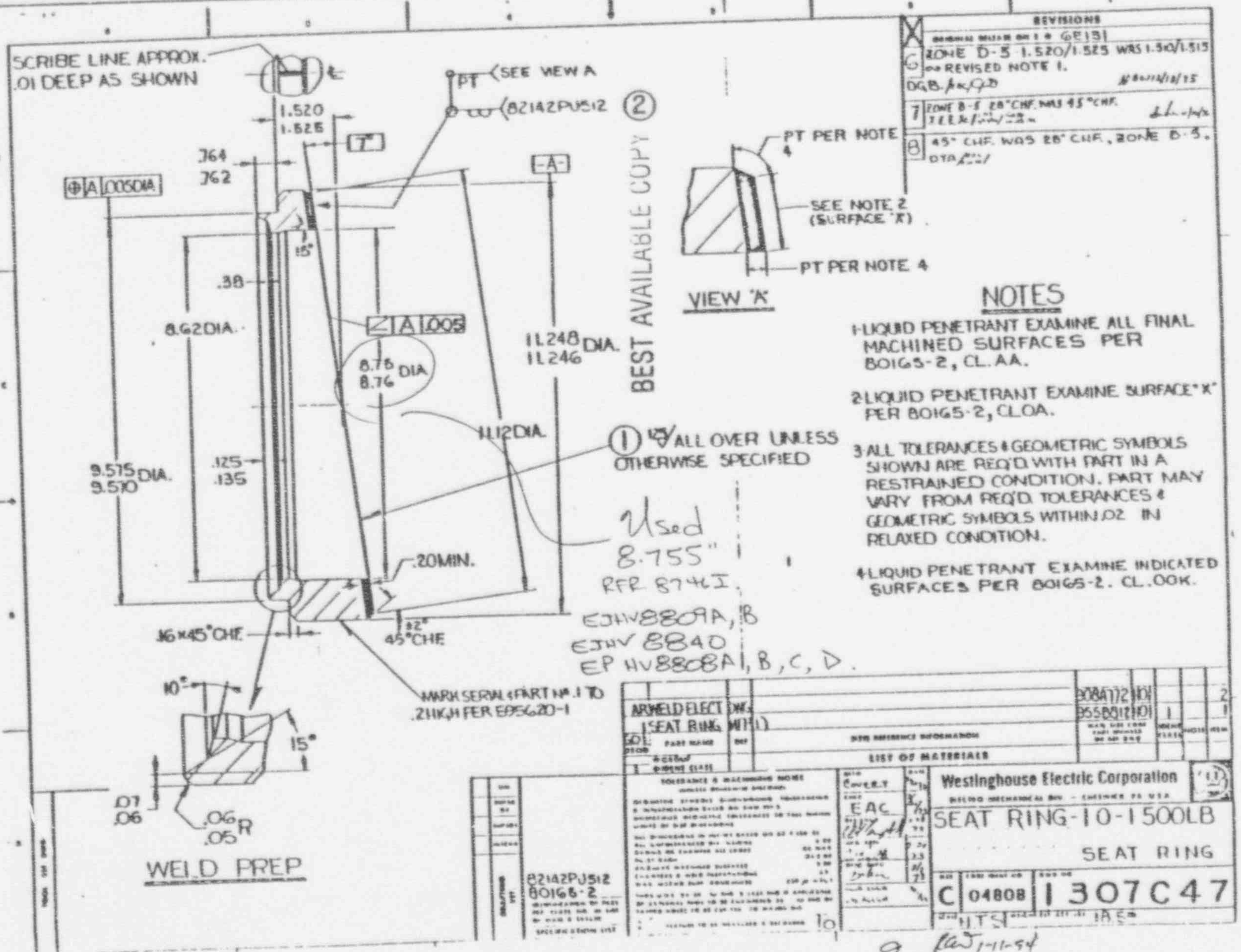
QTY REQD	PART NAME	DWG	SIZE REFERENCE INFORMATION	MATL, NO. CODE PART NUMBER OR SUB DWG		IDENT CLASS	NOTE	ITEM
AR	WELD ELECT	DWG		908A772	H1			2
1	SEAT RING	MFR(1)		955B811	H01	1		1
1	GROUP IDENT CLASS		LIST OF MATERIALS					

SPECIFICATION LIST
740QS002
82142PU514
80165-2

TOLERANCE & MACHINING NOTES (UNLESS OTHERWISE SPECIFIED)

DWN COVEET
CHKD EAC
Westinghouse Electric Corporation
ELECTRO-MECHANICAL DIV - CHESWICK PA U.S.A.
SEAT RING-10-0150LB & 10-0300LB
SEAT RING
SIZE C
CODE IDENT NO. 04808
DWG NO. 1307C46
SCALE N.T.S.
14

ATT 5 88 10/11 RAW 1-2054



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Used 8.755"
RFR 8746I

EJHV8809A, B
EJHV 8840
EP HV8808A1, B, C, D.

NOTES

1. LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER BOIG5-2, CL. AA.
2. LIQUID PENETRANT EXAMINE SURFACE "X" PER BOIG5-2, CL.OA.
3. ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D. TOLERANCES & GEOMETRIC SYMBOLS WITHIN .02 IN RELAXED CONDITION.
4. LIQUID PENETRANT EXAMINE INDICATED SURFACES PER BOIG5-2. CL.OOK.

REVISIONS

	[illegible] GE131
6	ZONE D-5 1.520/1.525 WAS 1.510/1.515 REVISED NOTE 1. DGB. [illegible] 11/18/75
7	ZONE B-5 28°CHF. WAS 45°CHF. [illegible]
8	45° CHF. WAS 28° CHF., ZONE D-5. DTA [illegible]

ARWELD ELECT	DWG	308A172	101		2
SEAT RING	WIT(1)	955B012	101	1	1

LIST OF MATERIALS

82142PU512
B0165-2

Westinghouse Electric Corporation

SEAT RING-10-1500LB

SEAT RING

C 04808 1307C47

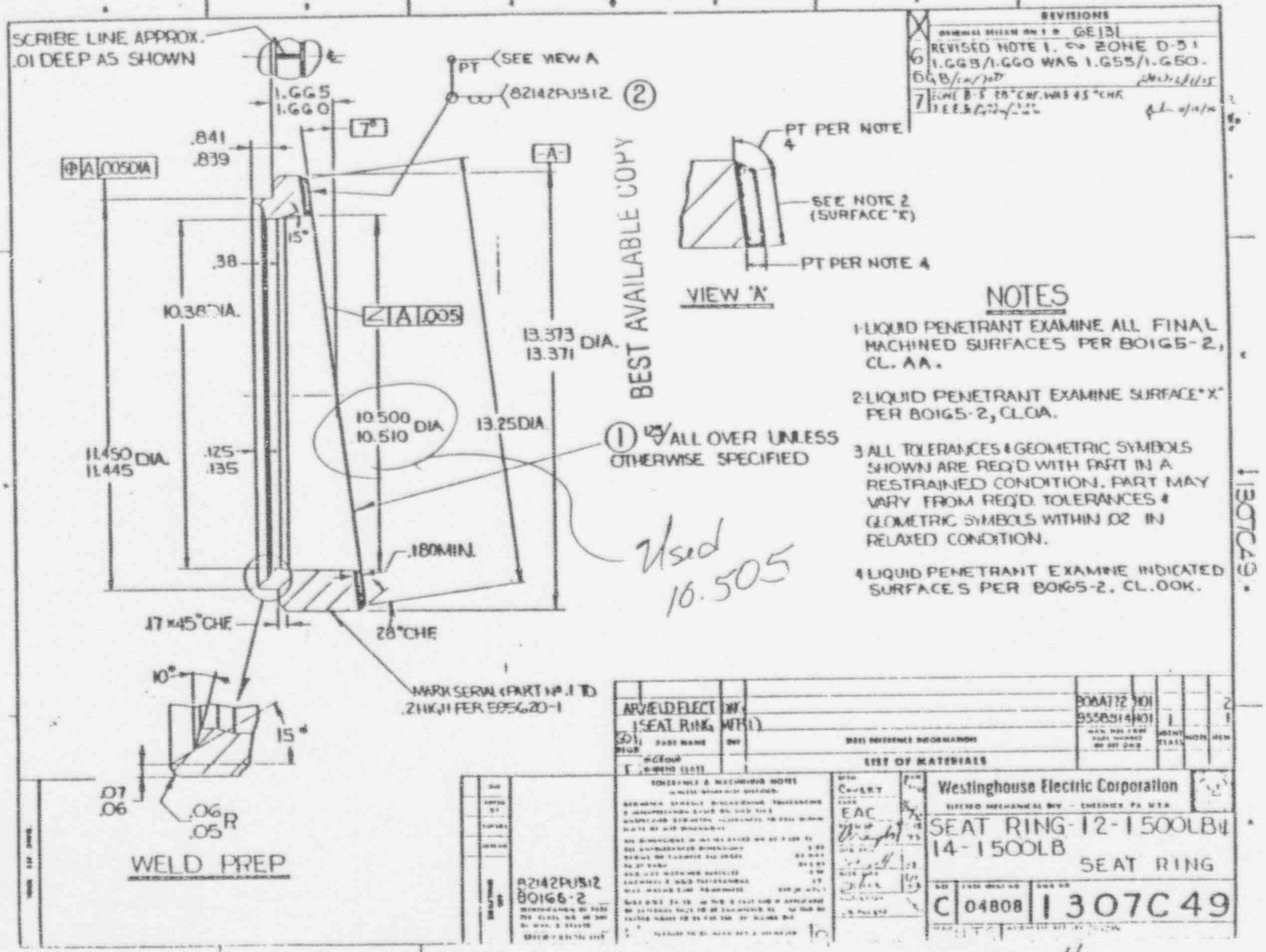
EAC

HTS

ATT 5 ~~8~~ 9 of ~~10~~ 11
RW 1-11-94

RFC 8746I

BBPV8701A/B; EJHV8701A/B



① 125∇ ALL OVER UNLESS OTHERWISE SPECIFIED

Used 10.505

NOTES

1. LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER B0165-2, CL. AA.
2. LIQUID PENETRANT EXAMINE SURFACE "X" PER B0165-2, CL.OA.
3. ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D TOLERANCES & GLOMETRIC SYMBOLS WITHIN .02 IN RELAXED CONDITION.
4. LIQUID PENETRANT EXAMINE INDICATED SURFACES PER B0165-2, CL.OOK.

REVISIONS

GE131

6 REVISED NOTE 1. & ZONE D-5: 1.665/1.660 WAS 1.655/1.650.

7 ZONE B-5 28°CHF. WAS 45°CHF.

AR/WELD ELECT

1 SEAT RING

308A772 H01

955B914H01

LIST OF MATERIALS

82142PU312

B0166-2

EAC

Westinghouse Electric Corporation

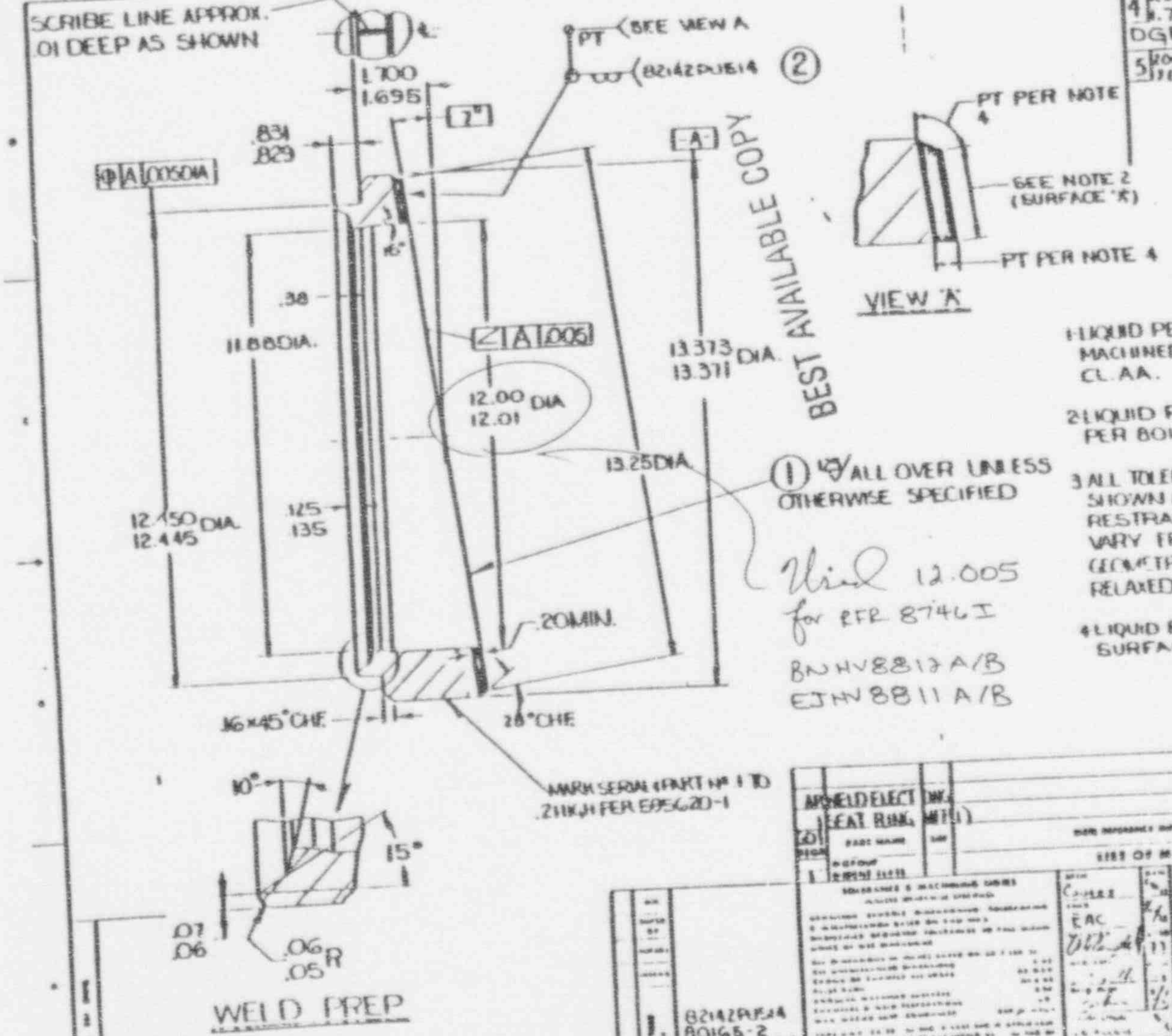
SEAT RING-12-1500LB & 14-1500LB

SEAT RING

C 04808 1307C49

ATT 5 10 of ~~10~~ 11 RAD 1-20-94

	REVISIONS	
1		
4	REVISED NOTE 1 ◇ ZONE D-5, 1.700/1.695 WAS 1.690/1.686 DGB	
5	ZONE B-5 28°CHF WAS 45°CHF	



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① 125 ALL OVER UNLESS OTHERWISE SPECIFIED

Used 12.005
for RFR 8746I
BNHV8812A/B
EJHV8811A/B

NOTES

1. LIQUID PENETRANT EXAMINE ALL FINAL MACHINED SURFACES PER 80165-2, CL. AA.

2. LIQUID PENETRANT EXAMINE SURFACE "X" PER 80165-2, CL. OA.

3. ALL TOLERANCES & GEOMETRIC SYMBOLS SHOWN ARE REQ'D WITH PART IN A RESTRAINED CONDITION. PART MAY VARY FROM REQ'D TOLERANCES & GEOMETRIC SYMBOLS WITHIN .02 IN RELAXED CONDITION.

4. LIQUID PENETRANT EXAMINE INDICATED SURFACES PER 80165-2, CL. OOK.

APWELD ELECT DWG.
SEAT RING MTL(1)
PART NAME
LIST OF MATERIALS
DOBA112 H01
D55B013 H01
82142RU514
80165-2

Westinghouse Electric Corporation

SEAT RING-12-0150LB &
12-0300LB & 14-0300LB,
SEAT RING

C 04808 1307C48

ATT 5 11 8 11

ATTACHMENT 6

WOLF CREEK DP TEST RESULTS FOR CONTAINMENT SPRAY PUMP DISCHARGE ISOLATION VALVES ENHV0006 AND 12

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PFR 8746I
2 of 3
ATT 6

WCNOC-86 DESIGN BASIS CALCULATION INPUT CHECK REV. 0

ENHV0006 ACTUAL STEM THREAD AND DISC/SEAT COEFFICIENTS OF FRICTION DETERMINATION

GENERAL INFORMATION CALCULATION: EN HV-006 Rev. 4

MEAN DIAMETER OF SEAT	Do	===>	9.875	(inch)
STEM DIAMETER AT PACKING	Ds	===>	1.5	(inch)
STEM LEAD	L	===>	1	(in/rev)
STEM PITCH	PITCH	===>	0.333	(inch)
HALF THREAD ANGLE	ALPHA	===>	14.5	(deg)
SEAT ANGLE	THETA	===>	5	(deg)
STEM THREAD COEFFICIENT OF FRICTION	Mut	===>	0.2	

ORIFICE AREA				Ao	===>	76.59	(in^2)
tan (a)				tan (a)	===>	0.239	
d	d (Stub ACME)	===> 1.389	(in)	d (Gen. ACME)	===>	1.334	(in)
cos (ALPHA)				cos (ALPHA)	===>	0.96815	(deg)
sin (THETA)				sin(THETA)	===>	0.08716	(deg)
cos (THETA)				cos(THETA)	===>	0.99619	(deg)
DISC/SEAT COEFFICIENT OF FRICTION				Mus	===>	0.35	

DP and VOTES TEST DATA TYPE TEST: DP DP TEST #: TP-TS-89 WR #: 0X581-93 VOTES TEST #: 9

<<<<<<<<<<<<<<<< CLOSING >>>>>>>>>>>>>>>> <<<<<<<<<<<<<<<< OPENING >>>>>>>>>>>>>>>>

CLOSE DP TEST DATA

DP DURING CLOSE	DPc	===>	199	(psi)
CLOSE AVERAGE RUNNING THRUST	Fapblhc	===>	562	(lbs)
CLOSE AVERAGE RUNNING TORQUE (approx.)	Fapltqc	===>	14.5	(ft-lbs)
CLOSE DP THRUST (C10)	C10Th	===>	N/A	(lbs)
CLOSE DP TORQUE (C10)	C10Tq	===>	N/A	(ft-lbs)
CLOSE WEDGING THRUST (C11)	C11Th	===>	N/A	(lbs)
CLOSE WEDGING TORQUE (C11)	C11Tq	===>	N/A	(ft-lbs)
CLOSE CST THRUST (C14)	C14Th	===>	3357	(lbs)
CLOSE CST TORQUE (C14)	C14Tq	===>	82.38	(ft-lbs)
CLOSE MAXIMUM THRUST (C16)	C16Th	===>	4000	(lbs)
CLOSE MAXIMUM TORQUE (C16)	C16Tq	===>	85.31	(ft-lbs)

OPEN DP TEST DATA

DP DURING OPEN	DPo	===>	232	(psi)
OPEN AVERAGE RUNNING THRUST	Fapblho	===>	81	(lbs)
OPEN DP THRUST (O10)	O10Th	===>	2805	(lbs)

TEST DP

Assumed ½ to DP prior test.

CALCULATIONS NOTE: The STEM FACTORs have an additional margin included (calculated by the SRSS methodology) due to the 10% V/C inaccuracy and the overall sytem thrust inaccuracy.

CLOSE STEM FACTORS Thrust Inaccuracy (%) = 10.3

CLOSE AVERAGE RUNNING LOAD (ARLc)	SF	===>	0.0295	(ft)
CLOSE DP LOAD (C10)	SF	===>	#VALUE!	(ft)
CLOSE WEDGING LOAD (C11)	SF	===>	#VALUE!	(ft)
CLOSE CST LOAD (C14)	SF	===>	0.0281	(ft)
CLOSE MAXIMUM LOAD (C16)	SF	===>	0.0244	(ft)

CLOSE STEM THREAD COEFFICIENTS OF FRICTION

CLOSE AVERAGE RUNNING LOAD (ARLc)	Mut	===>	0.23
CLOSE DP LOAD (C10)	Mut	===>	#VALUE!
CLOSE WEDGING LOAD (C11)	Mut	===>	#VALUE!
CLOSE CST LOAD (C14)	Mut	===>	0.21
CLOSE MAXIMUM LOAD (C16)	Mut	===>	0.16

CHECK ONE Mut: Mut = $\frac{(\cos(\text{ALPHA}) * \text{SF}) - [d/24 * \cos(\text{ALPHA}) * \tan(a)]}{(\tan(a) * \text{SF}) + (d/24)}$ Check for Stub or General ACME Thread

$$mut = \frac{(.96815)(.0281) - [.0578 \times (.96815)(.239)]}{(.239)(.0281) + .0578} = 0.21$$

Mut below design value ? YES ☐ NO ☒ CWR No.: (See remarks)

CLOSE CALCULATED ACTUAL DISC/SEAT COEFFICIENT OF FRICTION

CORRECTED DP THRUST (C10 less Fapblhc)	Fdpc	===>	#VALUE!	(lbs)
DIFFERENTIAL PRESSURE LOAD	Fdpc	===>	0	(lbs)
DISC/SEAT COEFF. OF FRICTION	Mus	===>		

CHECK Mus: Fdpc = Mus * DPC * Ao * {1 [cos(THETA) - Mus * sin(THETA)]} Not Required for Globe

N/A

Mus below design value ? YES ☐ NO ☐ CWR No.:

OPEN CALCULATED ACTUAL DISC/SEAT COEFFICIENT OF FRICTION

CORRECTED DP THRUST (O10 less Fapblho)	Fdpo	===>	3027	(lbs)
DIFFERENTIAL PRESSURE LOAD	Fdpo	===>	3027	(lbs)
DISC/SEAT COEFF. OF FRICTION	Mus	===>	0.17	

CHECK Mus: Fdpo = Mus * DPo * Ao * {1 [cos(THETA) + Mus * sin(THETA)]} Not Required for Globe

$$Fdpo = (.17)(232)(76.59) \times \{1.01\} = 3050$$

Mus below design value ? YES ☐ NO ☐ CWE No.:

REMARKS:

C10 and C11 marks not seen in the closing stroke trace as the torque switch tripped prior to wedging due to high flow. Close DP data is not required as the valve has no closing SR. function.

- no WR required for this valve for C14 mut being over design since the valve is not required to be set up to close under flow conditions.

Duane J Wenninger
PREPARED BY
8-10-93
DATE

Robert J Dandy
VERIFIED BY
8/10/93
DATE

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RFR
8746I
3 of 3
ATT 6

WCNOC-86 DESIGN BASIS CALCULATION INPUT CHECK REV. 0

ENHV0012 ACTUAL STEM THREAD AND DISC/SEAT COEFFICIENTS OF FRICTION DETERMINATION

GENERAL INFORMATION CALCULATION: EN-M-006 Rev ~~4~~ 5 CEH 8/8/93

MEAN DIAMETER OF SEAT	Do	--->	9.875	(inch)
STEM DIAMETER AT PACKING	Ds	--->	1.5	(inch)
STEM LEAD	L	--->	1	(in rev)
STEM PITCH	PITCH	--->	0.333	(inch)
HALF THREAD ANGLE	ALPHA	--->	14.5	(deg)
SEAT ANGLE	THETA	--->	5	(deg)
STEM THREAD COEFFICIENT OF FRICTION	Mu	--->	0.2	

ORIFICE AREA	Ao	--->	76.59	(in^2)
tan (a)	tan (a)	--->	0.239	
d d (Stub ACME) ---> 1.389 (in)	d (Gen. ACME)	--->	1.334	(in)
cos (ALPHA)	cos (ALPHA)	--->	0.96815	(deg)
sin (THETA)	sin(THETA)	--->	0.08716	(deg)
cos (THETA)	cos(THETA)	--->	0.99619	(deg)
DISC/SEAT COEFFICIENT OF FRICTION	Mus	--->	0.35	

DP and VOTES TEST DATA TYPE TEST: DP DP TEST #: TP-TS-90 WR #: ~~R~~ 578-93 CEH 8/6/93 VOTES TEST #: B

<<<<<<<<<<<<<<< CLOSING >>>>>>>>>>>>>>>

CLOSE DP TEST DATA

DP DURING CLOSE	DPc	--->	N/A	(psi)
CLOSE AVERAGE RUNNING THRUST	Fapktkc	--->	91	(lbs)
CLOSE AVERAGE RUNNING TORQUE (approx.)	Fapktcc	--->	8	(ft-lbs)
CLOSE DP THRUST (C10)	C10Th	--->	N/A	(lbs)
CLOSE DP TORQUE (C10)	C10To	--->	N/A	(ft-lbs)
CLOSE WEDGING THRUST (C11)	C11Th	--->	N/A	(lbs)
CLOSE WEDGING TORQUE (C11)	C11To	--->	N/A	(ft-lbs)
CLOSE CST THRUST (C14)	C14Th	--->	4987	(lbs)
CLOSE CST TORQUE (C14)	C14To	--->	115.9	(ft-lbs)
CLOSE MAXIMUM THRUST (C16)	C16Th	--->	5494	(lbs)
CLOSE MAXIMUM TORQUE (C16)	C16To	--->	123.8	(ft-lbs)

<<<<<<<<<<<<<<< OPENING >>>>>>>>>>>>>>>

OPEN DP TEST DATA

DP DURING OPEN	DPo	--->	231.5	(psi)
OPEN AVERAGE RUNNING THRUST	Fapktho	--->	368	(lbs)
OPEN DP THRUST (O10)	O10Th	--->	4617	(lbs)

ASSUMED VALUE FOR CALCS

CALCULATIONS NOTE: The STEM FACTORs have an additional margin included (calculated by the SRSS methodology) due to the 10% VTC inaccuracy and the overall system thrust inaccuracy.

CLOSE STEM FACTORS Thrust Inaccuracy (%) = 14.0

CLOSE AVERAGE RUNNING LOAD (ARLc)	SF	--->	0.1030	(ft)
CLOSE DP LOAD (C10)	SF	--->	#VALUE!	(ft)
CLOSE WEDGING LOAD (C11)	SF	--->	#VALUE!	(ft)
CLOSE CST LOAD (C14)	SF	--->	0.0272	(ft)
CLOSE MAXIMUM LOAD (C16)	SF	--->	0.0264	(ft)

CLOSE STEM THREAD COEFFICIENTS OF FRICTION

CLOSE AVERAGE RUNNING LOAD (ARLc)	Mut	--->	1.05
CLOSE DP LOAD (C10)	Mut	--->	#VALUE!
CLOSE WEDGING LOAD (C11)	Mut	--->	#VALUE!
CLOSE CST LOAD (C14)	Mut	--->	0.20
CLOSE MAXIMUM LOAD (C16)	Mut	--->	0.19

CHECK ONE Mut: Mut = [cos(ALPHA) * SF) - (d/24 * cos(ALPHA) * tan(a))] / (tan(a) * SF) + (d/24)   Check for Stub or General ACME Thread

$$\mu_t = \frac{(.96815 \times .0272) - (.0556 \times .96815 \times .239)}{(.239 \times .0272) + (.0556)} = 0.20$$

Mut below design value ? YES ☒ NO ☐ CWR No. : ____

REMARKS: In accordance with design, the torque switch tripped during the running portion of the stroke, where the load sensitive behavior would be high. Design scenarios, do not require the MOV to close under flow or D.P. conditions.

CLOSE CALCULATED ACTUAL DISC/SEAT COEFFICIENT OF FRICTION

CORRECTED DP THRUST (C10 less Fapktkc)	Fdpc	--->	#VALUE!	(lbs)
DIFFERENTIAL PRESSURE LOAD	Fdpc	--->	#VALUE!	(lbs)
DISC/SEAT COEFF. OF FRICTION	Mus	--->		

N A

CHECK Mus: Fdpc = Mus * DPc * Ac * [1/(cos(THETA) - Mus * sin(THETA))]   Not Required for Globe

SEE REMARKS

Mus below design value ? YES ☐ NO ☐ CWR No. : ____

OPEN CALCULATED ACTUAL DISC/SEAT COEFFICIENT OF FRICTION

CORRECTED DP THRUST (O10 less Fapktho)	Fdpo	--->	4848	(lbs)
DIFFERENTIAL PRESSURE LOAD	Fdpo	--->	4848	(lbs)
DISC/SEAT COEFF. OF FRICTION	Mus	--->	0.28	

ACTUAL VALUE OF FROM TEST

CHECK Mus: Fdpo = Mus * DPo * Ao * [1/(cos(THETA) + Mus * sin(THETA))]   Not Required for Globe

$$F_{dpo} = .28 \times 231.5 \times 76.59 \times \left(\frac{1}{.99619 + (.35)(.0876)} \right) = 4835$$

Mus below design value ? YES ☒ NO ☐ CWR No. : ____

Robert J. 8/6/93
PREPARED BY DATE

8-6-93
VERIFIED BY DATE

ATTACHMENT 7

RISK IMPORTANCE CATEGORIZATION OF MOV'S THAT CANNOT BE DP TESTED

FOR RFR 87461

Pat – I noted you were not copied on attachment

TEH
DEH
[illegible]

12/27/93

December 22, 1993

Mr. J. A. McGraw:

IPE Impact of Non-DP Tested MOVs
Ref.: UOTE 93-221

This letter responds to the referenced letter, which requested that a review be performed to assess the impact on the IPE due to the inability to ΔP test selected MOVs.

In order to perform a meaningful review, a draft NUMARC document, "Guidelines for Optimizing Safety Benefits in Assuring the Performance of Motor Operated Valves," was used as guidance. This document is provided as Attachment 1.

The procedure described in Attachment 1 involves categorization of MOVs into one of three importance groups (high, medium or low). Testing recommendations are then made for each importance category. MOVs are placed into an importance category based on their PRA numerical importance. MOVs that were not included in the PRA must be placed into an importance category using deterministic methods and/or engineering judgment. Attachment 2 is a flow chart that delineates the NUMARC guidance for application to Callaway MOVs.

Using the process represented by the flow chart, MOVs that were included in the Callaway at-power PRA were assigned to an importance category. The review/categorization process is documented in the table provided as Attachment 3.

Note on Attachment 3 that only those valves that were modeled in the PRA were assigned to an importance category. Those valves that are not in the PRA will have to be assessed by Engineering/Operations for assignment to an importance category.

If there are any questions, please contact Keith Connelly at 42868.

A. C. Passwater

KGC/kea
Attachments

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cc: W. B. Bobnar w/o attach.
K. G. Connelly " "
C. D. Naslund " "
T. E. Hermann " "
D. E. Heinlein " "

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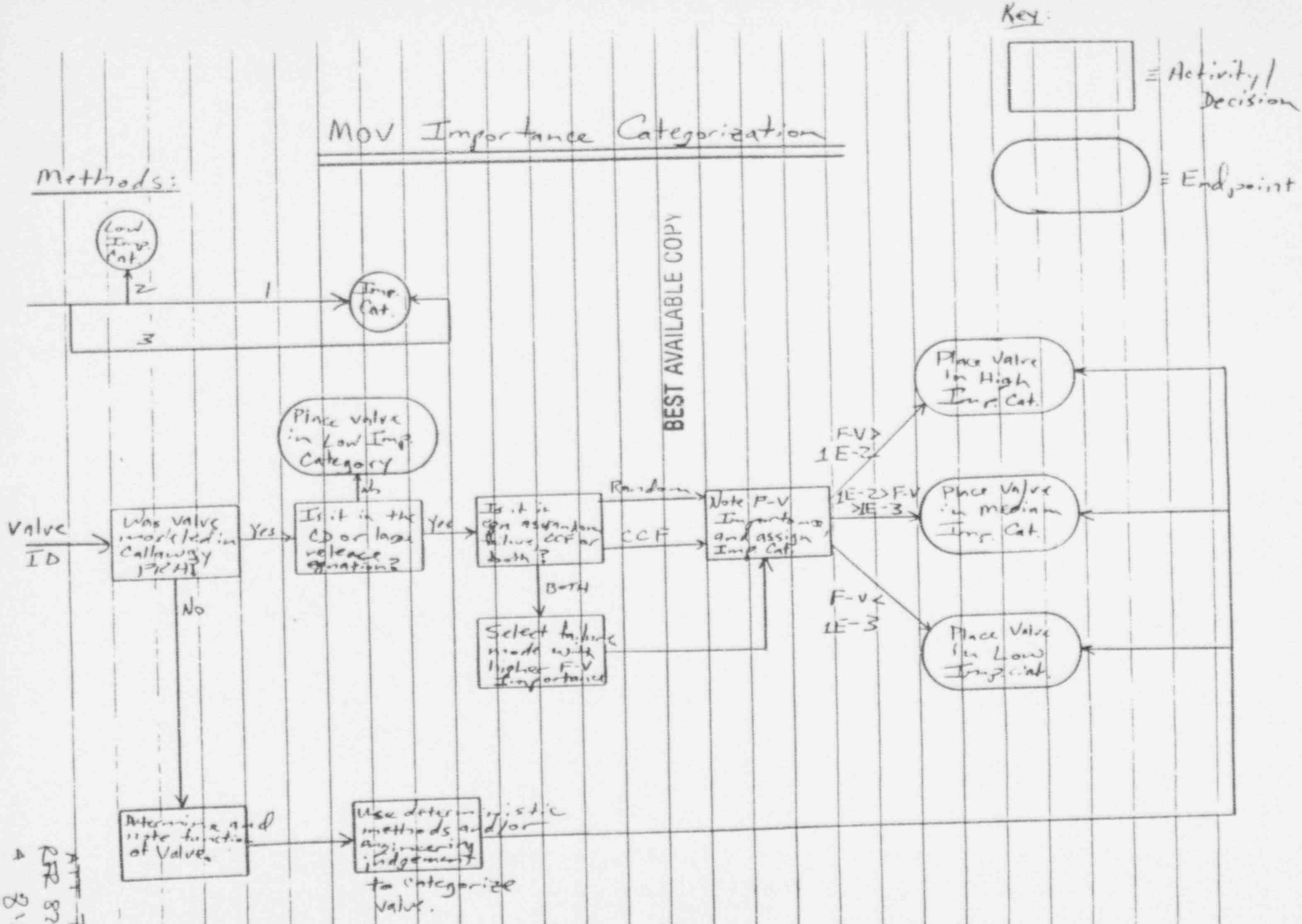
MOV Importance Categorization



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Attachment 2

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Attachment III

RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

or RL

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
BBHV8000A	Pz-PORV block valve	Y	Y	Both	1.335E-3	—	Med.	1
BBHV8000B	Pz-PORV block valve	Y	Y	Both	3.251E-4	—	Low	1
BBHV8037A	PRT/CTMT normal Sump Iso. Valve	N	—	—	—			
BBHV8037B	PRT/CTMT normal sump iso. valve	N	—	—	—			
BBHV8351A	RCP A Seal inj iso. valve	N	—	—	—			
BBHV8351B	RCP B seal inj. iso. valve	N	—	—	—			
BBHV8351C	RCP C seal inj. iso. valve	N	—	—	—			
BBHV8351D	RCP D seal inj. iso. valve	N	—	—	—			
BBPV8702A	RCS Loop 1 H/L to RHR suction iso. valve	Y	Y	Both	2.639E-4	—	Low	1

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
BBPV 8702B	RCS Loop 4 H/L to RHR suction iso. valve	Y	Y	Both	2.639E-4	–	Low	1
BGHV 8100	Seal water return outer CTMT iso. valve	N	–	–	–			
BGHV 8109	PDP recirc. iso. valve	N	–	–	–			
BGHV 8112	Seal water return inner CTMT iso. valve	N	–	–	–			
BGLCV112B	VCT outlet up-stream iso. valve	Y	Y	CCF	5.601E-6	–	Low	1
BGLCV112C	VCT outlet down-stream iso. valve	Y	Y	CCF	5.601E-6	–	Low	1
BN HV0003	RWST/CTMT Spray Pump B iso. valve	Y	Y*	Both	3.757E-4	–	Low	1

* Valve is in "large release" equation

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
BNHV0004	RWST/CTMT Spray Pump A iso. valve	Y	Y	Both	1.726E-4	—	Low	1
BNHV8812A	RWST/RHR Pump A iso. valve	Y	Y	Both	2.639E-4	—	Low	1
BNHV8812B	RWST/RHR Pump B iso. valve	Y	Y	Both	2.639E-4	—	Low	1
EFHV0023	SW/ESW Train A XCON iso. valve	Y	Y	Both	1.759E-2	—	High	1
EFHV0024	SW/ESW Train B XCON. iso. valve	Y	Y	Both	3.583E-3	—	med.	1
EFHV0025	SW/ESW Train A XCON. iso. valve	Y	Y	Both	3.640E-3	—	med.	1
EFHV0026	SW/ESW Train B XCON. iso. valve	Y	Y	Both	1.835E-2	—	High	1
EFHV0037	ESW Train A/ UHS iso. valve	Y	Y	Both	8.245E-3	—	Med.	1

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
EFPDV0019	ESW S/C Strainer A drain DP control valve	Y	N	—	--	—	Low	2
EFPDV0020	ESW S/C Strainer B drain DP control valve	Y	N	—	—	—	Low	2
EGHV0011	ESW/CCW Trn A upstream iso. valve	N	—	—	—			
EGHV0012	ESW/CCW Trn B upstream iso. valve	N	—	—	—			
EGHV0013	ESW/CCW Trn A downstream iso. valve	N	—	—	—			
EGHV0014	ESW/CCW Trn B downstream iso. valve	N	—	—	—			
EJHV8701A	RHR pump A suction iso. valve	Y	Y	Both	2.639E-4	—	Low	1

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
EJHV8701B	RHR pump B suction iso. valve	Y	Y	Both	2.639E-4	—	Low	1
EJHV8811A	CTMT Sump/ RHR pump A suction iso. valve	Y	Y	Both	5.789E-3	—	med.	1
EJHV8811B	CTMT Sump/ RHR pump B suction iso. valve	Y	Y	Both	5.789E-3	—	med.	1
ENHV0001	CTMT Sump/ CTMT Spray Pump A Suction iso valve	Y	Y*	Both	1.726E-4		Low	1
ENHV0006	CTMT Spray pump A disch. valve.	Y	Y*	Both	1.726E-4		Low	1
ENHV0007	CTMT Sump/ CTMT Spray pump B Suction iso. valve	Y	Y*	Both	3.257E-4		Low	1

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
ENHV0012	CTMT Spray pump B disch valve	Y	Y*	Both	3.757E-4		Low	1
ENHV0015	SMT/CS Trn A iso. valve	N	—	—	—			
ENHV0016	SMT/CS Trn B iso. valve	N	—	—	—			
EPHV8808A	Accum. A out-let iso. valve	N	—	—	—			
EPHV8808B	Accum. B out-let iso. valve	N	—	—	—			
EPHV8808C	Accum. C out-let iso. valve	N	—	—	—			
EPHV8808D	Accum [illegible] out-let iso. valve	N	—	—	—			
GSHV0020	H_2 purge in-CTMT iso. valve	N	—	—	—			

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random fa e, CCF or both?	F-V Importance	If deled in PRA, important C ction c' valve, if any.	Importance Category	Method
GSHV0021	H_2 Purge outer CTMT Iso. valve.	N	—	—	—			
KAHV0051	H_2 control sys. m/u air Hv	N	—	—	—			
KCHV0253	Fire prot. loop to Fx Build. outer CTMT downstream iso. valve	N	—	—	—			
ALHV0034	CST/MDAFP B iso. valve.	Y	N	—	—		Low	Z
ALHV0035	CST/MDAFP A iso. valve	Y	N	—	—		Low	Z
ALHV0036	CST/TDAFP iso. valve	Y	N**	—	—		Low	Z
BBHV0013	RCP A T/B clng. coil outlet iso. valve	N	—	—	—			

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** In CD eqn as Tm event,
which is NA here.

RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
EBHV0014	RCP B T/B clng. coil outlet iso. valve	N	—	—	—			
EBHV0015	RCP C T/B clng. coil outlet iso. valve	N	—	—	—			
EBHV0016	RCP D T/B clng. coil outlet iso. valve	N	—	—	—			
EFHV0039	ESW Trn A/SW Xcon. upstream iso valve	Y	Y	Both	3.602E-3		Med.	1
EFHV0040	ESW Trn B/SW Xcon. upstream iso. valve	Y	Y	Both	8.715E-3		med.	1
EFHV0041	ESW Trn B/SW Xcon. downstream iso. valve	Y	Y	Both	8.250E-3		med.	1

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RISK IMPORTANCE CATEGORIZATION OF MOVs THAT CANNOT BE DP TESTED

Valve ID	Valve Functional Desc.	Valve in PRA?	If yes, valve in CD equation?	If yes, random failure, CCF or both?	F-V Importance	If not modeled in PRA, important CSF function of valve, if any.	Importance Category	Method
EFHV0042	ESW Trn B/SW Xconn. down-stream iso. valve	Y	Y	Both	3.541E-3		Med.	1
EGHV0062	CCW/RCS Pt. loads in-CTMT iso. valve	N	—	—	—			
EGHV0137	EGHV62 bypass iso. valve	N	—	—	—		Low	2
EMHV8807A	RHR Hx A/ SI pumps parallel iso. valve "A"	Y	N	—	—		Low	2
EMHV8923A	RHR Hx A/ SIP's parallel iso. valve	Y	N	—	—			
EMHV8924	RHR Hx A/ SIP's upstream iso. Valve	N	—	—	—			

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ATTACHMENT 8

EPRI MOV PREDICTIVE PERFORMANCE PROGRAM

DATA USED IN THE DISPOSITION OF

RFR 8746I

RFL 8746I

EPRI MOV Performance Prediction Program

REVIEW MEETING

Dallas Airport Hyatt Regency Hotel

AGENDA

December 1, 1993

OPEN SESSION
(Open to all domestic utilities and to all participating international utilities)

1:00 pm	Introduction/Meeting Objectives	*J. Hosler (EPRI)*
1:15	Technical Advisory Group Perspective	*M. Eidson (SNC)*
1:30	NUMARC Perspective	*C. Callaway (NUMARC)*
1:45	EPRI Program Overview/Status	*J. Hosler (EPRI)*
2:00	Review of Flow Loop Test Program Results	*J. Hosler/W. Kennedy (EPRI)*
3:00	***Break***	
3:15	Assessment of Potential Implications for Installed MOV's	*N. Estep (Duke Power Co.)*
4:00	Question/Answer Period	*All*
4:45	EPRI MOV Program Follow-on Activities	*J. Allen (TVA)*
5:00	***Adjourn***	

ATT B
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EPRI MOV Performance Prediction Program

REVIEW MEETING

Dallas Airport Hyatt Regency Hotel

AGENDA

December 2, 1993

CLOSED SESSION (Open only to utilities participating in the EPRI MOV Program)

8:00 am	Introduction	
8:15	Review of Key Program Findings/Issues	*J. Hosler (EPRI)*
8:45	Methodology Overview	*P. Damerell (MPR)*
9:15	Globe Valve Modeling Approach/Status	*P. Damerell (MPR)*
10:00	***BREAK***	
10:15	Gate Valve Modeling Approach/Status	*P. Damerell (MPR)*
12:00	***LUNCH***	
1:00	Butterfly Valve Modeling Approach/Status	*M. S. Kalsi (KEI)*
2:00	Method for Assessment of Rate-of-Loading Effects	*P. Damerell (MPR)*
3:00	***BREAK***	
3:15	Question/Answer Period	*All*
4:00	*Adjourn*	

3874

Adv Cy - Jim Noebe
to Clive Callaway

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

November 30, 1993

NRC INFORMATION NOTICE 93-88: STATUS OF MOTOR-OPERATED VALVE PERFORMANCE PREDICTION PROGRAM BY THE ELECTRIC POWER RESEARCH INSTITUTE

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to preliminary results of motor-operated valve (MOV) tests conducted by the Electric Power Research Institute (EPRI). It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Background

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," to request that nuclear power plant licensees and construction permit holders verify the design-basis capability of their safety-related MOVs. In GL 89-10, the NRC staff requested that licensees and permit holders test each MOV within the scope of the generic letter under design-basis differential pressure and flow conditions, where practicable. The recommended schedule in GL 89-10 would have licensees and permit holders verify MOV design-basis capability by June 28, 1994, or three refueling outages after December 28, 1989 (whichever is later).

In response to concerns regarding MOV performance, EPRI and its utility advisors established a research program to develop a methodology to predict the performance of MOVs under design-basis conditions. NUMARC coordinates the interaction between EPRI, its utility Technical Advisory Group (TAG), and NRC staff related to the EPRI program. The EPRI program includes detailed analyses and testing of MOVs at test facilities and nuclear power plants. The EPRI MOV Performance Prediction Methodology is intended to allow licensees to demonstrate the design-basis capability of MOVs based on analytical predictions combined with diagnostic tests conducted under static conditions. In August and October 1993, EPRI presented the status and preliminary results from its Flow Loop Testing Program to the NRC staff. The flow loop results in

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the EPRI presentation have not received full quality assurance verification, but the preliminary information may be helpful to licensees as they implement their MOV programs.

In a letter on September 16, 1993, NUMARC provided responses from EPRI to NRC staff questions on the EPRI MOV Performance Prediction Program. Among the information provided in the enclosure to the letter, EPRI stated that its program is expected to cover about 90 percent of gate valves (about half with its computer code and half with empirically-based data), essentially all globe valves, and about 95 percent of butterfly valves. The globe and gate valves are covered primarily by the computer code. EPRI also stated its method for determination of operator output torque capability under degraded voltage conditions is to apply standard methods as documented in EPRI NP-6660-D (March 1990), "Application Guide for Motor-Operated Valves in Nuclear Power Plants."

Description of Circumstances

In conducting its MOV Performance Prediction Program, EPRI tested 28 gate, 4 globe, and 2 butterfly valves under a total of 62 test conditions. These tests were performed at Wyle Laboratories and Siemens test facilities. EPRI plans to obtain test data for an additional 35 valves being tested in nuclear power plants. In addition, EPRI completed testing at Kalsi Engineering of 10 butterfly valve designs to assess flow and upstream piping configuration effects. The results summarized below are based on the Wyle/Siemens MOV tests.

1. Gate Valves

EPRI stated that all gate valves tested were initially preconditioned by conducting a large number (50-1000) of short (no flow) strokes in cold water under differential pressure loading. Initial "sliding friction coefficients," prior to preconditioning, generally ranged from 0.2 to 0.4. EPRI indicated that, after preconditioning, "apparent friction coefficients" ranged from 0.3 to 0.6 for all but four valves tested under cold water pumped-flow conditions. The "apparent friction coefficients" for the remaining four valves ranged from 0.66 to 1.93. EPRI results demonstrated "apparent friction coefficients" ranging from 0.34 to 0.41 for hot water pumped-flow conditions, 0.35 to 0.8 for hot water blowdown conditions, and 0.25 to 0.64 for steam blowdown conditions. EPRI's "apparent friction coefficients" reflect all valve internal phenomena and are not necessarily indicative of a "sliding friction coefficient." The major difference between the "apparent friction coefficient" used by EPRI and the "valve factor" used historically by valve vendors in sizing motor operators is the consideration of the valve disc angle in determining the EPRI "apparent friction coefficient."

Most valve vendors have used a "valve factor" of 0.3 for flexible wedge gate valves and 0.2 for parallel disc gate valves in sizing motor operators. Therefore, the EPRI test results indicate that the thrust required to operate

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gate valves could be significantly greater than the thrust predicted by the valve vendors. The EPRI blowdown test results are generally consistent with those obtained in the limited testing program conducted by the Idaho National Engineering Laboratory (INEL) for the NRC Office of Nuclear Regulatory Research in 1989.

EPRI reported that the valve sliding friction coefficient tends to decrease with increasing differential pressure which lends support for linear extrapolation of reduced differential pressure results when there is a low potential for valve damage (for example, under nominal flow velocity pumped-flow conditions).

EPRI reported that several gate valves were damaged during hot water and steam blowdown testing. These included a 6-inch Anchor-Darling valve (disk and seat damage); a 6-inch Crane valve (guide damage); a 10-inch Velan valve (guide damage); a 6-inch Walworth valve (guide damage); and a 10-inch Edward valve (disk and seat damage). Two of the damaged valves exhibited "apparent friction coefficients" exceeding 0.6.

Two gate valves were damaged under cold water pumped-flow conditions. These included a Velan 6-inch valve (plastic bending of body guides at high flow velocity greater than 30 feet per second) and an 18-inch Anchor-Darling valve (valve disk forced through seating area resulting in leakage above disk).

EPRI test results revealed that it is generally not possible to determine accurately the point of flow isolation prior to disk wedging based on the thrust diagnostic trace alone.

EPRI stated that it had not observed differences in thrust requirements for valve operation between valves installed in horizontal pipes with the stem either vertical or horizontal. This finding differs from some operating experiences in nuclear power plants.

2. Globe Valves

EPRI stated that, for incompressible flow conditions, globe valve thrusts are consistent with industry calculational-method predictions only if the appropriate area is chosen for differential pressure application. The appropriate area (disk mean seat area versus disk guide area) appears to be unique to valve design. It was determined that use of disk mean seat area rather than disk guide area can result in significant underestimation of required thrust for some globe valve designs. Specifically, one globe valve tested under cold water pumped-flow conditions required approximately twice as much thrust to close using disk mean seat area and a valve factor of 1.0.

A two-inch Rockwell/Edward globe valve, tested under hot water blowdown conditions, exhibited thrust requirements exceeding predictions based on disk guide area by approximately 35 percent. This valve sustained damage to the portion of the body bore that guides the disk.

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Current industry practice for determining the required thrust for globe valves varies by manufacturer. Many manufacturers assume disk mean seat area multiplied by a valve factor in the 1.0 to 1.1 range. Others use disk guide area in making thrust predictions. Therefore, the EPRI results indicate that actual thrust requirements may exceed those predicted using current industry practice for some globe valve designs.

3. <u>Butterfly Valves</u>

EPRI stated that the Wyle flow loop testing revealed torque requirements to operate Pratt butterfly valves which were bounded by the most current torque predictions of the manufacturer. However, butterfly valves at some nuclear power plants (for example, Catawba and Palo Verde) have demonstrated torque requirements that exceed vendor predictions. EPRI is currently evaluating data from testing conducted at Kalsi Engineering to assess butterfly valve torque requirements for a wide range of butterfly valve designs.

4. <u>Data Interpretation and Assessment</u>

In July 1993, EPRI sent a Quarterly Status Report to all utilities participating in the EPRI MOV Performance Prediction Program. This report summarized preliminary flow loop test results. After the completion of Wyle/Siemens quality assurance checks, EPRI plans to update this information in its next Quarterly Status report scheduled for late 1993. Detailed test reports documenting these results are scheduled for delivery to participating utilities between October and December 1993. EPRI stated that, in interpreting the EPRI flow loop test results, utilities need to understand the assumptions and equations that were used by EPRI in presenting the data. For example, the EPRI calculated "apparent friction coefficient" for gate valves is based on the equation provided in EPRI Report NP-6660-D, "Application Guide for Motor-Operated Valves in Nuclear Power Plants." This equation is solved for "apparent friction coefficient" using (1) the maximum measured stem thrust which occurs prior to the initiation of wedging (for valve closing) or the maximum thrust which occurs after cracking (for valve opening); (2) full (valve closed) tested differential pressure; (3) mean seat area; (4) valve disk angle; (5) full (valve closed) upstream tested pressure for stem rejection thrust; and (6) measured values of packing load.

EPRI stated that valve design and test conditions, maintenance history, and operating experience may be important in assessing the applicability of EPRI test results to plant MOVs.

EPRI uses the greatest thrust requirement to overcome differential pressure and flow to determine its "apparent friction coefficient." EPRI assumes the highest differential pressure observed during the test regardless of the stem position where the greatest differential pressure/flow required thrust occurs. This results in a lower calculated friction coefficient than would be determined if the actual differential pressure at the point of greatest thrust was used in determining the friction coefficient.

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EPRI plans to submit sections of a topical report for NRC review as they are completed between November 1993 and April 1994. EPRI intends to submit supporting reports in advance of the final topical report to allow the staff to raise questions with EPRI early in the review process.

EPRI stated that its final methodology is scheduled for delivery to utilities in April 1994 as a tool that may be used to confirm many aspects of MOV calculations and setup. Further, the EPRI flow loop test results provide licensees with information which might be helpful in supplementing other "best available" data in establishing MOV switch settings.

Discussion

Since EPRI initiated its MOV Performance Prediction Program, the NRC staff has conducted public meetings with NUMARC and EPRI to discuss the goals of the EPRI program, the development of the program activities to accomplish those goals, the tests conducted in support of the program and the results of those tests, and the completion schedule for the program. The staff has provided questions and comments to NUMARC and EPRI on the EPRI MOV program as a result of these meetings. For example, in a public meeting on October 6-7, 1993, the staff emphasized the need for EPRI to ensure that licensees clearly understand the application of the EPRI test data and methodology. Also at this meeting, contents of this notice were discussed and the comments from EPRI have been considered. The staff expressed concern about the valves damaged during the EPRI testing and the apparent lack of action by some valve manufacturers in response to the valve damage. The staff also discussed the need for EPRI to ensure that adequate peer review of the EPRI methodology is conducted.

Although some issues remain to be resolved, the EPRI testing program should provide a significant amount of MOV test data that can assist nuclear power plant licensees in demonstrating the design-basis capability of MOVs that cannot be tested under dynamic conditions as installed. The preliminary test information provided in this notice is provided for licensee consideration in implementing programs in response to GL 89-10 . The staff plans to conduct additional public meetings with NUMARC and EPRI to discuss the status of the EPRI MOV program. The staff will consider the need for additional generic communications to nuclear power plant licensees and construction permit holders as additional information is obtained from the EPRI MOV program.

Related Generic Communications

- NRC Information Notice 90-40, "Results of NRC-Sponsored Testing of Motor-Operated Valves."

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This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the person listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Brian Grimes

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contact: Thomas G. Scarbrough, NRR
(301) 504-2794

Attachment:
List of Recently Issued NRC Information Notices

1-21-94
8 9 8 7 4

EPRI/NPD

EPRI MOV Program Review Meeting

Flow Loop Test Results

Data Tables

DFW Airport Hyatt
December 1-2, 1993

Engineering & Operations

10874

HUNTSVILLE COLD WATER PUMPED FLOW TEST LOOP

SUMMARY OF GATE VALVE TEST RESULTS

Valve No.	MFG/Size	V Ft/Sec	TEMP °F	LOW DP PERFORMANCE DP Psid	LOW DP Apparent Disc μ Open	LOW DP Apparent Disc μ Close	LOW DP Apparent Disc μ Isol.	HIGH DP PERFORMANCE DP Psid	HIGH DP Apparent Disc μ Open	HIGH DP Apparent Disc μ Close	HIGH DP Apparent Disc μ Isol.	Comments
2	A-D/6	15	AMB	90	0.287	0.163	0.141	275	0.168	0.140	0.135	
8	B-W/6	15	AMB	80	0.924	0.881	0.347	270	0.643	0.620	0.571	Note A
15	Aloyco/4	15	AMB	90	0.278	0.297	0.225	275	0.206	0.200		
18	Pacific/4	15	AMB	90	0.347	0.361	0.325	270	0.304	0.298	0.297	
23	Velan/6	15	AMB	90	0.446	0.374	0.253	260	0.431	0.417	0.375	
23	Velan/6	30	AMB	90	0.510	0.454	0.296					
23	Velan/6	50	AMB					260		0.564	0.387	Note B
29	Wal/6	15	AMB	90	0.399	0.452	0.414	260	0.346	0.399	0.390	

COMMENTS

Note A	High apparent μ under study, no damage
Note B	Cantilevered guides bent at 250 psid/50 ft./sec

1-21-94

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64TBL/WSK/

HUNTSVILLE INTERMEDIATE PRESSURE PUMPED FLOW SIMULATION TEST LOOP

SUMMARY OF GATE VALVE TEST RESULTS

				LOW DP PERFORMANCE				HIGH DP PERFORMANCE				
		V	TEMP	DP	Apparent Disc μ			DP	Apparent Disc μ			
Valve No.	MFG/Size	Ft/Sec	°F	Psid	Open	Close	Isol.	Psid	Open	Close	Isol.	Comments
4	A-D/10	15	AMB	250	0.451	0.385	0.371	630	0.389	0.361	0.347	
4	A-D/10	15	AMB	250	0.460	0.401	0.397	650	0.379	0.370	0.365	Note A
4	A-D/10	15	AMB	250	0.455	0.417	0.392	640	0.413	0.407	0.389	Note B
4	A-D/10	15	AMB	250	0.448	0.406	0.384	630	0.411	0.403	0.380	Note C
10	B-W/12	15	AMB	250	0.685	0.663	0.560	630	0.627	0.570	0.497	Note D
17	Pacific/10	15	AMB	100	0.594	0.546	0.483	270	0.513	0.489	0.447	
25	Velan/10	15	AMB	260	0.540	0.594	0.499	750	0.493	0.529	0.447	Note F
31	Wal/12	15	AMB	100	0.752	0.497	0.426	265	0.701	0.478	0.405	Note G
43	Edward/10	15	AMB	650	0.486	0.700	0.584	1800	0.438	0.495	0.363	Note H

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N/A 1-11-94

COMMENTS

Note A	Stem Horizontal
Note B	Elbow from side
Note C	Elbow from top
Note D	Wear on interior surface of one body guide -- no seat damage
Note E	Heavily scratched at 4:30 and 7:30 positions on disc and seat -- leaked 1 ml/min
Note F	No torque arm
Note G	High opening μ's associated with disc/body interference on opening
Note H	Valve flow isolated but failed to wedge on max dp closure due to motor stall

63TBL/WSK/jp

NORCO HIGH PRESSURE COLD/HOT WATER TEST LOOP
SUMMARY OF GATE VALVE TEST RESULTS

				LOW DP PERFORMANCE				HIGH DP PERFORMANCE				
		V	Temp	DP	Apparent Disc μ			DP	Apparent Disc μ			
Valve No.	MFG/Size	Ft/Sec	°F	Psid	Open	Close	Isol.	Psid	Open	Close	Isol.	Comments
1	A-D/3	15	AMB	200	0.464	0.504	0.320	780	0.440	0.432	0.361	
3	A-D/6	15	AMB	660	0.526	0.615	0.535	1830	0.475	0.515	0.463	
3	A-D/6	15	450°	630	0.418	0.423	0.410	1300	0.382	0.416	0.399	
3	A-D/6	50	AMB	660	0.585	0.569	0.489	1900	0.539	0.561	0.435	
3	A-D/6	B/D	530°					1210		0.453	0.430	Note A
3	A-D/6	B/D	530°					1290		0.420	0.402	Note B
7	B-W/3	15	AMB	630	0.458	0.637	0.537	2600	0.521	0.564	0.480	
7	B-W/3	50	AMB	670	0.514	0.715	0.514	2630	0.513	0.553	0.430	
9	B-W/6	15	AMB	650	0.665	0.710	0.480	1800	0.610	0.642	0.423	Note C
9	B-W/6	B/D	530°					1250		0.393	0.366	
13	Velan/2.5	15	AMB	1300	0.646	0.484	0.260	2650	0.593	0.460	0.282	
13	Velan/2.5	50	AMB	1360	0.635	0.496	0.284	2660	0.580	0.452	0.287	
13	Velan/2.5	B/D	530°					2660		0.328	0.279	

COMMENTS

Note A	Some body and disc seat damage, flow limited by loop piping
Note B	Some disc seat damage
Note C	Wear on downstream side of body guides

138, 74

65TBL/WSK jp

NORCO HIGH PRESSURE COLD/HOT WATER TEST LOOP
SUMMARY OF GATE VALVE TEST RESULTS

				LOW DP PERFORMANCE				HIGH DP PERFORMANCE				
		V	Temp	DP	Apparent Disc μ			DP	Apparent Disc μ			
Valve No.	MFG/Size	Ft/Sec	F	Psid	Open	Close	Isol.	Psid	Open	Close	Isol.	Comments
14	Crane/6	15	AMB	650	0 442	0 419	0 295	1930	0 379	0 415	0 344	
14	Crane/6	50	AMB	650	0 507	0 378	0 337	1900	0 436	0 429	0 347	
14	Crane/6	B/D	530°					1280		0 788	0 762	Note D
16	A-D/3	15	AMB	500	0 672	0 620	0 526	1870	0 487	0 451	0 436	
21	Rock/Ed/2-1/2	15	AMB	470	0 320	1 930	0 928	1810	0 375			
24	Velan/6	15	AMB	480	0 530	0 567	0 324	1910	0 531	0 501	0 365	
24	Velan/6	15	AMB	460	0 585	0 596	0 451	1930	0 539	0 486	0 385	Note E
24	Velan/6	15	450°	670	0 527	0 343	0 300	1180	0 487*	0 324	0 280	
24	Velan/6	50	AMB	640	0 602	0 567	0 353	1800	0 536	0 498	0 367	
24	Velan/6	15	AMB	940	0 640	0 592	0 383	1720	0 621	0 552	0 401	Note F
24	Velan/6	B/D	530°					1270		0 468	0 417	
30	Walworth/6	15	AMB	650	0 359	0 287	0 207	1890	0 422	0 399	0 331	
30	Walworth/6	B/D	530°					1320		0 531	0 497	Note G
34	West/3	15	AMB	750	0 475	0 319	0 315	2650	0 313			
41	A-D/6/PD	15	AMB	480	0 762	0 950	0 469	1900	0 545	0 548	0 444	
41	A-D/6/PD	B/D	530°					1270		0 348	0 331	

COMMENTS

Note D Damage to guide rails

Note E Stem horizontal

Note F Torque arm disconnected

Note G Gouging damage to guide rails

* Downstream seat Temperature lower than 450: (probably 200 300 F range)

65TBL/WSK/jp

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SIEMENS/KWU HIGH PRESSURE COLD WATER AND STEAM TEST LOOP

SUMMARY OF GATE VALVE TEST RESULTS

				LOW DP PERFORMANCE				HIGH DP PERFORMANCE				
		V		DP	Apparent Disc μ			DP	Apparent Disc μ			
Valve No.	MFG/Size	Ft/Sec	Temp	Psid	Open	Close	Isol.	Psid	Open	Close	Isol.	Comments
5	A/D/10	15	AMB	460	0.576	0.465	0.408	1350	0.442	0.394	0.376	
6	A/D/18	15	AMB	167	0.226	0.327	0.194	333		0.295	0.18	Note A
24	Velan/6	200	Sat. Steam	——	——	——	——	1200	*	*	*	
24	Velan/6	B/D	Sat. Steam	600	*	*	*	1200	*	*	*	
26	Velan/10	B/D	Sat. Steam	——	——	——	——	1200	——	0.718	0.56	Note B
41	A/D/6/PD	B/D	Sat. Steam	——	——	——	——	1200	0.333	0.591	0.347	
43	Edwards/10	B/D	Sat. Steam	——	——	——	——	1200	0.344	0.41	0.33	Note C

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COMMENTS

Note A	Disc driven below normal wedge location; flow leakage above disc; disc permanently "pinched"
Note B	No damage to disc and seat, severe damage to body guide rails
Note C	Some stellite edge damage to disc and seat

* Still under evaluation

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SUMMARY OF GLOBE VALVE FLOW LOOP TEST RESULTS

Valve No.	MFG/Size	Max ΔP Psid	V Ft/Sec	Temp	Valve Factor (Seat Based)	Valve Factor (Guide Based)	Comments
44	B-W/6	1800	15	AMB	1.925	0.978	
44	B-W/6	1800	50	AMB	1.998	0.976	
48	Edward/2	2500	15	AMB	1.246	0.905	
48	Edward/2	2500	50	AMB	1.417	0.922	
48	Edward/2	2500	B/D	530 HW	2.146	1.480	Note A
49	Velan/2-1/2	2500	15	AMB	1.039	0.514	
50	A-D/10	740	15	AMB	1.062	0.719	Note B
50	A-D/10	740	15	AMB	1.065	0.738	Note C

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COMMENTS

Note A	Valve did not close, valve factor abnormally high
Note B	Flow over disc
Note C	Flow under disc

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Key In Situ Test Results, Gate Valves

Valve Number	Manufacturer, Size and Type	Maximum Differential Pressure	Flow Velocity	Fluid Temperature	Maximum Apparent Disk Friction Coef.		Maximum Apparent Stem Friction Coef.		Stem Thrust at Torque Switch Trip	
					Open	Close	Open	Close	Static	Dynamic
1	Borg Warner 4-inch FWG	1620 psid	17 ft/sec (water)	Ambient	0.305	0.304 * (0.555)	0.135	0.105	24,605 lbs	20,376 lbs
3	Borg Warner 16-inch FWG	300 psid	13 ft/sec (water)	86 °F	0.332	0.373	0.161	0.113	36,622 lbs	34,114 lbs
4	Borg Warner 16-inch FWG	300 psid	12 ft/sec (water)	86 °F	0.371	0.355	0.166	0.134	35,039 lbs	35,281 lbs
11	Anchor/Darling 16-inch FWG	340 psid	6.2 ft/sec (water)	110 °F	0.210	0.174 * (0.328)	- - -	- - -	65,827 lbs	52,948 lbs
12	Anchor/Darling 16-inch FWG	350 psid	6.4 ft/sec (water)	105 °F	0.208	0.238	- - -	- - -	39,990 lbs	34,994 lbs
17	Velan 4-inch FWG	900 psid	30 ft/sec (steam)	535 °F	0.394	0.338 * (0.512)	0.167	0.122	9,810 lbs	10,020 lbs
18	Anchor/Darling 4-inch PDG	965 psid	60 ft/sec (steam)	540 °F	0.196 **	0.353	- - -	- - -	13,410 lbs	Limit Seated

* These valves showed brief thrust increases just before wedging. The first value of apparent disk friction coefficient is just prior to the increase. The second value in parenthesis is at initial wedging.

** Data indicate a possible zero shift during opening stroke which would increase apparent disk friction coefficient to about 0.30.

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EPRI MOV Performance Prediction Program

Technical Advisory Group Perspective
Industry Update Meeting

December 1-2, 1993

Michael Eidson (SNC)

EPRI MOV Performance Prediction Program
TAG Perspective
December 1-2, 1993

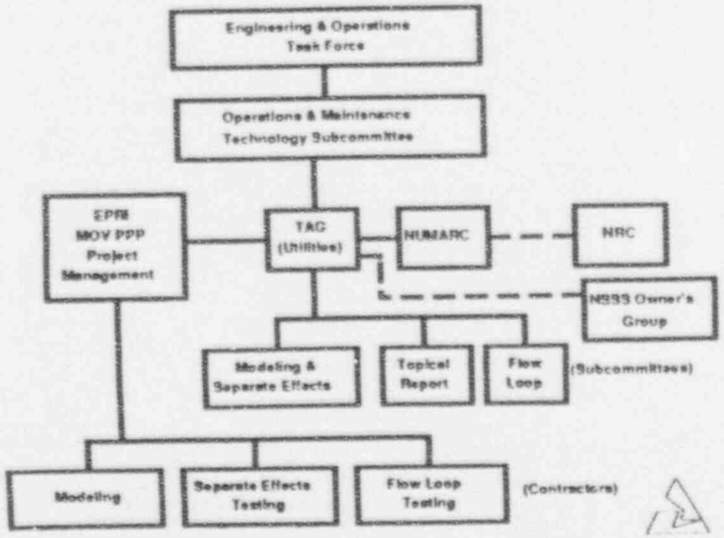
I. TAG Overview

II. Recent TAG Activities

III. TAG Perspective
   - A. Positive Notes
   - B. TAG Concerns
   - C. Program Objectives
   - D. Program Results/Impact

IV. Summary

EPRI MOV PPP Technical Advisory Group



Engineering & Operations Task Force

Operations & Maintenance Technology Subcommittee

EPRI MOV PPP Project Management

TAG (Utilities)

NUMARC

NRC

NSSS Owner's Group

Modeling & Separate Effects

Topical Report

Flow Loop

(Subcommittees)

Modeling

Separate Effects Testing

Flow Loop Testing

(Contractors)

EPRI MOV PPP Technical Advisory Group and Subcommittee Structure

○ The EPRI MOV Performance Prediction Program (PPP) Technical Advisory Group (TAG) provides technical guidance to the EPRI Staff in the planning and implementation of the program.

○ The primary TAG focus is on program goals, significant technical issues, scheduling and budget activities, i.e., the TAG acts like a steering committee. The TAG provides monitoring and oversight of technical issues by reviewing and approving subcommittee and EPRI project staff recommendations.

○ The detailed program technical aspects are monitored and reviewed by the subcommittees, which include an expanded membership from the MOV PPP member utilities. The subcommittees report back to the TAG.

○ The TAG represents the MOV PPP member utilities.

○ The TAG reports to the EPRI Operations & Maintenance Technology Subcommittee and the EPRI Engineering & Operations Task Force.

○ The TAG interfaces with outside organizations such as NSSS Owner's Groups, NUMARC and NRC.

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1993 EPRI MOV PPP TAG Members

NAME	COMPANY
* John Allen	Tennessee Valley Authority
Denver Atwood	Southern Nuclear
Bill Black	TU Electric
Clive Calleway	NUMARC
Brian Curry	Philadelphia Electric
Michael Eidson, Chairman	Southern Nuclear
Neal Estep, Vice Chairman	Duke Power
Chris Hensen	Yankee Atomic
Sam Henry	Tennessee Valley Authority
Nick Konstantinou	Commonwealth Edison
Fred Martsen	New York Power Authority
Bob McPheerson	Southern California Edison
Ron Schermen	Cleveland Electric
* Robert Woehl	PG&E

** Lieson to Operations & Maintenance Subcommittee.*

EPRI MOV PPP TAG Subcommittees

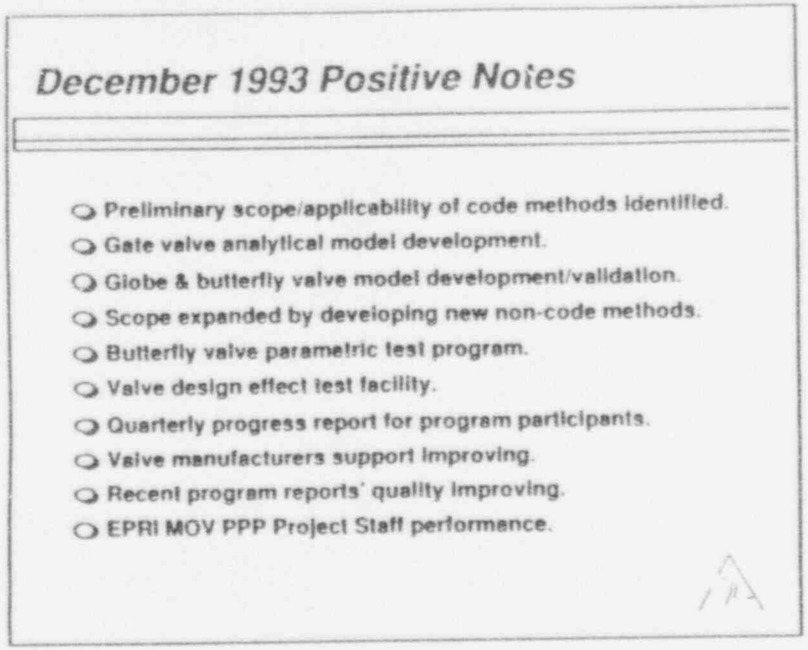
FLOW LOOP	
Larry Dorfman	EPRI
Mike Eidson	Southern Nuclear
Neal Estep, Chairman	Duke Power
Bill Kennedy	EPRI
MODELING & SEPARATE EFFECTS	
Buzz Beltz	TVA
Lorraine Benesky	PP&L
Bill Black	TU Electric
Brian Curry	Philadelphia Electric
Norm Dingman	Nebraska Public Power District
Chuck Lynch	Southern Company Services
Fred Martsen, Co-Chairman	NYPA
Steve Reed	Union Electric
Ron Scherman, Co-Chairman	Cleveland Electric
Ken Wolfe	EPRI
TOPICAL REPORT	
Clive Calleway	NUMARC
Chris Hansen, Chairman	Yankee Atomic
John Hosler	EPRI
John Sutton	Yankee Atomic
Brian Sullivan	Boston Edison
Joe Price	FP&L

Recent TAG Activities 1993

Jan 7	NRC memo closes 6 of 22 concerns and adds 6 new concerns.
Jan 12	TAG Subcommittee meetings.
Jan 13-14	TAG expressed concerns over testing progress; requested action plans to resolve 3 MOV phenomena.
Jan 18	EPRI/TAG report to O&M Tech Subcommittee.
Feb 5	TAG letter to participants requests MOV in situ test data.
Feb 22	EPRI MOV PPP update meeting with program participants; 90% population to be included in program.
Apr 7-8	TAG informed of new flow loop test sequence deletions and in situ test data losses; approved 3 action plans.
Apr 22	TAG/EPRI/NUMARC/Valve Manufacturer meeting with NRC.
May 5	EPRI memo provides assessment of test data losses on methodology validation.
May 19-20	EPRI/TAG report to E&O Task Force and DAC.
June 8	DAC letter to executive contacts requests MOV in situ test data.
June 15	EPRI/TAG agreement on additional flow loop testing.
June 18	Topical Report Subcommittee meeting.

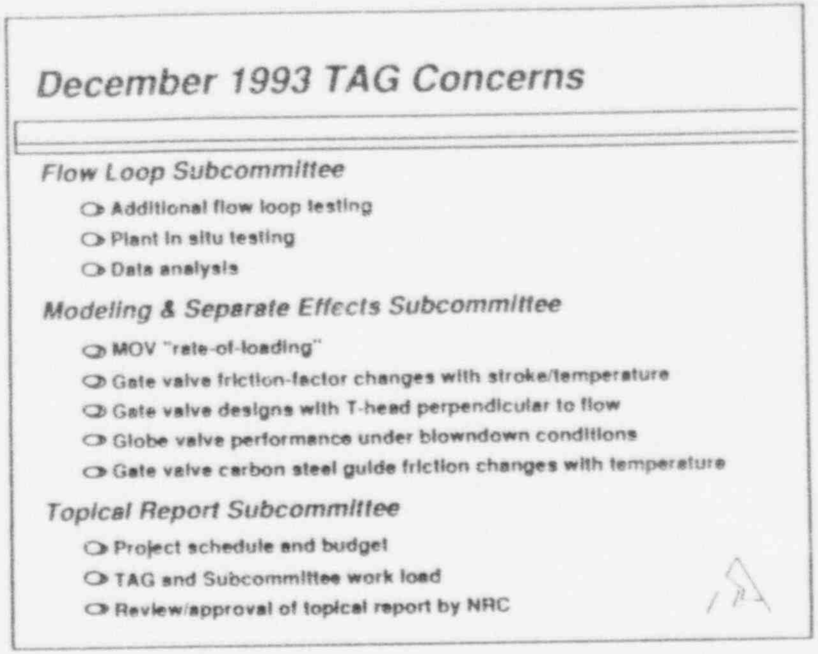
Recent TAG Activities 1993 (Cont'd)

June 30	Modeling & Separate Effects Subcommittee meeting.
July 15	EPRI MOV PPP update meeting with program participants.
July 30	EPRI E&O letter to utility management requests continued TAG and Subcommittee membership support.
Aug 3	Flow Loop Subcommittee meeting.
Aug 4-5	TAG meeting.
Aug 19-20	TAG/EPRI/NUMARC meeting with NRC at Wyle Labs to review flow loop results and inspect valves.
Sept 8	EPRI letter to NUMARC formally responds to NRC concerns.
Sept 27-28	EPRI/TAG report to O&M Tech Subcommittee and E&O Task Force.
Oct 5	TAG/EPRI/NUMARC meeting with ACRS.
Oct 6-7	TAG/EPRI/NUMARC/Valve Manufacturer meeting with NRC.
Oct 26-27	TAG meeting.
Nov 16	Modeling and Separate Effects Subcommittee meeting.
Dec 1-2	EPRI MOV PPP update meeting with industry and program participants.



December 1993 Positive Notes

- ❍ Preliminary scope/applicability of code methods identified.
- ❍ Gate valve analytical model development.
- ❍ Globe & butterfly valve model development/validation.
- ❍ Scope expanded by developing new non-code methods.
- ❍ Butterfly valve parametric test program.
- ❍ Valve design effect test facility.
- ❍ Quarterly progress report for program participants.
- ❍ Valve manufacturers support improving.
- ❍ Recent program reports' quality improving.
- ❍ EPRI MOV PPP Project Staff performance.



December 1993 TAG Concerns

Flow Loop Subcommittee

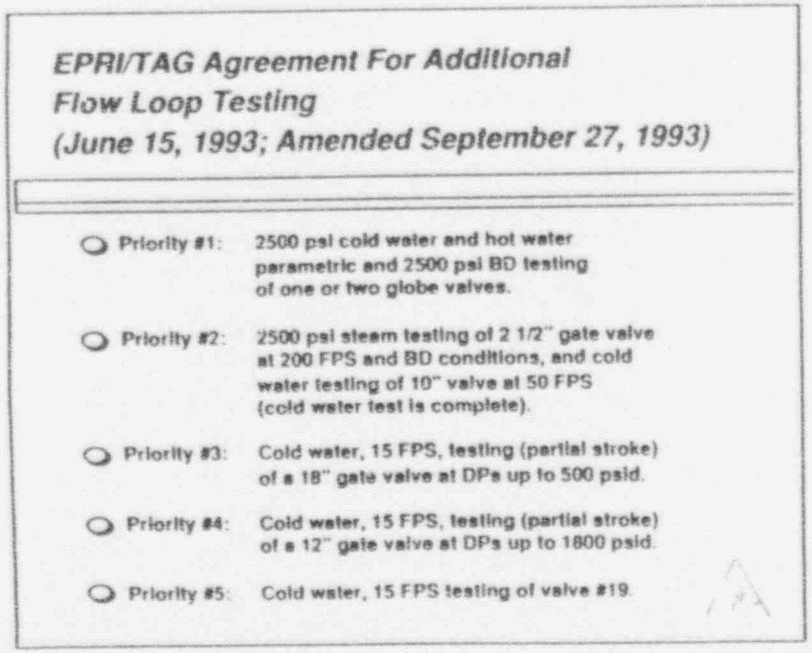
- ❍ Additional flow loop testing
- ❍ Plant in situ testing
- ❍ Data analysis

Modeling & Separate Effects Subcommittee

- ❍ MOV "rate-of-loading"
- ❍ Gate valve friction-factor changes with stroke/temperature
- ❍ Gate valve designs with T-head perpendicular to flow
- ❍ Globe valve performance under blowdown conditions
- ❍ Gate valve carbon steel guide friction changes with temperature

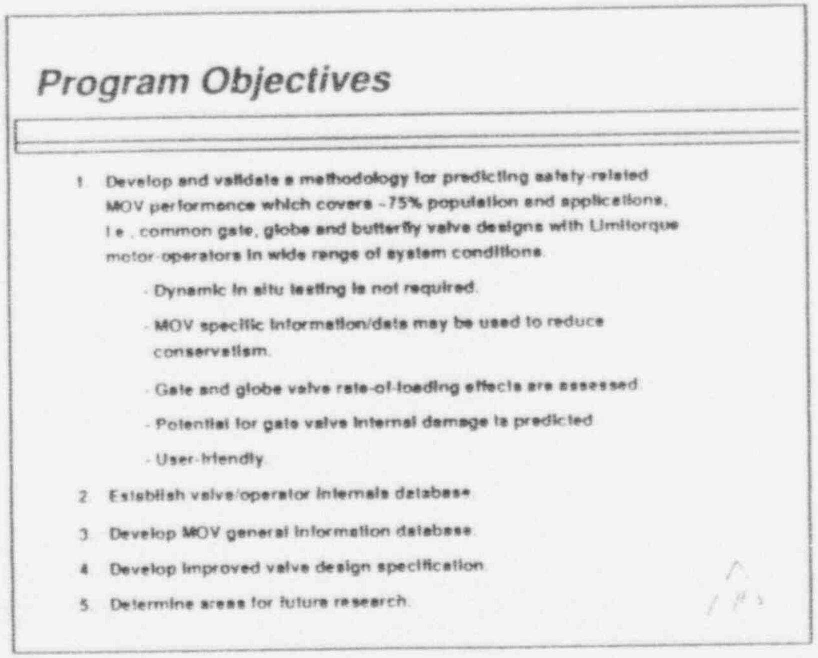
Topical Report Subcommittee

- ❍ Project schedule and budget
- ❍ TAG and Subcommittee work load
- ❍ Review/approval of topical report by NRC



EPRI/TAG Agreement For Additional Flow Loop Testing (June 15, 1993; Amended September 27, 1993)

- ❍ Priority #1: 2500 psi cold water and hot water parametric and 2500 psi BD testing of one or two globe valves.
- ❍ Priority #2: 2500 psi steam testing of 2 1/2" gate valve at 200 FPS and BD conditions, and cold water testing of 10" valve at 50 FPS (cold water test is complete).
- ❍ Priority #3: Cold water, 15 FPS, testing (partial stroke) of a 18" gate valve at DPs up to 500 psid.
- ❍ Priority #4: Cold water, 15 FPS, testing (partial stroke) of a 12" gate valve at DPs up to 1800 psid.
- ❍ Priority #5: Cold water, 15 FPS testing of valve #19.

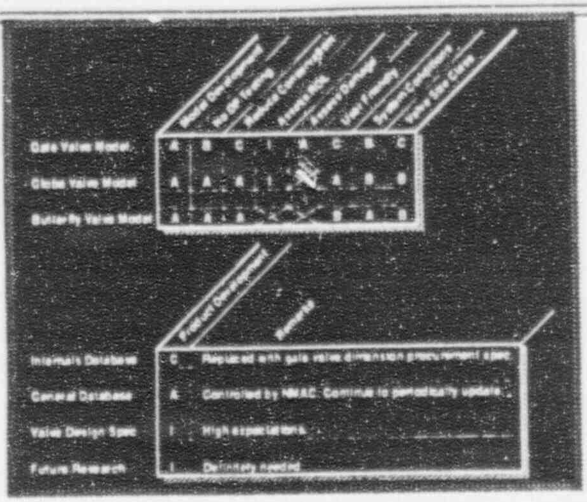


Program Objectives

1. Develop and validate a methodology for predicting safety-related MOV performance which covers ~75% population and applications, i.e., common gate, globe and butterfly valve designs with Limitorque motor-operators in wide range of system conditions.
    - Dynamic in situ testing is not required.
    - MOV specific information/data may be used to reduce conservatism.
    - Gate and globe valve rate-of-loading effects are assessed.
    - Potential for gate valve internal damage is predicted.
    - User-friendly.
2. Establish valve/operator internals database.
3. Develop MOV general information database.
4. Develop improved valve design specification.
5. Determine areas for future research.

[illegible] TAG
Mtg 12-1-94

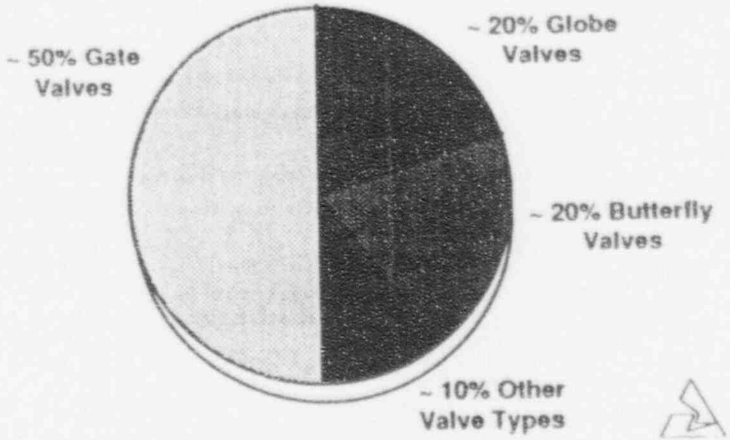
Program Objectives - The Report Card



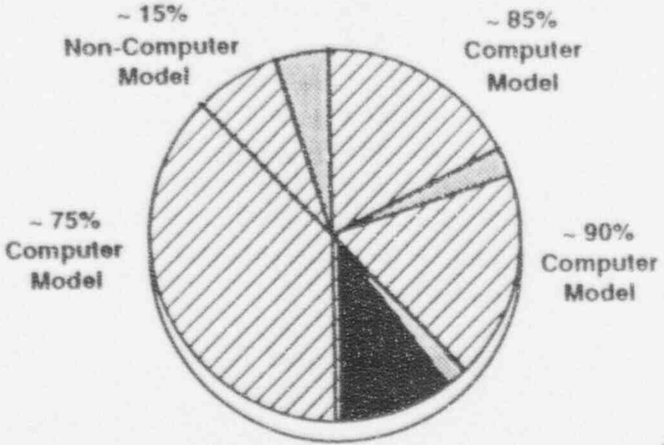
Gate Valve Model	A	B	C	I	A	C	B	C
Globe Valve Model	A	A	A	I	[illegible]	A	B	B
Butterfly Valve Model	A	A	A	[illegible]	[illegible]	B	A	B

	Product Development	Remarks
Internals Database	C	Replaced with gate valve dimension procurement spec
General Database	A	Controlled by NMAC. Continue to periodically update.
Valve Design Spec	I	High expectations.
Future Research	I	Definitely needed

Distribution Of ~16,000 Safety-Related MOVs



~80% Population Covered By EPRI MOV PPP



EPRI MOV Program Results/Impact - Good News & Bad News

1. Modelers have developed detailed gate valve prediction methodology.
   - Scope may be limited due to insufficient flow loop test data and certain gate valve design features.
   - Classic valve vendor equations are not sufficient and give non-conservative results.
   - Some valve manufacturer designs and/or manufacturing processes result in valves that will have non-predictable performance.
   - Utilities without aggressive MOV Programs may have many MOVs with low torque switch settings or undersized motor-operators.
   - Some valves may have to be reworked, replaced, and/or have motor-operators resized.
   - All gate valve designs, sizes, manufacturers, and non-stellite are not covered.

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EPRI MOV Program Results/Impact - Good News & Bad News (Cont'd)

2 Modelers have refined globe valve prediction methodology.
  - Scope does not include blowdown.
  - Valve manufacturers and utility engineers using classic vendor equations and valve "nominal" dimensions may underpredict thrust requirements.
  - Some existing switch settings may be insufficient or the motor-operators may be undersized.
  - All globe valve designs, sizes, manufacturers are not in scope.

EPRI MOV Program Results/Impact - Good News & Bad News (Cont'd)

3. Modelers have developed detailed butterfly valve prediction methodology.
   - Valve manufacturers using older-generation equations and utility engineers using classical equations may under-predict torque.
   - Some existing switch settings may be insufficient or the motor-operators may be undersized.
   - All butterfly valve designs, sizes, and manufacturers are not in scope.

4. NRC has agreed to review EPRI MOV PPP topical report and issue SER.

Summary

- Must complete investigation/resolution of key MOV phenomena.
  - Rate-of-loading
  - Gate valve T-head influences
  - Stellite behavior in cold water
  - Globe valve blowdown performance
  - Carbon steel behavior in warm water
- Must complete additional testing.
  - Flow loop
  - In situ
- Continued utility support for TAG and Subcommittees is imperative.
- Must adhere to very tight schedule to ensure April 1994 completion.
- Program funding is marginal.

Summary (Cont'd)

- Model validation process and/or NRC review may necessitate additional testing.
- NRC tentatively agrees to use generic funding for EPRI MOV PPP topical report review.
- Quality of recent program reports is much improved.
- Excellent progress with butterfly and globe valve model development and validation.
- Good progress with gate valve model development and validation.
- Scope of applicability exceeds objective.
- Plants without aggressive MOV Programs may be in trouble.
- Long-term EPRI MOV PPP support for utilities is necessary.

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Assessment of Potential Implications for Installed MOV's

EPRI MOV Program Review Meeting

DFW Airport Hyatt

December 1, 1993

N. Estep

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Introduction

- Information Available for Evaluation
  - EPRI Weekly Status Reports
  - EPRI Special Update Reports
  - EPRI industry Meeting Presentations
  - NRC Information Notices
- Issues:
  - Gate valve apparent disk-seat friction coefficient and anomalous behavior
  - Globe valve apparent valve factors and anomalous behavior
  - Butterfly valve hydrodynamic torque coefficients
  - Stem-stem nut friction coefficient - generic issue and not considered in this evaluation
  - Rate-of-Loading - generic issue and not considered in this evaluation

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~~23~~ 24 of 74

Approach

Step 1:

- EPRI weekly status reports, special update notices, and industry presentation results were reviewed to identify valves with performance that:
  - a. Would not have been bounded by Duke thrust/torque predictions, and/or
  - b. Sustained damage during testing

25874

Approach

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Considerations for Step 1:

1. In presenting the apparent disk to seat sliding friction coefficient (μ) results for gate valves, EPRI used the NMAC Guide [1] equations for differential pressure load, FDP:
   - » Closing (Equation 5-3a)

$$F_{DP}(lbs) = (\mu)(\Delta P)(A_{mean\_seat})\frac{1}{(\cos\theta - \mu\sin\theta)}$$

   - » Opening (Equation 5-3b)

$$F_{DP}(lbs) = (\mu)(\Delta P)(A_{mean\_seat})\frac{1}{(\cos\theta + \mu\sin\theta)}$$

EPRI - Dallas Update Meeting

Approach

Duke uses the following equation to predict the open and close FDP term [2]:

$$F_{DP}(\mathrm{lbs}) = (VF)(\Delta P)(A_{mean\_seat})$$

Therefore, to convert the EPRI apparent seat friction coefficient values to the valve factor (VF) term used in the Duke equations, the following relationships are used:

- Closing:

$$VF_{close} = \frac{\mu}{(\cos\theta - \mu\sin\theta)}$$

- Opening:

$$VF_{open} = \frac{\mu}{(\cos\theta + \mu\sin\theta)}$$

Duke Power Company

Approach

VF and μ are identical when the disk half-wedge angle (θ) is 0-degrees (for example, Anchor-Darling double disk gate valves).

For a 5-degree half wedge angle and a μ of 0.5:

- » VFc = 0.525
- » VFo = 0.481

For a 5-degree half wedge angle and a VF of 0.5:

- » Close μ = 0.477
- » Open μ = 0.520

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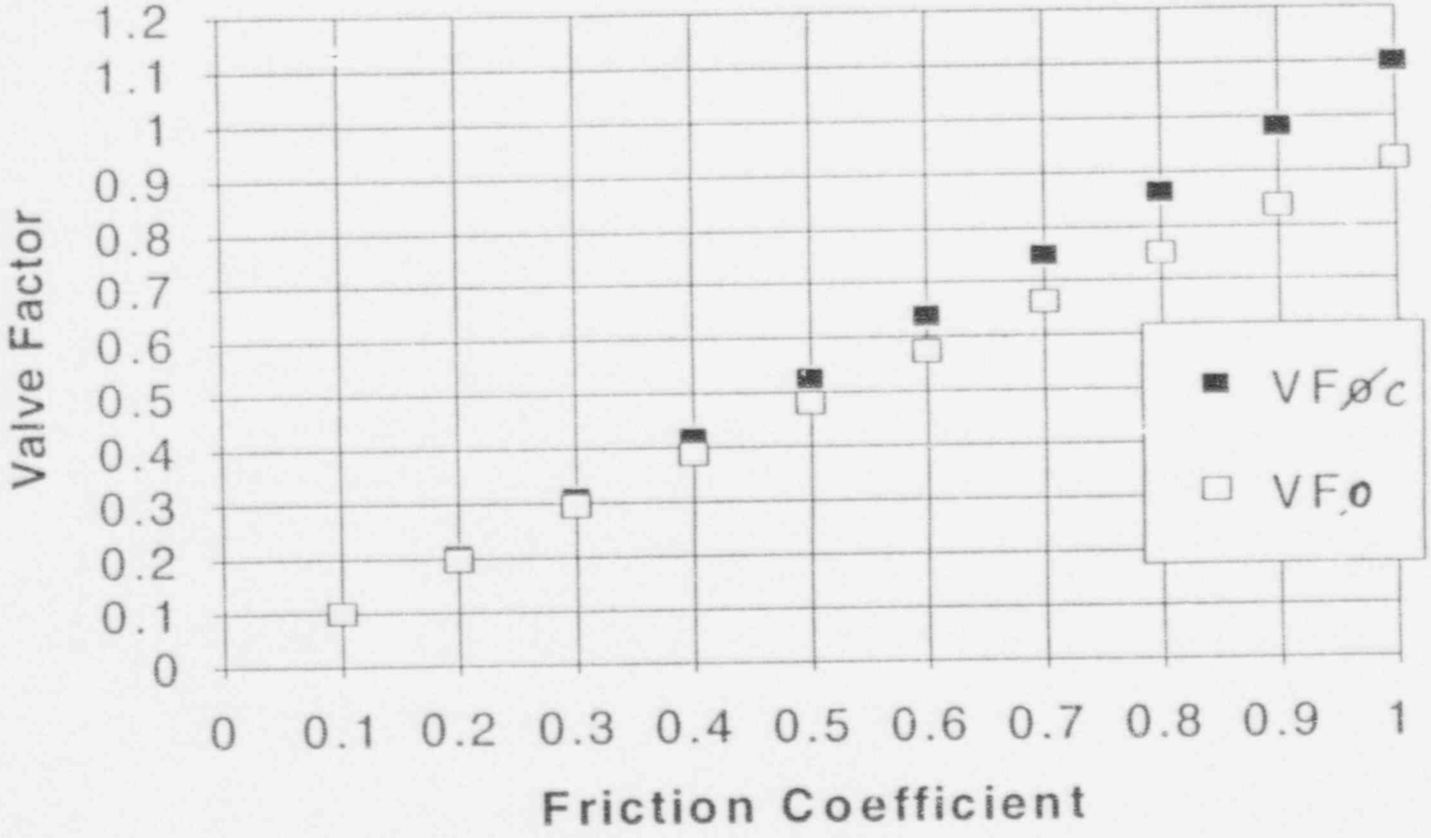
EPRI - Dallas Update Meeting

Valve Factor vs Friction Coefficient
(for 5-degree half wedge angle)



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Duke Power Company

Approach

Consideration 2:

- The EPRI values for seat friction coefficient under cold water test conditions represent "preconditioned" values. Therefore, the EPRI friction coefficient results may represent worst case conditions for cold water test conditions. For elevated temperature water (above 200 degrees F) and steam testing, it was observed that seat preconditioning had little effect on the apparent seat friction coefficient results.

Consideration 3:

- For globe valves, the valve factor (VF) is essentially a correction term to account for the difference between the assumed and actual area upon which the DP is acting. Duke typically uses a VF for globe valves of 1.1. Therefore, EPRI globe valve test results with a VF greater than 1.1 were noted.

9730874

Table 1 - EPRI Test Valves Exceeding Duke Criteria

EPRI Valve No.	Type	Mfg	Size	ANSI Class / Material
3	FWG	Anchor Darling	6	900 cs
6	FWG	Anchor Darling	18	300 cs
7	FWG	Borg-Warner	3	1500 cs
8	FWG	Borg-Warner	6	150 cs
9	FWG	Borg-Warner	6	1500 cs
10	FWG	Borg-Warner	12	300 cs
13	FWG	New Velan	2.5	1500 ss
14	FWG	Crane	6	900 cs
19	FWG	Powell	6	150 cs
21	FWG	Rockwell	2.5	900 cs
23	FWG	Velan	6	150 cs
24	FWG	Velan	6	900 cs
25	FWG	Velan	10	300 cs
26	FWG	Velan	10	900 cs
30	FWG	Walworth	6	900 cs
41	PDG	Anchor Darling	6	900 cs
43	SWG	Edwards	10	900 cs
44	Globe	Borg Warner	6	900 cs
48	Globe	Rockwell / Edwards	2	1500 ss

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Approach

Step 2:

This list was further reviewed to determine if MOVs of similar design were in service at Oconee, McGuire or Catawba:

a. MOV data bases were searched for a match of manufacturer and valve type.

b. MOVs with matching manufacturer and type were further grouped based on size and ANSI pressure class similarity.
   - » An EPRI test valve 6-inches in size may include a review of 4, 6, 8 and 10-inch valves of similar pressure class
   - » Pressure classes of 150/300, and 600/900/1500 were grouped together

32,274

Approach

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Step 2, continued:

c. Next, MOV design similarity was determined from a review of the EPRI and Duke valve outline drawings.
  - » Disk shape
  - » Stem-disk connection
  - » Guide configuration
  - » Valve disk materials (for some valve designs)

Table 2 - EPRI Test Valves Exceeding Duke Criteria and Having Potential Applicability to MOVs in Duke Plants

EPRI Valve No.	Type	Mfg	Size	ANSI Class / Material
7	FWG	Borg-Warner	3	1500 cs
8	FWG	Borg-Warner	6	150 cs
9	FWG	Borg-Warner	6	1500 cs
10	FWG	Borg-Warner	12	300 cs
14	FWG	Crane	6	900 cs
21	FWG	Rockwell	2.5	900 cs
26	FWG	Velan	10	900 cs
30	FWG	Walworth	6	900 cs
41	PDG	Anchor Darling	6	900 cs
43	SWG	Edwards	10	900 cs
44	Globe	Borg Warner	6	900 cs
48	Globe	Rockwell / Edwards	2	1500 ss

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Approach

Step 3:

Each valve is individually examined to assess applicability to the EPRI test results:

a. MOVs that are not safety-related or included in the Generic Letter 89-10 scope were eliminated from consideration.

b. MOVs that do not have design-basis requirements similar to the EPRI test conditions that produced the unexpected behavior were eliminated from consideration.
   - » Pumped vs Blowdown
   - » Design-basis stroke direction

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Approach

Step 3, continued:

c. Next, Duke in-plant DP and flow test results for MOVs similar to EPRI test valves were reviewed to determine if more favorable results were obtained. For purposes of this evaluation the Duke in-plant test results and not the EPRI test results are considered to be the "best available data" for evaluation purposes.

d. Finally, if an MOV of concern remains the Duke Problem Investigation Process (PIP) is entered for further action.

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Final Results

EPRI Valve No.	Disposition
7	No corrective actions
8	Some corrective actions necessary - PIP generated
9	No corrective actions
10	Some corrective actions necessary - PIP generated
14	No corrective actions
21	No corrective actions per letter from manufacturer
26	No corrective actions
30	No corrective actions
41	No corrective actions
43	No corrective actions
44	Some corrective actions necessary - PIP generated
48	No corrective actions

[illegible] 37 of 74

References

1. NMAC, Application Guide for Motor-Operated Valves in Nuclear Power Plants, NP-6660-D, March 1990.
2. DPS-1205.19-00-0002, Guideline for Performing Motor Operated Valve Reviews and Calculations.
3. NRC Information Notice 89-61, "Failure of Borg-Warner Gate Valves to Close Against Differential Pressure," August 1989.
4. EPRI Weekly Status Reports
5. EPRI Special Update Notices
6. EPRI Program Update Information
7. NRC Draft Information Notice on EPRI Test Results
8. Letter, Earl Bake of Edward Valves to William Kennedy of EPRI, January 15, 1993.
9. Telecopy Message, Earl Bake of Edward Valves to N. Estep of Duke Power, October 25, 1993.

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EPRI/NPD

EPRI MOV
Performance Prediction Program

OVERVIEW & STATUS

EPRI MOV PROGRAM REVIEW MEETING

DFW Airport Hyatt

December 1, 1993

JOHN F. HOSLER

Add: 50-374

Engineering & Operations

BACKGROUND

- NRC Generic Letter 89-10
- In Situ Design Basis Testing of MOV's
- Initiation of EPRI MOV Performance Prediction Program
  - Formation of Utility Technical Advisory Group (TAG)
  - Establishment of NUMARC/TAG/NRC interface

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PROGRAM OBJECTIVES

- Provide Utilities with a validated methodology to analytically predict MOV performance
- Provide a technically defensible alternative to In Situ design basis testing

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APPROACH

- Utilize NMAC MOV Application Guide as starting point
- Develop improved methodology for MOV Performance Prediction to include:
  - fluid system modeling
  - valve computer modeling (gate, globe, and butterfly)
  - methods to apply flow loop/in situ MOV test results to plant specific applications (some gate valve designs)
  - motor-operator dynamic response assessment

APPROACH

- Perform separate effects evaluations to address areas of known uncertainty
  - rate of loading
  - valve design effects
  - friction
  - stem lubrication

#3 of 74

APPROACH

- Develop engineering models and software modules to predict MOV performance
  - DP vs stroke position
  - required thrust/torque vs stroke position
  - assessment of potential for gate valve internal damage
  - prediction of motor-operator dynamic response
    - Rate-of-loading effects to be addressed by in situ static test -- validation of test method in progress

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APPROACH

- Refine engineering models based on results of Separate Effects Testing
- Validate predictive methodology by comparison to flow loop and in situ test results

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Summary of All MOV Test Data to be used for Methodology Validation/Assessment

	No. Valves	No. Test Seq.
EPRI Wyle/Siemens Flow Loop Testing	34	62
Duke F/L Testing at Utah State	2	8
EPRI Kalsi Butterfly Valve F/L Testing	10	37
EPRI In-Situ Testing (Fully Enhanced)	28	28
	74	135
EPRI In-Situ Tests w/o full enhancement	8	8
	82	143
INEL/NRC Blowdown Test Program	9	12
	91	155

EPRI MOV PERFORMANCE PREDICTION PROGRAM PRODUCTS

Product	DRAFT	FINAL	PUBLISH
Application Guide for MOV's in Nuclear Power Plants (NMAC Product)*	Complete	Complete	Complete
Review of INEL Gate Valve Test Program	Complete	Complete	Complete
In Situ Test Guide*	Complete	Complete	Complete
MOV Margin Improvement Guide*	Complete	Complete	Complete
MOV General Information Database*	Complete	Complete	Complete
Butterfly Application Guide (NMAC Product)*	Complete	Complete	Complete
Stem Nut Lubricant Test Report	Complete	Complete	Complete
Methodology Input Specification Draft	Complete	Complete	Complete
Huntsville Low Pressure Flow Loop Test*	**Complete**	**Complete**	**Dec. 3, 1993**
Friction Test Report	Complete	Complete	Dec. 3, 1993
Computational Fluid Dynamics Analysis Report	Complete	Complete	Dec. 15, 1993
Globe Valve Model Report*	**Complete**	**Dec. 3, 1993**	**Jan. 31, 1994**
Huntsville Int. Pressure Flow Loop Test*	**Dec. 3, 1993**	**Jan. 7, 1994**	**Feb. 7, 1994**
Norco Flow Loop Test Report*	**Dec. 13, 1993**	**Jan. 20, 1994**	**Feb. 20, 1994**
Butterfly Valve Model Report*	**Dec. 31, 1993**	**Jan. 31, 1994**	MAR **~~Feb.~~ 20, 1994**
Siemens/KWU Flow Loop Test Report*	**Dec. 17, 1993**	**Jan. 31, 1994**	**Feb. 28, 1994**
Butterfly Valve Subscale Test Report	**Dec. 3, 1993**	**Jan. 15, 1994**	**Mar. 7, 1994**
System Model Report	**Dec. 31, 1993**	**Jan. 31, 1994**	**Mar. 20, 1994**
In Situ Test Report (Phase 1)*	**Dec. 31, 1993**	**Jan. 31, 1994**	**Mar. 20, 1994**
Integrated Methodology PC Code*	**Mar. 20, 1994**	**Mar. 20, 1994**	**Mar. 20, 1994**
Gate Valve Design Effects Report	Dec. 10, 1993	JAN ~~Feb.~~ 15, 1994	MAR ~~Apr.~~ 7, 1994
Operator Test Report	Feb. 1, 1994	Mar. 1, 1994	Apr. 23, 1994
Gate Valve Model Report	**Feb. 15, 1994**	**Mar. 15, 1994**	**May 7, 1994**
PC Code Users Manual*	**Feb. 14, 1994**	**Mar. 15, 1994**	**May 7, 1994**
Operator Effects Methodology Report*	**Feb. 28, 1994**	**Mar. 31, 1994**	**May 20, 1994**
In Situ Test Report (Phase 2)*	**Mar. 15, 1994**	**Apr. 15, 1994**	**June 7, 1994**
Integrated Methodology Assessment Report	**Mar. 20, 1994**	**Apr. 20, 1994**	**June 10, 1994**
Model Implementation Guide*	**Mar. 20, 1994**	**Apr. 20, 1994**	**June 10, 1994**
Empirically Based Methods Reports*	**Mar. 31, 1994**	**Apr. 30, 1994**	**June 20, 1994**
MOV PPP Topical Report *(Draft Sections to be issued as completed.)*	**Oct. 1993 to Apr. 1994**	**May 15, 1994**	**July 7, 1994**

* Products which can be directly applied by Utilities in assessing MOV performance capability.

Note: Bolded products are developed under 10CFR50 Appendix B Q/A Program

Portions of this Document were externally generated
and are the best copies available.
This Document is considered acceptable as-is
for processing as a QA Record per review
performed by K Shaw date 1/20/94

EPRI MOV Program Product Distribution

- Two catagories of products
    - Non-Q/A
    - Q/A
- All non-Q/A products will be distributed to MOV Program technical contacts automatically as published
- All Q/A products must be procured directly from Power Computing Corporation in Dallas, Texas via a P.O. which imposes Appendix B and Part 21 requirements
    - A single blanket P.O. will be sufficient to procure all Q/A products
    - Q/A products will be issued as they are published and once P.O. has been received

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Power Computing

Babcock & Wilcox a McDermott company

1930 Hi Line Drive
Dallas, Texas 75207
(214) 655-8822

November 2, 1993

TO: EPRI MOV Program Participants - Technical Contacts

FROM: John Hosler, Electric Power Research Institute
Sarah Scott, Power Computing Company

The EPRI MOV Performance Prediction Program will produce a computer program and a number of reports which have been developed under 10CFR50 Appendix B. In addition, some of the work will be reported in non-QA reports. As a participating member of the MOV program, you are entitled to receive all reports and the software.

The non-QA reports will be sent to you automatically as they are published by EPRI. Additional copies of all non-QA reports can be ordered from EPRI's Report Distribution Center at (510) 934-421[illegible].

The QA reports and software will be distributed for EPRI by the Electric Power Software Center (EPSC), operated by Power Computing Company (PCC) in Dallas, Texas. In order to receive the QA material, each utility should place a purchase order with PCC (nominal cost $100). The P.O. should request all MOV QA Program Products (shown here as Attachment A) and should specify that the terms of the agreement be in accordance with the applicable provisions of 10CFR50 Appendix B and 10CFR21. In addition, the P.O. should specify the name of the utility contact to whom the product should be shipped.

It is recommended that a blanket P.O. be placed with PCC for all products shown in Attachment A. In that case, PCC will distribute the products as soon as they are available. It is suggested that sufficient copies of each report be ordered to support utility engineering and each nuclear site. Utilities should minimize the number of Flow Loop Test Reports ordered, since each of these is comprised of approximately 10 volumes with a total of as many as 600 pages per volume.

Purchase Orders should be sent to the attention of Sarah L. Scott at PCC at the address above. If you have any questions or need further information, please feel free to contact Ms. Scott at (214) 655-8828.

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Attachment A

EPRI MOV PERFORMANCE PREDICTION PROGRAM
QA PRODUCTS

1. MOV Performance Prediction Methodology Computer Code and Supporting Hardcopy Documentation (SW-103242)

   The PC-based code will predict the force or torque required to open or close a valve at each position in its stroke. The computer code shall consist of five modules.

   - The <u>System Module</u> will calculate the differential pressure across the valves at each stroke position. Input to this module will include pipe lengths, fluid properties, pump curves, etc.

   - Three Valve Modules will be required. The <u>Gate Valve Module</u> and the <u>Globe Valve Module</u> shall calculate the required stem thrust at each stroke position. The <u>Butterfly Valve Module</u> shall calculate the required torque. Input to these modules includes a differential pressure calculated by the System Module as well as valve dimensional parameters, material types, etc. In addition to calculating thrust, the gate valve module shall determine if the valve is likely to exhibit anomalous performance during its stroke.

   - These four modules shall be integrated under the <u>User Interface Module</u> which will handle I/O routines and manage module execution and file maintenance fucntions.

   - The code will be delivered with a User's Manual(TR-103243) and a Model Implementation Guide(TR-103244).

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Attachment A (continued)

EPRI MOV PERFORMANCE PREDICTION PROGRAM
QA PRODUCTS

2. Additional reports which are being made available as QA controlled documents include:

TR - 103220	In-Situ Test Report (Phase 1)
TR - 103224	Butterfly Valve Model Report
TR - 103225	System Model Report
TR - 103226	Operator Methodology Report
TR - 103227	Globe Valve Model Report
TR - 103229	Gate Valve Model Report
TR - 103231	Integrated Methodology Assessment Report
TR - 103237	EPRI MOV Performance Prediction Program Topical Report
TR- 103232	Engineering Analysis Report: Anchor/Darling Double Disk Valve
TR - 103233	Engineering Analysis Report: Westinghouse Gate Valves
TR - 103234	Engineering Analysis Report: Edward Equiwedge Valves
TR - 103235	Engineering Analysis Report: Aloyco Split-Wedge Valves
TR - 103236	Engineering Analysis Report: WKM Gate Valves
TR - 103190	Cold Water Pumped Flow Loop Test Report
TR - 103239	Cold Water Intermediate Pressure Flow Loop Test Report
TR - 103240	Norco Flow Loop Test Report
TR - 103241	Karlstein Flow Loop Test Report
TR - 103238	In-Situ Test Report (Phase 2)

EPRI/NPD

Review of Flow Loop Test Program Results

EPRI MOV PROGRAM REVIEW MEETING

DFW Airport Hyatt

December 1, 1993

John F. Hosler/W. Kennedy

1-15-94 52974

Engineering & Operations

185VG JFH jp 11 93 1

KEY RESULTS FROM FLOW LOOP TESTING

- Objectives
- Scope
- Gate Valve Preconditioning Approach/Philosophy
- Data analysis Techniques
- Key results

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OBJECTIVES

- Obtain test and inspection data (both valve and operator) for most populous valve designs over a range of size, pressure, ΔP, and flow conditions to:

  1. Provide data for validation of the MOV Performance Prediction Methodology; and
  2. Quantify the performance of valves typical of those installed in nuclear power plants under a wide range of media, flow, differential pressure and temperature conditions.

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SCOPE

FLOW LOOP FACILITIES (Wyle & Siemens)

1. Low pressure, cold water pumped flow at Wyle Laboratories, Huntsville, Alabama. 6" valves tested at DPs up to 250 psi.
2. Intermediate pressure, cold water blowdown (simulating pumped flow) at Wyle Laboratories, Huntsville, Alabama. 12" valves tested up to 500 psi, 10" valves tested up to 740 psi.
3. High pressure, cold water and hot water pumped flow simulation and hot water and steam blowdown at Wyle Laboratories, Norco, California. 6" valves tested up to 1800 psi, 3" valves tested up to 2500 psi.
4. High pressure, cold water pumped flow simulation and steam blowdown at Siemens/KWU, Karlstein, Germany. 10" valves tested up to 1800 psi, 18" valves tested up to 500 psi.

SCOPE

Wyle/Siemens Flow Loop Test Program

- Testing completed on 34 valves (62 test sequences) at 4 Wyle/Siemens flow loop facilities.
  - 28 flex or solid wedge or parallel disc gate valves ranging in size from 2-1/2 to 18 inch and 150 to 1500 lb. class
  - 4 globe valves ranging in size from 2-1/2 to 10 inch and 300 to 1500 lb class
  - 2 butterfly valves; 6", 150 lb. class

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TABLE 3
FLOW LOOP TEST MATRIX

No	Valve Type	Manufacturer	Size (Inch)	ANSI Class/ Material	Limitorque Actuator SMB-Type (Note 4)	Ambient Water 15 FPS (Note 6) MAX DP	Ambient Water 50 FPS (Note 5) MAX DP	450 F Water 15 FPS (Note 1) MAX DP	500 F Water Blowdown (Note 2) MAX DP	Sat. Steam 200 FPS MAX DP	Sat. Steam Blowdown (Note 2) MAX DP	Alternate Configuration Testing Notes
1	FWG	Anchor Darling	3	300 cs	00	740 (HI)						
2	FWG	Anchor Darling	6	150 ss	000	250 (HP)						
3	FWG	Anchor Darling	6	900 cs	0	1800 (N)	(N)1800	(N) 1200	(N) 1200			
4	FWG	Anchor Darling	10	300 ss	0	740 (HI)						B.C. F
5	FWG	Anchor Darling	10	900 cs	2-150	1800 (S)						
6	FWG	Anchor Darling	18	300 cs	2	500 (S)						
7	FWG	Borg Warner	3	1500 cs	00	2500 (N)	(N) 2500					
8	FWG	Borg-Warner	6	150 cs	Rotork	250 (HP)						
9	FWG	Borg-Warner	6	1500 cs	1	1800 (N)			(N) 1200			
10	FWG	Borg Warner	12	300 cs	1-25	500 (HI)						
13	FWG	New Velan	2-1/2	1500 ss	000	2500 (N)	(N) 2500		(N) 2500			
14	FWG	Crane	6	900 cs	0	1800 (N)	(N) 180(		(N) 1200			
15	FWG	Walworth/Aloyco	4	150 ss	Rotork	250 (HP)						
16	FWG	Anchor Darling	3	900 cs	00	1800 (N)						
17	FWG	Pacific	10	150 cs	000	250 (HP)						
18	FWG	Pacific	4	150 cs	Rotork	250 (HP)						
21	FWG	Rockwell	2-1/2	900 cs	000-5	1800 (N)						
23	FWG	Velan	6	150 cs	000	250 (HP)	(HP) 250					
24	FWG	Velan	6	900 cs	0	1800 (N)	(N) 1800	(N) 1200	(N) 1200	(S) 1200	(S) 1200	
25	FWG	Velan	10	300 cs	0	500 (HI)						
26	FWG	Velan	10	900 cs	2	1800 (HI)					(S) :200	
29	FWG	Walworth	6	150 cs	Rotork	250 (HP)						
30	FWG	Walworth	6	900 cs	0	1800 (N)			(N) 1200			
31	FWG	Walworth	12	150 cs	Rotork	250 (HI)						
34	FWG	Westinghouse	3	1500 ss	00	2500/750 (N)						G
41	PDG	Anchor/Darling	6	900 cs	0	1800 (N)			(N) 1200		(S) 1200	
43	SWG	Edwards	10	900 cs	2	1800 (HI)					(S) 1200	
44	Globe	Borg - Warner	6	900 cs	2	1800 (N)	(N) 1800					
48	Globe	Rockwell/Edwards	2	1500 ss	00	2500 (N)	(N) 2500		(N) 2500			
49	Globe	Velan	2-1/2	1500 ss	00	2500 (N)						
50	Globe	Anchor Darling	10	300 cs	2	500 (HI)						D
54	BFly	Pratt 1400 Sym	6	150 cs	000 HOBC	150 (HP)						
55	BFly	Pratt 1200 Single O/S	6	150 cs	000 HOBC	150 (HP)						D
XX	FWG	Powell	14	600 cs		500 (HI)						

HP - Wyle Huntsville Pumped Flow Loop Test Facility

HI - Wyle Huntsville Intermediate Pressure Test Facility

N - Wyle Norco High Pressure Test Facility

S - Siemens KWU High Pressure Test Facility

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SCOPE

TEST CONFIGURATIONS

- Pump flow - simulates opening or closing against the head of an upstream centrifugal pump with some specified downstream resistance
  - — Accomplished in each facility by holding test valve upstream pressure nearly constant and providing a throttle in series to limit flow
- Blowdown - valve is opened or closed against a storage vessel of hot water or stream whose pressure remain essentially constant and whose piping has low flow resistance

DATA CHANNELS

Stem thrust

Stem torque

Stem position

Valve upstream pressure

Valve downstream pressure

Valve differential pressure

Valve bonnet pressure

Valve under disc pressure

Valve downstream total pressure

Flow rate

Spring pack displacement

Spring pack force

Switch timing (5)

Motor speed

Motor voltage (3 phases)

Motor current (3 phases)

Motor power

Motor power factor

Valve temperature

Fluid temperature

59 FR [illegible] RAS 1-21-04

GATE VALVE PRECONDITIONING APPROACH/PHILOSOPHY

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- Preconditioning of Flow Loop Gate Valves
  - Objective
    - Precondition (age) test valves prior to test to eliminate stroke effect (reach "plateau" level)
    - Flow loop parametrics would be unaffected by stroke effect
    - Determine relationship between contact stress and number of strokes required to reach plateau
  - Approach
    - Short stroke (~ 10%) open/close MOV in test loop with DP and very low cold water flow until apparent μ reaches "plateau" level
    - DP to be based on max test DP or DP resulting in a contact stress of 20 ksi on seats, whichever is less

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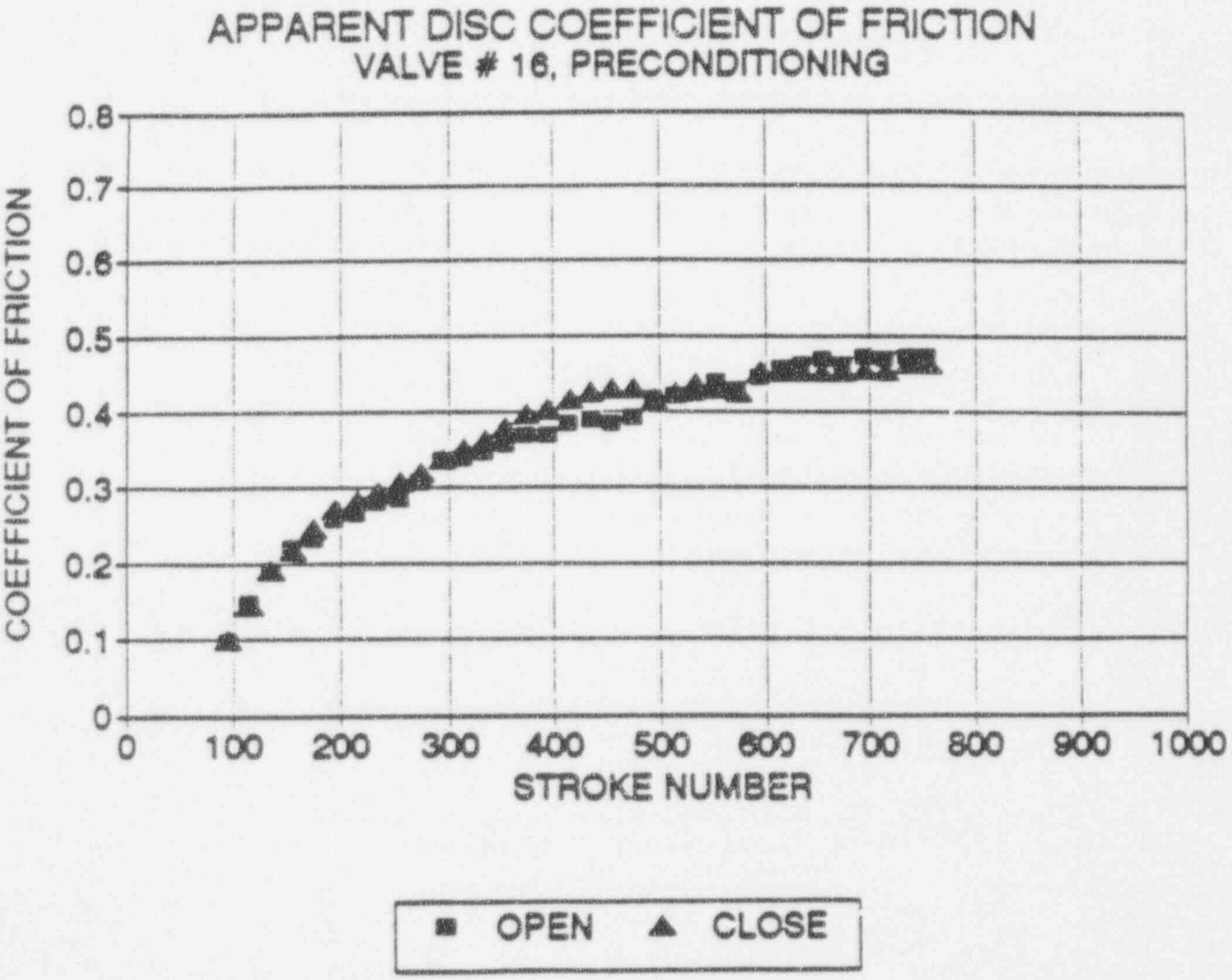

APPARENT DISC COEFFICIENT OF FRICTION
VALVE # 16, PRECONDITIONING

PRELIMINARY

DATA ANALYSIS TECHNIQUES

- Data sheets are completed on each test stroke to document the values of key parameters at specific "events" in the stroke.

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EPRI Gate Valve Test Analysis Data Sheet

Valve # 1 Test Date 10-2-92 Test Time 12:22:13

Test # 01-1-000-713-11 Stroke Direction O -> C

Test Description 15 FPS 100% ΔP

Valve Mean Seat Diameter 3.25 in.

Data File E2014 Data Set 17

Motor Current Start Time* 2.649

Motor Current Stop Time* 19.493

Contactor Dropout Time* 0.013

Packing Load at Running 441.0 lb.

Venturi/Supply Temp. 82.8 °F

Test Valve Inlet Temp. 83.6 °F

Analyzed by:

Verified by: 1/29

SS BYPASS: 18.203 sec

MC1 & MS1 SHOW MOTOR LOAD IN JUST PRIOR TO TORQUE SWITCH T.

Closed to Open	Time (sec)	Thrust (lb.)	Torque (ft-lb)	SPDISP (in.)	Mean Upstream Press (psig)	Mean DP PSID	App Disk µ	App Stem µ
A. At cracking*					----	----	----	
B. Just after cracking								
C. Max after cracking								
D. Running (No DP)							----	----
E. Limit SW Trip		----	----	----	----	----	----	----
F. At Flow Initiation								

Open to Closed	Time (sec)	Thrust (lb.)	Torque (ft-lb)	SPDISP (in.)	Mean Upstream Press (psig)	Mean DP PSID	App Disk µ	App Stem µ
A. Running (No DP)	4.320	-983.7	7.65	0.0029	781.5	0.75	----	----
B. Max prior to initial wedging	19.156	-3877.4	32.92	0.0693	795.5	772.1	.4316	.1280
C. At initial wedging	19.243	-3839.8	32.48	0.0693	795.8	772.4	.4262	.1271
D. TS Trip*	19.478	-8023.6	68.66	0.1738	----	----	----	.1301
E. Max after wedging	19.526	-8746.8	70.04	0.1854	----	----	----	.1132
F. Final	20.472	-8734.3	66.20	0.1851	----	----	----	.0999
G. At flow isolation	17.543	-3371.3	28.30	0.0521	790.0	766.2	.3583	.1251

MJS050

* Values to nearest .001 second, all other values to nearest .01 second.

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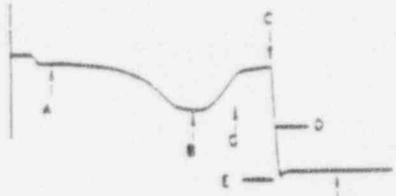

Typical
Closing
Thrust
Trace

N/A RAJ 1-11-94

$$T = T_A - P_A A_s + P_c A_s + \mu \Delta P_c A_o / (\cos \theta - \mu \sin \theta)$$

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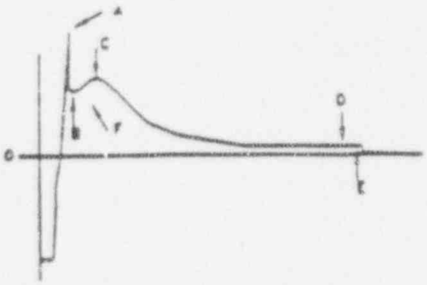
N/A
RAJ
1-11-94



Typical
Opening
Thrust
Trace

$$T = T_D + P_D A_s - P_B A_s + \mu \Delta P_B A_o / (\cos \theta + \mu \sin \theta)$$

Opening Stroke

T = Stem Thrust, lb.
P = Upstream pressure, psi
A_s = Stem area, in.^{2}
A_o = Disk mean seat area, in.^{2}

ΔP = Different pressure, psi
μ = Disk coefficient of friction
θ = Half disk angle

$$\text{Stem } \mu = (24FS \cos \sigma - d \cos \alpha \tan a)/(24FS \tan a + d)$$

FS = Torque/thrust, ft.
d = Stem OD - P/2, in.
p = Pitch, in.

α = Half thread angle
a = Thread lead angle
Stem μ = Stem coefficient of friction

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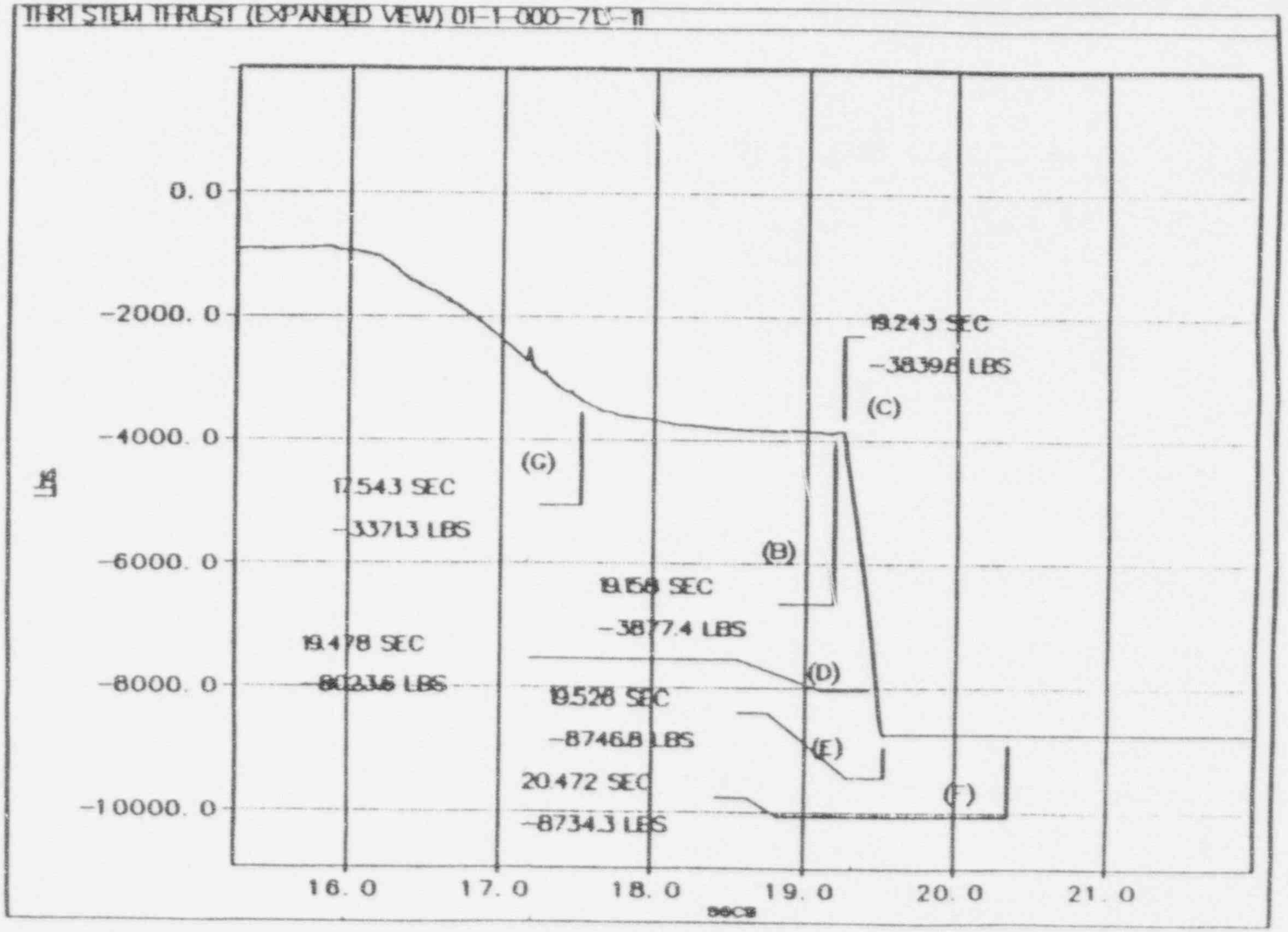

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Method Used to Determine Point of Flow Isolation

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1. Determine change in stem position from cracking peak to flow initiation from hydropump opening stroke
2. Determine stem position at initial wedging from a flow/DP stroke
3. Subtract change in stem position from (1) above to determine stem position and time of flow isolation

Evaluation of Globe Valve Apparent Valve Factor

$$F_R \text{ (lbs)} = F_{PACK} + F_P + f(A_{orifice})\ \Delta P$$

Where:

F_R = Maximum stem thrust measured at anytime during stroke

F_{PACK} = Packing friction load (lbs) - determined from avg of pre/post test static strokes

F_P = Piston Effect load (lbs) - above disk pressure X A stem (valve closed)

f = Valve factor (dimensionless)

$(A_{orifice})$ = Mean seat or guide area (evaluated for both assumptions)

ΔP = Pressure difference across the valve (psi) (valve closed)

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PRINCIPAL FINDINGS

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Butterfly Valves

- Comparison of measured torque to vendor torque predictions not generally possible due to unavailability of vendor methods
  - — No conclusion relative to adequacy of current methods possible at this time

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PRINCIPAL FINDINGS

Globe Valves

- Incompressible flow (non-flashing)
  - Use of mean seat area and a value factor of 1.0-1.1 found to match data for some valves but found to be significantly non-conservative for others

PRINCIPAL FINDINGS

Globe Valves (Con't)

- Accurate prediction of globe valve thrust requires use of appropriate area for DP application (disc mean seat or guide area). Determination of appropriate area for a specific valve design requires evaluation of valve physical design characteristics

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PRINCIPAL FINDINGS

Globe Valves (con't)

- Flashing or compressible flow
  - Data for single valve tested found to exceed even guide area based predictions
  - High thrust requirements attributed to plug side loading due to circumferential pressure variations within valve body

EPRI/NPD

PRINCIPAL FINDINGS

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Gate Valves

- Number of strokes to achieve a plateau in apparent disc coefficient of friction during cold water preconditioning varied from 100 to 900 (Initial μ values in 0.1 - 0.4 range)
- Maximum apparent disc μ's during cold water pumped flow testing (after preconditioning) were generally between 0.2 and 0.9, with the exception of one valve

  (Industry practice had been to assume a μ of 0.3)

PRINCIPAL FINDINGS

- Disc sliding μ tends to decrease with higher ΔP (higher seat bearing stress) -- supports use of linear extrapolation of reduced DP data -- particularly for non-blowdown applications
- Hot water (450°F, 15 FPS) testing after cold water preconditioning and testing, decreased apparent disc μ to the range of 0.32 to 0.49
- No damage or anomolous performance observed under 15 fps flow conditions except:
  - — The disc was pushed through seats allowing leakage above disc on an 18", 3° angle gate valve

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PRINCIPAL FINDINGS

- Hot water (530°F) blowdown apparent disc μ's ranged between 0.30 and 0.79 -- some valves sustained significant guide and/or seat damage
- Steam blowdown disc μ's ranged between 0.33 to 0.72 -- some valves sustained significant guide and/or seat damage
- No measurable effect on apparent disc μ (gate valves) due to upstream elbow orientation or stem orientation

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