PDR-016

U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) REQUEST

NRC FOIA REQUEST NUMBER(S): FOIA-88-165

RESPONSE TYPE: FINAL [ ] XX PARTIAL

DATE: JUN 13 1988

DOCKET NUMBER(S) (if applicable): 50/440 and 50/441

REQUESTER: Mr. Bruce Maxwell

PART I. – RECORDS RELEASED OR NOT LOCATED (See checked boxes)

	No agency records subject to the request have been located.
	No additional agency records subject to the request have been located.
X	Agency records subject to the request that are identified in Appendix C are already available for public inspection and copying in the NRC Public Document Room, 1717 H Street, N.W., Washington, DC.
X	Agency records subject to the request that are identified in Appendix D* are being made available for public inspection and copying in the NRC Public Document Room, 1717 H Street, N.W., Washington, DC, in a folder under this FOIA number and requester name.
	The nonproprietary version of the proposal(s) that you agreed to accept in a telephone conversation with a member of my staff is now being made available for public inspection and coving at the NRC Public Document Room, 1717 H Street, N.W., Washington, DC, in a folder under this FOIA number and requester name.
	Enclosed is information on how you may obtain access to and the charges for copying records placed in the NRC Public Document Room, 1717 H Street, N.W., Washington, DC.
	Agency records subject to the request are enclosed. Any applicable charge for copies of the records provided and payment procedures are noted in the comments section.
	Records subject to the request have been referred to another Federal agency(ies) for review and direct response to you.
	In view of NRC's response to this request, no further action is being taken on appeal letter dated ______

PART II.A – INFORMATION WITHHELD FROM PUBLIC DISCLOSURE

X	Certain information in the requested records is being withheld from public disclosure pursuant to the FOIA exemptions described in and for the reasons stated in Part II, sections B, C, and D. Any released portions of the documents for which only part of the record is being withheld are being made available for public inspection and copying in the NRC Public Document Room, 1717 H Street, N.W., Washington, DC, in a folder under this FOIA number and requester name.

Comments

*Copies of Appendix D records are being made available at the Local Public Document Room maintained in the Perry Public Library, 3753 Main Street, Perry, Ohio.

SIGNATURE, DIRECTOR, DIVISION OF RULES AND RECORDS

Donnie H. Grimsley

NRC FORM 464 (Part I)
(9-86)

FREEDOM OF INFORMATION ACT RESPONSE FOIA NUMBER(S) 88-165 DATE JUN 13 1988

PART II.B – APPLICABLE FOIA EXEMPTIONS

Records subject to the request that are described in the enclosed Appendices E are being withheld in their entirety or in part under FOIA Exemptions and for the reasons set forth below pursuant to 5 U.S.C. 552(b) and 10 CFR 9.5(a) of NRC Regulations.

	1. The withheld information is properly classified pursuant to Executive Order 12356 (EXEMPTION 1)
	2. The withheld information relates solely to the internal personnel rules and procedures of NRC. (EXEMPTION 2)
	3. The withheld information is specifically exempted from public disclosure by statute indicated: (EXEMPTION 3)
	Section 141-145 of the Atomic Energy Act which prohibits the disclosure of Restricted Data or Formerly Restricted Data (42 U.S.C. 2161-2165).
	Section 147 of the Atomic Energy Act which prohibits the disclosure of Unclassified Safeguards Information (42 U.S.C. 2167).
	4. The withheld information is a trade secret or commercial or financial information that is being withheld for the reason(s) indicated. (EXEMPTION 4)
	The information is considered to be confidential business (proprietary) information.
	The information is considered to be proprietary information pursuant to 10 CFR 2.790(d)(1).
	The information was submitted and received in confidence from a foreign source pursuant to 10 CFR 2.790(d)(2).
X	5. The withheld information consists of interagency or intraagency records that are not available through discovery during litigation. Disclosure of predecisional information would tend to inhibit the open and frank exchange of ideas essential to the deliberative process. Where records are withheld in their entirety, the facts are inextricably intertwined with the predecisional information. There also are no reasonably segregable factual portions because the release of the facts would permit an indirect inquiry into the predecisional process of the agency. (EXEMPTION 5)
	6. The withheld information is exempted from public disclosure because its disclosure would result in a clearly unwarranted invasion of personal privacy. (EXEMPTION 6)
	7. The withheld information consists of investigatory records compiled for law enforcement purposes and is being withheld for the reason(s) indicated. (EXEMPTION 7)
	Disclosure would interfere with an enforcement proceeding because it could reveal the scope, direction, and focus of enforcement efforts, and thus could possibly allow them to take action to shield potential wrongdoing or a violation of NRC requirements from investigators. (EXEMPTION 7(A))
	Disclosure would constitute an unwarranted invasion of personal privacy (EXEMPTION 7(C))
	The information consists of names of individuals and other information the disclosure of which would reveal identities of confidential sources. (EXEMPTION 7(D))

PART II.C – DENYING OFFICIALS

Pursuant to 10 CFR 9.9 and/or 9.15 of the U.S. Nuclear Regulatory Commission regulations, it has been determined that the information withheld is exempt from production or disclosure, and that its production or disclosure is contrary to the public interest. The persons responsible for the denial are those officials identified below as denying officials and the Director, Division of Rules and Records, Office of Administration, for any denials that may be appealed to the Executive Director for Operations (EDO).

DENYING OFFICIAL	TITLE/OFFICE	RECORDS DENIED	APPELLATE OFFICIAL	
			SECRETARY	EDO
Mr. Bert Davis	Regional Administrator Reg III	App. E		X

PART II.D – APPEAL RIGHTS

The denial by each denying official identified in Part II.C may be appealed to the Appellate Official identified in that section. Any such appeal must be in writing and must be made within 30 days of receipt of this response. Appeals must be addressed as appropriate to the Executive Director for Operations or to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and should clearly state on the envelope and in the letter that it is an "Appeal from an Initial FOIA Decision."

Appendix C
Records Available in the PDR

FOIA 88-165

	Date	Description
1.	11/09/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8805130239
2.	11/12/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8711240094
3.	11/13/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8711200278
4.	11/23/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8712040317
5.	11/25/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8712030169
6.	11/30/87	Confirmatory Action Letter ACCESSION NO. 8712070041
7.	11/30/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8712070358
8.	12/04/87	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8712110227
9.	12/08/87	Ltr NRC to Cleveland Electric Illuminating Company ACCESSION NO. 8712140480
10.	01/22/88	Inspection Report No. 50-440/87024(DRS) ACCESSION NO. 8802030312
11.	02/10/88	Inspection Report No. 50-440/87027(DRS) ACCESSION NO. 8802160330
12.	02/12/88	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8802180163
13.	02/19/88	Inspection Report No. 50-440/87027(DRS) ACCESSION NO. 8802160330
14.	03/18/88	Ltr Cleveland Electric Illuminating Company to NRC ACCESSION NO. 8803220099
15.	11/13/87	Ltr NRC to Cleveland Electric Illuminating Company ACCESSION NO. 8711190227

Appendix D FOIA 88-165

Records Being Placed at the PDR & LPDR

	Date	Description
1.	Various dates	Various work orders, logs and reports (328 pages)
2.	10/29/87	Report Evaluation Form/RIII Tracking System (1 page)
3.	10/29/87	Condition Report (5 pages)
4.	10/29/87	Event Notification Worksheet (2 pages)
5.	10/30/87	Daily Report Region III (1 page)
6.	10/30/87	Reportable Event Number 10515 (1 page)
7.	Undated	Handwritten Partial Sequence of Events (2 pages)
8.	11/87	Perry Power Plant Photos of MSIV Inspection Due to Slow Valve Closure (44 pages)
9.	11/87	Sequence of Events and Operator Actions (2 pages)
10.	11/02/87	Daily Report Region III (1 page)
11.	11/02/87	Daily Report Region III (1 page)
12.	11/03/87	Preliminary Notification re: Shutdown Because of Excessive MSIV Closure Times (1 page)
13.	11/03/87	Event Notification Worksheet (2 pages)
14.	Various dates	Slow Strokes/MSIVs w/various documents from Cleveland Electric (54 pages)
15.	11/04/87	Confirmatory Action Letter A. B. Davis to M. R. Edelman (1 page)
16.	11/05/87	Quarantine List of Main Steam Isolation Valves (1 page)
17.	11/05/87	Memo J. P. Eppich to K. R. Pech re: Relationship of MSIV Air Pack Vendors w/attachment (2 pages)
18.	11/05/87	Sequence of Troubleshooting Plant (6 pages)
19.	11/05/87	Memo E. G. Greenman to R. D. Lanksbury re: AIT Charter w/AIT Charter (3 pages)
20.	11/05/87	Perry Nuclear Power Plant Work Orders (16 pages)

	Date	Description
21.	11/05/87	MSIV Forced Shutdown Recovery Plan (1 page)
22.	11/05/87	Draft evaluations and actions (7 pages)
23.	11/5-6/87	Plan of the Day (15 pages)
24.	11/06/87	AIT Action Items (3 pages)
25.	11/06/87	Perry Nuclear Power Plant Work Orders (114 pages)
26.	11/06/87	Nuclear Quality Assurance Dept Inspection Rpt (2 pages)
27.	11/06/87	Nuclear Quality Assurance Dept Inspection Rpt (6 pages)
28.	11/06/87	Nuclear Quality Assurance Dept Inspection Rpt (3 pages)
29.	11/06/87	Nuclear Quality Assurance Dept Inspection Rpt (2 pages)
30.	11/06/87	Memo F. A. Kearney to M. W. Gmyrek re: Training Procedures Relative to Failure of MSIV Closing Events w/attachments (12 pages)
31.	Undated	Analysis of loading on steamlines w/attachments a. 11/6/87 ltr T. R. McIntyre to J. Eppich re: effects of isolation of 3 main steam lines b. 11/6/87 memo J. E. Meyer to J. P. Eppich re: main steam line design (4 pages)
32.	Undated	Perry Nuclear Power Plant Evaluations of Single MSIV Slow Closure w/attachments a. 11/6/87 ltr D. D. Jones to G. Rhoades re: estimate of mass flows for break outside of containment b. 11/6/87 ltr M. M. Waselus/J. Ioannidi to K. R. Pech evaluation boundary dose with a single MSIV closure at 18 seconds w/calculations c. 11/4/87 memo L. S. Burns to T. R. McIntyre re: effect of isolation delay or failure in one steamline d. 11/4/87 memo T. R. McIntyre to J. P. Eppich re: MSIV closure testing (20 pages)
33.	11/07/87	Perry Nuclear Power Plant Work Orders (13 pages)
34.	11/07/87	Nuclear Quality Assurance Dept Inspection Rpt (2 pages)

	Date	Description
35.	11/07/87	Step Description (12 pages)
36.	11/07/87	Sequence of Troubleshooting Plan (15 pages)
37.	11/08/87	Preliminary Results Summary: Instrument Air at MSIVs (4 pages)
38.	11/08/87	Nuclear Quality Assurance Dept Inspection Rpt (2 pages)
39.	11/08/87	Nuclear Quality Assurance Dept Inspection Rpt (2 pages)
40.	11/08/87	Nuclear Quality Assurance Dept Inspection Rpt (3 pages)
41.	11/08/87	Draft Root Cause Analysis Executive Summary (61 pages)
42.	11/09/87	Perry Nuclear Power Plant Work Order (30 pages)
43.	11/09/87	Memo K. Matheny to V. Concel re: MSIV ASCO Solenoid Valves (1 page)
44.	11/09/87	Memo J. P. Eppich to G. G. Rhoads re: MSIV Closure/ Scram Test w/attachments a. 11/6/87 ltr T. R. McIntyre to J. Eppich b. 11/6/87 memo J. E. Meyer to J. P. Eppich re: Main Steam Line Design (4 pages)
45.	11/09/87	AIT Action Items (3 pages)
46.	11/09/87	Memo K. Matheny to W. Kanda re: MSIV Temperature Monitoring w/handwritten notes and sketches (6 pages)
47.	11/09/87	Ltr M. R. Edelman to A. B. Davis w/Executive Summary (6 pages)
48.	11/09/87	Root Cause Analysis Executive Summary (69 pages)
49.	11/10/87	Memo E. G. Greenman to H. G. Miller re: Transfer of Lead Responsibilities - Main Steam Isolation Valves (MSIV) at Perry (1 page)
50.	11/11/87	Draft evaluation and actions w/fax request (9 pages)
51.	11/12/87	Draft evaluation and actions w/fax request (9 pages)
52.	11/12/87	Draft evaluation and actions w/fax request (5 pages)
53.	11/13/87	Ltr M. R. Edelman to A. B. Davis w/enclosures (10 pages)

	Date	Description
54.	11/23/87	Perry Nuclear Power Plant, Task 3 Solenoid Valve Environmental (Thermal Endurance) Test Plan (26 pages)
55.	12/02/87	Report on Particles - Instrument Air at MSIVs (4 pages)
56.	12/30/87	Ltr A. Kaplan to A. B. Davis w/Final Report MSIV 3-Way Dual Solenoid Valve Failures (82 pages)
57.	Undated	ISEG Review of R61 & C91 for MSIV Failure (78 pages)
58.	Undated	Figure M47-1 Steam Tunnel Cooling System (1 page)
59.	Undated	Class 1E Solenoid Valves (1 page)
60.	Undated	Handwri.ten note (1 page)
61.	Undated	ASCO Installation and Maintenance Instructions General Purpose and Explosion-Proof Solenoids (5 pages)
62.	Undated	ACCO Installation and Maintenance Instructions 3-Way Nuclear Power Plant Solenoid-Operated Pilot Valves (6 pages)
63.	Undated	Description of valves (2 pages)
64.	Undated	Handwritten Sequence of Events (33 pages)
65.	Undated	STI package for test on 10/24/87 (21 pages)
66.	Undated	Reportability Review (1 page)
67.	Undated	History (1 page)
68.	Undated	Schematic Control Diagram (1 page)
69.	Undated	Valve drawings (2 pages)
70.	Undated	Work order description and summary (3 pages)
71.	Undated	Handwritten outline (5 pages)
72.	Undated	System design (1 page)
73.	Undated	ASCO 1E printouts w/drawing and bill of material (13 pages)
74.	Undated	Various drawings (46 pages)

	Date	Description
75.	02/17/88	Memo C. E. Rossi to H. J. Miller re: Transfer of Operating Event Long-Term Followup w/enclosures EFR 87-172, EFR 88-02 and TAC 67092 (14 pages)
76.	03/09/88	Memo E. G. Greenman to A. B. Davis re: Topic for Senior Management Meeting (3 pages)
77.	10/30/87	Morning Report - Region II (2 pages)
78.	10/30/87	Daily Report - Region III (1 page)
79.	10/30/87	Reportable Event Number 10515 (1 page)
80.	11/2/87	Daily Report - Region III (1 page)
81.	11/3/87	Reportable Event Number 10560 (1 page)
82.	11/3/87	Preliminary Notification of Event or Unusual Occurrence PNO-III-87-138 (1 page)
83.	11/4/87	Letter to Murray Edelman from A. Bert Davis (2 pages)
84.	11/5/87	Memorandum for R.D. Lanksbury from Edward Greenman, Subject: AIT CHARTER (3 pages)
85.	11/6/87	AIT ACTION ITEMS (3 pages)
86.	11/9/87	Letter to A. Bert Davis from Murray Edelman (6 pages)
87.	11/10/87	Memorandum for Hubert Miller from Edward Greenman, Subject: Transfer of Lead Responsibilities - Main Steam Isolation Valves (MSIV) at Perry (1 page)
88.	11/10/87	Notice of Significant Licensee Meeting (1 page)
89.	11/13/87	Letter to A. Bert Davis from Murray Edelman (10 pages)
90.	11/30/87	Event Followup Report 87-172 (2 pages)

Appendix E

FOIA 88-165

To be withheld entirely

	Date	Description	Exemption
1.	Undated	"Pre-Decisional Talking Paper"(3 pages)	5

WTOL-TV
TOLEDO 11

730 N. Summit Street
P.O. Box 715
Toledo, Ohio 43695-0715
Telephone (419) 248-1111

Cosmos Broadcasting Corporation
A CBS Affiliate

FREEDOM OF INFORMATION
ACT REQUEST
FOIA-88-165
Rec'd 3-11-88

March 7, 1988

Freedom of Information Officer
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

FREEDOM OF INFORMATION REQUEST

Dear Sir or Madam:

This is a request for information under the provisions of the Freedom of Information Act as amended (5 U.S.C. 552).

I request a complete and thorough search of all filing systems for all records or documents maintained by your agency pertaining to an incident that occurred at the Perry nuclear power plant in Ohio.

The incident involved problems with closure of main steam isolation valves. The test that found the problem started on Oct. 29, 1987, and the plant was shut down on Nov. 3, 1987, because of the valve problem.

I am seeking copies of any and all documents related to this incident. These documents include, but are not limited to, utility reports on the incident and its causes; daily operating reports for the plant for the days in question; correspondence between the utlity and the NRC about the incident; any internal NRC reports or documents about the incident, including minutes of any internal NRC meetings at which the incident was discussed; and any reports by outside consultants about the incident.

I am making this request in my capacity as a news reporter for WTOL-TV. I hope to use the requested information for a news story.

If all or any part of this request is denied, please cite the specific exemption(s) which you think justifies your refusal to release the information and inform me of your agency's administrative appeal procedures available to me under the law.

If there are any fees for searching for, or copying, the records I have requested, please supply the records without informing me if the fees do not exceed $50.00.

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As you know, the Act permits you to reduce or waive the fees "if disclosure of the information is in the public interest because it is likely to contribute significantly to public understanding of the operations or activities of the government and is not primarily in the commercial interest of the requester." I believe that my request fits this category, and I therefore ask that you waive any fees.

I would appreciate your handling this request as quickly as possible, and I look forward to hearing from you within 10 working days, as the law requires.

Sincerely,

Bruce Maxwell
Reporter

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-III-87-138 Date November 3, 1987

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This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region III staff on this date.

Facility: Cleveland Electric Illuminating Company
Perry
Perry, OH 44081

Docket No. 50-440

Licensee Emergency Classification:
____ Notification of an Unusual Event
____ Alert
____ Site Area Emergency
____ General Emergency
X Not Applicable

Subject: SHUTDOWN BECAUSE OF EXCESSIVE MSIV CLOSURE TIMES

At 1:38 p.m. (EST) on November 3, 1987, the licensee initiated an orderly reactor shutdown from 83 percent power after two Main Steam Isolation Valves (MISVs) failed to close during testing within the required Technical Specification limits. The remaining six MSIVs closed within the 3 to 5 second requirement. There are two valves in sequences on each of the four Main Steam Lines, one valve inside the reactor containment and one valve outside the containment. The valves that did not meet the closure time were both on the "D" steam line -- the inboard valve closed in 18 seconds and the outboard valve had not closed within the two minutes after the control switch was in the close position. The tests were observed by the Resident Inspectors.

Subsequent tests of the two valves resulted in closure times within the Technical Specification limit.

During testing on October 29, three valves did not meet the closure limit -- the two valves on the "D" line and the outboard valve on the "B" line. Subsequent cycling of the valves provided acceptable time responses.

An Augmented Inspection Team (AIT) is being dispatched to the plant site to review the circumstances and possible causes of the MSIV closure problems. The team will consist of the resident inspectors and personnel from Region III (Chicago) and the Office of Nuclear Reactor Regulation. A Region III Supervisor will head the team.

Region III will issue a Confirmatory Action Letter to the licensee documenting the licensee's agreement not to resume operation of the plant without concurrence of the Regional Administrator.

The State of Ohio will be notified.

Region III was informed of the test results and shutdown at 1:15 p.m. (EST) by the licensee. This information is current as of 2:30 p.m. (EST).

CONTACT: R. Knop (FTS 388-5547) M. Ring (FTS 388-5602)

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN ILLINOIS 60137

NOV 4 1987

Docket No. 50-440
Docket No. 50-441

The Cleveland Electric Illuminating
Company
ATTN: Mr. Murray R. Edelman
Vice President
Nuclear Group
Post Office Box 5000
Cleveland, OH 44101

Gentlemen:

This letter confirms the telephone conversation on November 3, 1987, between Mr. Greenman and others of this office and Mr. A. Kaplan of your staff regarding the Main Steam Isolation Valve (MSIV) failures occurring at the Perry Nuclear Power Plant Unit 1 on November 3, 1987. With regard to the matters discussed, we understand that you will:

1. Take those actions necessary to ensure that complete documentary evidence of the "as found" condition of equipment being inspected is maintained.

2. Provide a step by step troubleshooting program to establish the root cause of the MSIVs failure to meet acceptance criteria.

3. Not disturb any components that offer a potential for being the root cause including power sources, switches, solenoids, and the air system directly feeding the MISVs until that action is approved by the NRC AIT team leader.

4. Except as dictated by plant safety, advise the NRC AIT Leader prior to conducting any troubleshooting activities. Such notification should be provided soon enough to allow time for the team leader to assign an inspector to observe activities.

5. Submit to NRC Region III a formal report of your findings and conclusions within 30 days of receipt of this letter.

None of these actions should be construed to take precedence over actions which you feel necessary to ensure plant and personnel safety.

We also understand that Perry Nuclear Power Plant Unit 1 will not be made critical without the concurrence of the Region III Regional Administrator or his designee.

CONFIRMATORY ACTION LETTER

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The Cleveland Electric Illuminating Company

2 NOV 4 1987

Please let me know immediately if your understanding differs from that set out above.

Sincerely,

A. Bert Davis
Regional Administrator

cc: F. R. Stead, Manager, Perry Plant Technical Department
M. D. Lyster, Manager, Perry Plant Operations Department
Ms. E. M. Buzzelli, General Supervising Engineer, Licensing and Compliance Section
DCD/DCB (RIDS)
Licensing Fee Management Branch
Resident Inspector, RIII
Harold W. Kohn, Ohio EPA
Terry J. Lodge, Esq.
James W. Harris, State of Ohio
Robert M. Quillin, Ohio Department of Health
State of Ohio, Public Utilities Commission
J. M. Taylor, DEDO
T. E. Murley, NRR
J. Lieberman, OE
R. Cooper, EDO
W. Lanning, NRR
F. Miraglia, NRR
G. Holahan, NRR
M. Virgilio, NRR
J. Partlow, NRR
K. Connaughton, SRI
J. Strasma, RIII

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

NOV 5 1987

MEMORANDUM FOR: R. D. Lanksbury, Team Leader, Perry Augmented Inspection Team (AIT)

FROM: Edward G. Greenman, Deputy Director, Division of Reactor Projects

SUBJECT: AIT CHARTER

Enclosed for your implementation is the Charter developed for the inspection of the events associated with the Perry MSIV failures which occurred on October 29 and November 3, 1987. This Charter was prepared in accordance with the NRC Incident Investigation Manual and the draft AIT implementing procedure issued for use on October 2, 1987. As stated, the objectives of the AIT are to communicate the facts surrounding this event to regional and headquarters management, to identify and communicate any generic safety concerns related to this event to regional and headquarters management, and to document the findings and conclusions of the onsite inspection. If you have any questions regarding these objectives or the enclosed Charter, please do not hesitate to contact either myself or R. Knop of my staff.

Edward G. Greenman

Edward G. Greenman, Deputy Director
Division of Reactor Projects

Enclosure: AIT Charter

cc w/enclosure:
A. B. Davis, RIII
C. J. Paperiello, RIII
F. Miraglia, NRR
J. Partlow, NRR
C. Rossi, NRR
G. Holahan, NRR
W. Lanning, NRR
M. Virgilio, NRR
R. Cooper, EDO
K. Connaughton, SRI

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Perry MSIV Stroke Time Failure

Augmented Inspection Team (AIT) Charter

Investigate:

1. Failure of MSIVs to close/close within Technical Specification limits.
2. Safety Significance, Root Cause(s).
3. Interaction of prior maintenance activities to the event.
4. Safety implications if actual Group 1 isolation signal had been present.
5. History of any previous problems.
6. Broader Implications e.g. other systems, other valve/components.
7. Event Reporting.
8. Conclusions.

Questions for Perry AIT

1. Failure of MSIVs to close/close within Technical Specification limits. (10/29/87 and 11/03/87)

   KC 1.1 What was the sequence of events?
   1.2 What were the closure times generated during the surveillance?
   1.3 What operator actions were taken during the event? Were they appropriate?

   1.4 Is there a history of any previous problems (e.g. 10/29 event, etc) with the MSIVs?
   ~~1.5 Did the RPS logic makeup per design during the surveillances?~~
   1.6 What additional testing was being performed?

2. Safety Significance, Root Cause(s).

   2.1 Was there any immediate safety significance from this event? If so, what was significant?
   2.2 What was the root cause of the event?

3. Interactions of maintenance activities to the event.

   SE 3.1 What is the past and present maintenance history of the MSIVs?
   3.2. What is the maintenance history of the Service Air (SA) and Instrument Air (IA).
   3.3 What testing was performed as the result of maintenance activities?
   AS 3.4 What is the material condition of the affected valves and inter-connected instrument air and control systems as it would affect the valve closure function?

4. Safety implications if actual Group I isolation signal had been present.

   KC 4.1 Does the licensee have procedures in place to handle this event?
   4.2 Are they adequate?
   4.3 Have the operators been trained on them?

JS 4.4 Does the accident analysis bound this event?

KC 4.5 What actions were taken by the operators? ✓

4.6 Was the event properly categorized? ✓

4.7 Was the event reported as required? ✓

JS 4.8 Analysis of loadings on steamlines with 3 closing + 1 open.

5. History of any previous problems. (etc.)

JS/HO 5.1 Have there been previous events similar to this? ✓

5.2. If there were previous events was the licensee aware of them? ✓

5.3 If not, why not? ✓

5.4 Is there information available on other similar events? ✓

5.5 Have there been any IEIN's or IEB's issued or similar subjects? ✓

5.6 Is there information avaiable from other sites of similar problems?

6. Broader Implications.

Group 6.1 Is a IEIN or IEB warranted or a result of this event? Yes

6.2 Are there other valves or instruments that require investigation? ✓ Yes

6.3 If the problem lies external to the MSIV's, are there generic implications? e.g. for other plant systems or other plants with same components. Yes

7. Conclusion.

EDL 7.1 What corrective actions are proposed, and are they adequate?

7.2 Examine generic implications to other plants and advise NRC management subsequent to the site inspection.

7.3 Document inspection findings in accordance with draft manual chapter 0325.

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PERRY NUCLEAR POWER PLANT

Murray R. Edelman
SR. VICE PRESIDENT
NUCLEAR

November 9, 1987
PY-CEI/OIE-0288 L

Mr. A. Bert Davis
Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Perry Nuclear Power Plant
Docket No. 50-440
Augmented Inspection Team (AIT)
Status and Commitments

Dear Mr. Davis:

This letter provides a preliminary description on the sequence of events, troubleshooting, and conclusions surrounding the MSIV slow closure problem. It also contains corrective actions and commitments made to the AIT on November 9, 1987. The formal report required by your Confirmatory Action letter dated November 4, 1987 will be submitted on or before December 4, 1987.

Based upon the information provided to date, we plan to restart the plant on November 10, 1987 with your concurrence. If you have any questions, please feel free to call.

Very truly yours,

Murray R. Edelman
Senior Vice President
Nuclear Group

MRE:njc

Attachment

cc: K. Connaughton
T. Colburn
Document Control Desk

D-47

I. Executive Summary

On October 29, 1987 the Perry Nuclear Power Plant was completing the final stages of the Startup Test Program. One of these tests involved fast closing one Main Steam Isolation Valve (MSIV). During this test, the valve (1B21-F028D) failed to stroke closed within the required time. All other MSIVs (7) were cycled in order to verify adequate stroke times. Two of the other MSIVs failed to satisfy the required stroke time.

The three valves that initially failed were stroked satisfactorily upon subsequent demand. Based on industry experience involving MSIV control air, the problem was attributed to a one time deposit of debris in the respective solenoids which was exhausted as shown by the subsequent successful stroke. The debris was believed to have caused a delay in the solenoid responses. Based upon the satisfactory stroke, the valves were considered operable and startup testing resumed. Plant management decided to perform the MSIV stroke tests again prior to the last startup test, the full MSIV isolation scram. This approach was discussed with NRC Region III.

On November 3, in preparation for the final startup test, additional stroke timing tests of MSIVs were performed. During the first stroke attempt, two of the same MSIVs (1B21F022D, 1B21F028D) that previously stroked slowly, again failed to close within the required time. The valves were subsequently recycled satisfactorily within minutes of their first tests. However, because the valves again failed to meet the required closure time on the first attempt, the basis for an isolated failure was no longer considered valid. NRC Region III was informed of the problem. The decision was made to shutdown the plant and troubleshoot the problem.

On November 4, an NRC Augmented Inspection Team (AIT) arrived onsite. A troubleshooting plan was established and implemented. The air actuators of the three valves which had exhibited slow closing times were disassembled and the inspection results documented. The conclusion drawn is that the dual solenoids exhibited sluggish action after operating in localized high temperature conditions. It is felt that steam leaks caused a raised temperature environment in the vicinity of the solenoids. The raised temperatures degraded the Ethylere Propylene Diene Monomer (EPDM) material causing the solenoid to stick or to -- sluggish. Corrective actions included disassembling all 8 MSIV's dual solenoids, and replacing or rebuilding the solenoids as applicable.

II. Chronology of Events

On October 29, 1987 at 1837 Startup Test Instruction (STI)-B21-025A, "Main Steam Isolation Valve (MSIV) Functional Test" was being performed on 1B21-F022D, the steam line D inboard MSIV. This valve closed in 22.14 seconds. Technical Specification 3.4.7 requires the MSIVs to close in 2.5 to 5.0 seconds. At 2103 and 2106 the D inboard MSIV was cycled with closure times of 3.24 and 2.94 seconds, respectively. All other MSIVs were then cycled to verify closure times. The B outboard MSIV closed in 11.9 seconds and the D outboard MSIV closed in 77 seconds. Each was cycled again with satisfactory results. Since initial conditions causing MSIV slow closure could not be repeated, all MSIVs were declared operable and plant startup testing continued.

On November 3 at 1150, MSIV fast closure timing was commenced in preparation for the MSIV fast closure scram test in accordance with agreements made with the NRC on October 30. At 1157 the D inboard MSIV closed in 18 seconds and was cycled again at 1159 with a closure time of 3.0 seconds. At 1208 the D outboard MSIV failed to close. A second attempt was satisfactory at 1213 with a closure time of 3.4 seconds. The D inboard and outboard MSIVs were declared inoperable and placed in the closed position in accordance with the requirements of Technical Specification 3.6.4.a. Based on repeat failures a plant shutdown commenced at 1330. The reactor was manually scrammed at 1819.

On November 4, the Nuclear Regulatory Commission (NRC) issued a Confirmatory Action Letter (CAL) detailing various steps Perry management was to take and not to take in preparation for an NRC Augmented Inspection Team (AIT). The team arrived onsite November 4.

III. Troubleshooting Activities

Prior to performing any work in the field, a troubleshooting plan was written. Based on the symptoms shown on October 29 and November 3, it was felt that the component with the highest probability of causing the slow closures was the ASCO model number NP-8323A20E dual solenoid found on each MSIV air actuator. Numerous possibilities existed which could have somehow affected these solenoids. The troubleshooting plan was set up to determine what the root cause was and whether any secondary problems had an impact.

On November 5 "As Found" conditions were documented and a more detailed troubleshooting plan was developed to establish the root cause of the MSIV failures and corrective actions necessary to restore the valves to operable condition. The troubleshooting plan was agreed to by the NRC AIT. On November 5 through November 8 various troubleshooting activities were carried out.

The first MSIV investigated was the 1B21-F022D valve (inboard MSIV on "D" line). Solenoid voltages and solenoid air exhaust port samples were taken as the valve was cycled all results were satisfactory. Next the field wiring and air lines were disconnected from the air actuator or air pack. All connections and pipe openings were inspected and any discrepancies noted. The air pack was then removed from the valve actuator and taken to the I&C hotshop for disassembly.

The above steps were repeated for the 1B21-F028B outboard valve and then the 1B21-F028D outboard valve. Any discrepancy no matter how small was documented for further evaluation. Whenever possible pictures were taken of what was found. The major discrepancies appear to be the following:

1. All dual solenoids disassembled have impact marks on the star shaped disk subassembly and a deep depression (dimple) on the disc holder seal (EPDM), with the solenoids of the B21-F028D indicating the most degradation.

2. Many of the EPDM Body Assembly O-Rings were hard, flattened, and adhering to metal surfaces.

3. In the 1B21-F022D valve rust was found inside the solenoid valve body, and the B solenoid coil was badly corroded.

In addition to the component disassembly three types of air analyses were performed to determine what contribution, if any, instrument air quality may have had in the failure of the MSIV valves. Filter samples were collected to determine particulate matter present in the instrument air system at the solenoid and actuator supply points. Various unknown substances observed in or collected from internal component surfaces were analyzed using infrared spectrophotometry to deduce origin of materials found. Grab samples of the air supply were analyzed by gas chromatography for hydrocarbon content and quantification of organic contaminants if present in significant quantities.

The samples collected on filter paper for particulate were analyzed under a microscope. Very small quantities of particles greater than 40 micron were identified which indicates acceptable air system quality. Therefore, it is a very low probability that the particles had an adverse effect upon the solenoid valve operation. Analyses of the substances collected during disassembly identified the presence of thread sealant and silicone lubricant, both of which are normally used during assembly of solenoid valves and air lines. Air supply grab samples indicated no hydrocarbons present in the instrument air supply.

Based on all the information it appears that the EPDM material used in various parts of the solenoid was interfering with solenoid valve movement. Thus, the decision was made to disassemble the dual solenoids on all 8 MSIVs, and refurbish as necessary.

IV. Root Cause

The cause of the MSIV delayed closures has been isolated to a failure of the ASCO dual solenoid valves. This failure is attributed to EPDM elastomer degradation due to elevated temperatures in the vicinity of the air packs resulting from steam leaks. The observed hardened dimples on the disc holder assembly and core assembly hardened elastomer seals is consistent with high temperature conditions. Other evidence of localized steam effects include degradation of the solenoid valve O-rings and observed rust/moisture discoloration of the 1B21-F022D solenoid coil.

Localized high temperature conditions existed during the plant cycle due to steam leakage and elevated area temperature indications. Steam leakage is known to have occurred in MSIV 1B21-F022B packing and the MSIV leakage control system isolation valves. This leakage was in the direct vicinity of those MSIV's which exhibited slow closure. Steam in excess of 300 degrees F is suspected of leaking in the direct location of the subject MSIV air packs based upon the degredation of the EPDM.

V. Corrective Actions

The following evaluations and actions have been or will be completed prior to plant startup:

1. For the dual (fast closure) solenoid the total air pack will be replaced for the 1B21-F028D valve, and the whole dual solenoid will be replaced on the 1B21-F022D valve. No other solenoids showed significant degradation or required replacement. All of the other MSIV dual solenoids have been rebuilt.

2. For the single (slow closure) solenoid the solenoid will be replaced on the 1B21-F028D, since the whole air pack is being replaced. Based on the inspection results above, no other replacements were necessary.

3. A evaluation has been performed of other ASCO solenoid Class 1E harsh environment applications in the plant, including those which may have been subject to the steam leak environment which affected the MSIV solenoids. The review identified two normally deenergized solenoids which do not serve an active safety function. Work history review of all other applications has shown no solenoid failures.

4. An evaluation will be made of other equipment in the vicinity of the 1B21-F022D, 1B21-F028D, and 1B21-F028B valves, to assess any impact that the steam leaks may have had on these components.

5. Additional temporary temperature monitoring will be installed in the steam tunnel on the preselected sample points in the MSIV area including the dual and test solenoid bodies. This monitoring will be used to evaluate the actual temperature profile of the complete MSIV actuator assembly and the surrounding area. Following completion of the Startup Test Program, temporary temperature indication will also be installed in the drywell for monitoring of the inboard MSIVs.

The following additional evaluations and actions will be performed:

1. Further evaluation will be performed on the exsisting industry experience and efforts on ASCO solenoid valve failure investigations. This evaluation will include such areas as using different metal, and non-metal materials, and the effect of hydrocarbons. Possible design improvements, including an exhaust port screen will be evaluated. Based on these evaluations a determination will be made on future actions including replacement frequencies.

2. A sampling plan for the solenoid elastomer components will be established. Analyses of these components are expected to confirm that hydrocarbons did not contribute to the EPDM degradation. Dew point and particulate sampling of the instrument air system will continue at the existing test frequency.

   A preventive maintenance requirement will be established for periodic replacement of the instrument air system prefilters. The maintenance frequency will be consistent with replacement of the instrument air system after filters. Additionally a generic precaution will be added into air system work orders regarding the use of thread lubricants and sealants.

   An evaluation will also be made of the relative physical location of the air compressors reduction gear vents, and the compressor air intake, to determine the need for modification, and/or periodic replacement of the intake filter.

3. Until the first refueling outage the full closure dual solenoids will be checked for proper operation during the monthly slow closure check. This will be performed by fully closing each MSIV individually utilizing the test solenoid, followed by taking the control switch to close, thus verifying the proper operation of the dual solenoid. Also during this time frame the MSIVs will be cycled individually on a quarterly basis regardless of plant operating conditions, and the fast closure time verified. On an interval not to exceed six months an inspection will be performed on a dual solenoid during an outage of opportunity. This inspection will verify no degradation of the solenoid valve internals.

ROOT CAUSE ANALYSIS

EXECUTIVE SUMMARY

This document describes the evaluations performed to determine the cause of events on October 29 and November 3, 1987 when Perry Unit 1 Main Steam Isolation Valves (MSIVs) failed to fast close on command. The most probable root cause, based on data currently available, is failure of an Automatic Switch Company (ASCO) Model 8323 3-way dual solenoid valve. The primary suspected cause is hardening and dimpling of the EPDM rubber disc seat material and other EPDM seals, causing the disc holder assembly to wedge in place when the solenoid was de-energized. Several mechanisms have been proposed that could lead to EPDM degradation, the most probable of which is a local high temperature environment.

This document is organized into four sections. Section 1 describes the most probable root cause, and the basis for its selection as such. Section 2 gives an overview of how the root cause analysis team reached its conclusions. Section 3 describes potential component failure modes that could lead to MSIV failure to close, and finally, Section 4 describes specific failures within the ASCO Model 8323 valve that could lead to the observed conditions, and discusses environmental conditions that could lead to the failure.

11/09/87

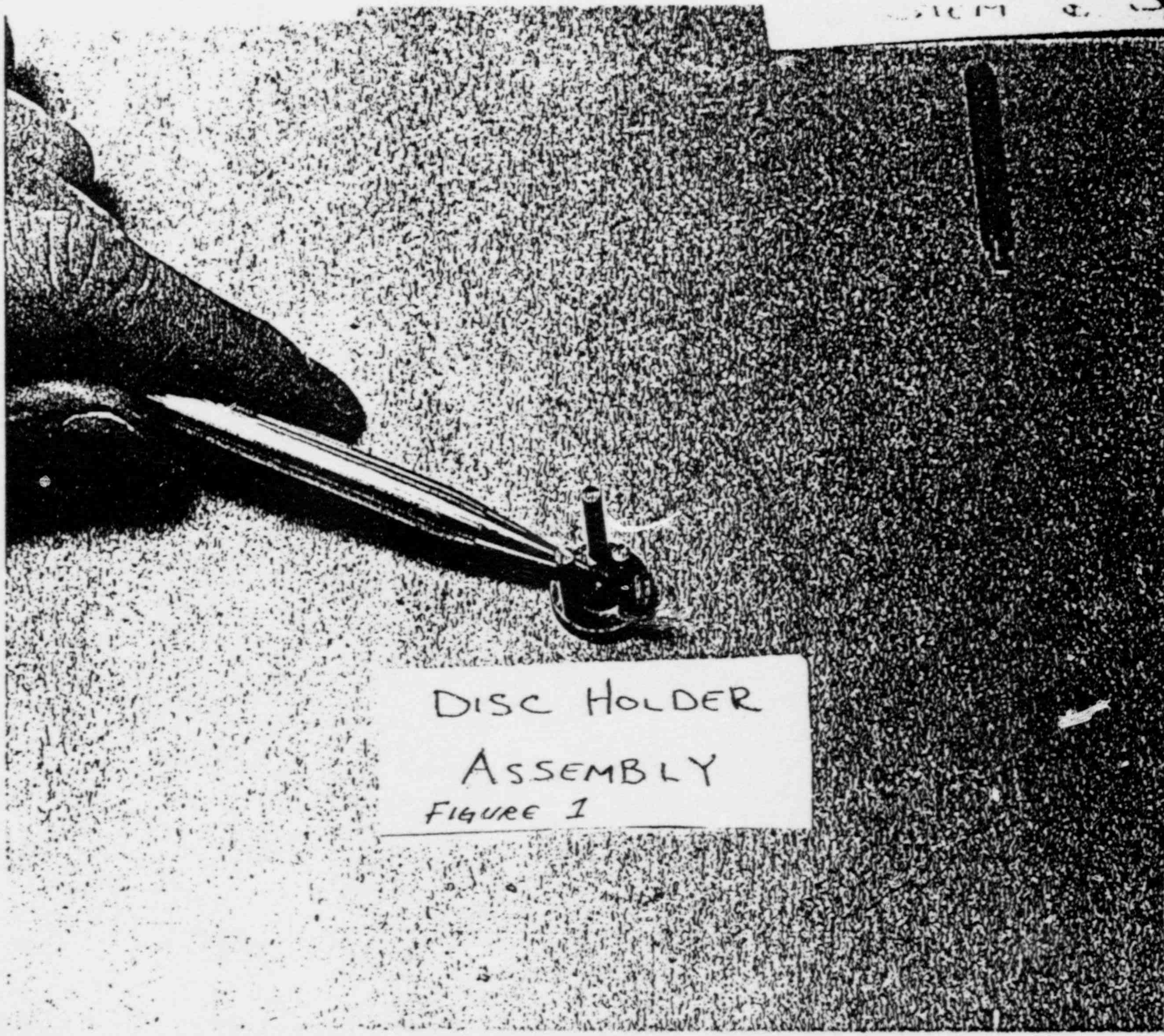
SECTION 1 MOST PROBABLE ROOT CAUSE

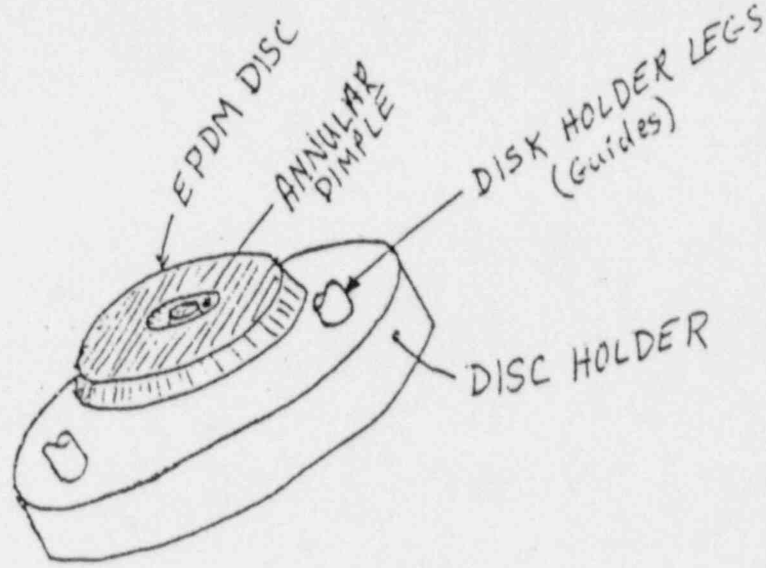
The most probable root cause of the observed MSIV failure to close is failure of the Automatic Signal Company (ASCO) Model 8323 3-way dual solenoid valve to shift from the energized to de-energized position. Within the component, the Ethylene Propylene Diene Monomer (EPDM) rubber disc seat material was found to be deformed. A "dimple" (see figure 1 and 2) was found in the EPDM seat material on the disc holder. This is also indicative of a general hardening and degradation of the rubber seals within the valve. If the disc holder sticks to the orifice the MSIV will not close. Delayed closure is consistent with de-energizing of the solenoid, followed by sticking of the disc holder to the orifice for some period of time, when the disc holder breaks loose and allows the air pressure to relieve through the orifice. Once the air pressure is relieved, the MSIV will close.

Failure of this component is the only failure that is consistent with the observed failure. No other single component failure will result in a delayed MSIV closure.

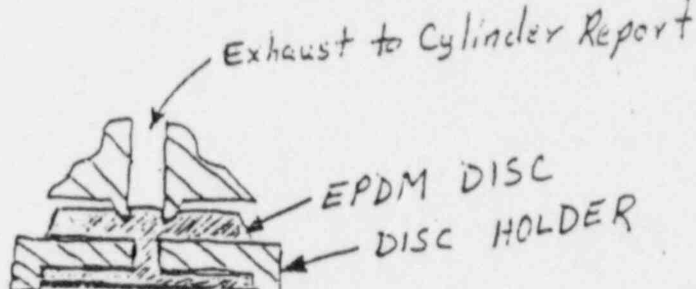
The EPDM degradation is most probably caused by exceeding the temperature limits of the EPDM material. EPDM was chosen for this application because of its radiation resistance from an equipment qualification standpoint. Perry has experienced bulk drywell and steam tunnel temperatures which have approached tech spec limits during much of the startup test program. Additionally, steam leaks have occurred in the vicinity of the affected MSIV solenoids. While no data exists to actually confirm that the local temperatures have exceeded the capability of the EPDM rubber, a good correlation exists between the location of steam leaks and the affected valves.

Several other mechanisms have been postulated for the EPDM degradation, and sufficient data does not currently exist to absolutely prove or disprove any hypothesis. It is true, however, that the temperatures near the valves have been close to the maximum allowable for EPDM material, and this is the most likely cause.


DISC HOLDER
ASSEMBLY
FIGURE 1



SKETCH SHOWING DISC HOLDER GENERAL APPEARANCE



SKETCH SHOWING CROSS-SECTION OF DISC IN ITS SEATED POSITION

Figure 2

SECTION 2 ANALYSIS TECHNIQUES AND OVERVIEW

Following the failure of the B21-F022"B" and "D" Main Steam Isolation Valves, a multi-discipline team was convened with the charter to determine the most likely cause of the problem. This activity would be useful prior to actuator disassembly and inspection. The team consisted of senior engineers from the CEI mechanical and electrical engineering and technical departments, as well as the architect engineer (Gilbert) and NSSS supplier (General Electric).

Problems analysis proceeded using standard Kepner-Tregoe (KT) Problem Analysis techniques. The initial thrust of the team was to determine which equipment failures would cause the failure of a MSIV to close in the delayed manner observed. An initial brainstorming session was held to determine potential component failure which might cause the observed behavior. These potential failures were then compared with known facts and design conditions, using "is/is-not" techniques to rate the postulated failures as to probability.

Twenty four (24) potential component failures were initially postulated. Of these, 19 were rated as unlikely, one (1) as potential, and four (4) as probable causes. All five of the potential and highly likely candidates involved either the ASCO Model 8323 3-way Dual Solenoid Valve, or the air supply to these components. Specific work items and inspection steps were thus incorporated in other site action plans to address these components in detail.

Section 3 of this report documents each of the 24 postulated component failures. It is organized in order of highest to lowest probability. Each potential cause is described, discussed and conclusions drawn with regard to root component failure.

Following disassembly of the actuator air packs and diagnostic tests on the air supply system, it was determined that the most likely failure mode was, in fact, the ASCO Model 8323 3-way dual solenoid valve. The suspected cause was dimpling of the EPDM rubber disc seat material, causing the disc holder assembly to wedge in place when the solenoid was de-energized. The team was again convened, this time to evaluate the environmental and design conditions which could be responsible for the observed component failure.

Analysis techniques similar to those utilized in the component evaluation were used to screen the potential causes. Absolute determination of the root cause is difficult. However, the most likely condition leading to the failure was local high temperatures leading to EPDM degradation. Analysis results are given in Section 4, again describing each of the nine (9) postulated root cause conditions and discussion of the evidence to confirm or deny the postulated condition as root cause.

SECTION 3

COMPONENT FAILURE DESCRIPTIONS

Potential Cause

Failure of the Part #4 ASCO Model 8323 3-way Dual Solenoid Valve

Discussion

Failure of the ASCO Model 8323 3-way dual solenoid valve to shift from the energized to de-energized position could cause the delayed closure event experienced by Perry.

This failure mode has happened in the past due to various reasons as evidenced by IE Notices 85-17 and 86-57, (copies attached) and INPO SER 57-85.

Conclusion

This failure mode is the most likely candidate for root component failure of the problem. The post-disassembly inspection has found dimpling of the EPDM rubber disc seat material. This could cause the disc holder assembly to wedge in place when the solenoid is de-energized. This would in turn not allow air pressure to relieve through the #3 air port, and preclude MSIV closure.

SSINS No.: 6835
IN 85-17

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, DC 20555

March 1, 1985

IE INFORMATION NOTICE NO. 85-17: POSSIBLE STICKING OF ASCO SOLENOID VALVES

Addressees:

All nuclear power reactor facilities holding an operating license (OL) or construction permit (CP).

Purpose:

This notice is provided to inform recipients of a potential problem with ASCO solenoid valves that may prevent the main steam isolation valves (MSIVs) from closing on BWRs and may prevent other safety functions on BWRs or other types of plants. It is expected that recipients will review the information for applicability to their facilities and consider actions, if appropriate, to preclude a similar problem occurring at their facilities. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On February 10, 1985, at Grand Gulf Unit 1, one inboard and two outboard MSIVs failed to remain shut following manual closure. The problem is now attributed to failure of the ASCO solenoid valves used to provide fast closure of the MSIVs in the event of an accident.

At the time of the event, the plant was using a slow-closure procedure to close the MSIVs prior to a drywell entry following a reactor scram. The procedure calls for one set of solenoid valves to slowly close the MSIVs and another set of solenoid valves, which are the fast closure solenoid valves used in an accident, to hold the MSIVs closed. Evaluations and tests performed subsequent to the event have attributed the problem to the second set of solenoid valves (type HTX 8323-20V). Each of these solenoid valves contains two solenoids, one solenoid rated at 16 watts and the other solenoid rated at 6 watts.

Preliminary test results, to date, have reproduced spurious sticking of the solenoid actuator of the solenoid valve when the solenoids are subjected to temperatures of about 180°F. However, these tests have not been definitive.

Discussion:

Although the NRC is not aware of all applications of this type of dual solenoid valve in all types of plants, a list provided by General Electric of BWRs that are believed to use this valve for closing the MSIVs includes:

Brunswick 1 & 2
Clinton
Cooper
Duane Arnold
Fitzpatrick
Grand Gulf 1 & 2
Hatch 2
LaSalle 1 & 2
Shoreham

No specific action or written response is required by this information notice. If you need additional information about this matter, please contact the Regional Administrator of the appropriate NRC regional office or the technical contact listed below.

E. L. Jordan

Edward L. Jordan, Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contact: Eric W. Weiss, IE
(301) 492-9005

Attachment: List of Recently Issued IE Information Notices

LIST OF RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
85-16	Time/Current Trip Curve Discrepancy Of ITE/Siemens-Allis Molded Case Circuit Breaker	2/27/85	All power reactor facilities holding an OL or CP
85-15	Nonconforming Structural Steel For Safety-Related Use	2/22/85	All power reactor facilities holding an OL or CP
85-14	Failure Of A Heavy Control Rod (B4C) Drive Assembly To Insert On A Trip Signal	2/22/85	All power reactor facilities holding an OL or CP
85-13	Consequences Of Using Soluble Dams	2/21/85	All BWR and PWR facilities holding an OL or CP
85-12	Recent Fuel Handling Events	2/11/85	All power reactor facilities holding an OL or CP
85-11	Licensee Programs For Inspection Of Electrical Raceway And Cable Installation	2/11/85	All power reactor facilities holding a CP
85-10	Posttensioned Containment Tendon Anchor Head Failure	2/6/85	All power reactor facilities holding an OL or CP
85-09	Isolation Transfer Switches And Post-Fire Shutdown Capability	1/31/85	All power reactor facilities holding an OL or CP
85-08	Industry Experience On Certain Materials Used In Safety-Related Equipment	1/30/85	All power reactor facilities holding an OL or CP
85-07	Contaminated Radiography Source Shipments	1/29/85	All NRC licensees authorized to possess industrial radiography sources

OL = Operating License
CP = Construction Permit

SSINS No.: 6835
IN 85-17, Supplement 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

October 1, 1985

IE INFORMATION NOTICE NO. 85-17, SUPPLEMENT 1: POSSIBLE STICKING OF ASCO SOLENOID VALVES

Addressees:

All nuclear power reactor facilities holding an operating license (OL) or a construction permit (CP).

Purpose:

This notice is to inform recipients of the results of followup investigations regarding the reasons for sticking of Automatic Switch Company (ASCO) solenoid valves used to shut main steam isolation valves (MSIVs) under accident conditions. Recipients are expected to review the information for applicability to their facilities and consider actions, if appropriate, to preclude similar problems occurring at their facilities. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Information Notice No. 85-17, "Possible Sticking of ASCO Solenoid Valves," described the problem that occurred with ASCO Model HTX 832320V solenoid valves at Grand Gulf Unit 1.

General Electric (GE) and ASCO conducted tests to determine the cause and any further corrective actions. The following is a summary of the GE and ASCO tests and analyses:

> Two of the three solenoid valves which failed at the Grand Gulf Nuclear Station also sporadically failed to transfer during testing at elevated temperatures. These two valves were the only valves that failed during these tests. However, these failures were not predictable. Subsequently, five valves from Grand Gulf service were disassembled and inspected. This inspection identified a microscopic foreign substance on the lower core/plug nut interfaces on all five valves.
>
> Further evaluations of this microscopic substance were inconclusive because of the small foreign substance sample size. After cleaning and reassembly of these valves, tests were conducted on four of these five valves at elevated temperatures. These four valves functioned normally. ASCO felt certain that the valve failures resulted from high-temperature sticking of the lower core-to-plug nut faces resulting from a foreign substance or combination of substances collected at this interface.

A detailed dimensional analysis and comparison among the valves returned from Grand Gulf indicated that all parts were within allowable limits and differences were not enough to cause a failure to shift. Therefore, this examination tended to relieve concerns related to a generic design defect.

GE has attempted to locate additional foreign substance from other valves of the same type in use at Grand Gulf to determine how the foreign substance got in the valve, or where it originated. GE was able to scrape some small amounts of foreign substance from the lower core-to-plug nut interface. However, there was not enough residue to make a definitive identification of the nature of the foreign substance.

GE has recommended that the licensee replace the potentially contaminated MSIV solenoid valves and institute a periodic examination and cleaning of the MSIV solenoid valves. Grand Gulf has replaced the eight MSIV HTX832320V dual solenoid valves with fully environmentally qualified ASCO Model NP 8323A20E dual solenoid valves. The environmentally qualified valve Model NP 8323A20E was included in a control sample placed in the test ovens with the solenoid valves that stuck at Grand Gulf. The environmentally qualified model did not stick under the test conditions that cause sticking in the other solenoid valves.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate regional office or this office.

Edward L. Jordan, Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contact: Eric Weiss, IE
(301) 492-9005

Attachment: List of Recently Issued IE Information Notices

LIST OF RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
85-79	Inadequate Communications Between Maintenance, Operations, And Security Personnel	9/30/85	All power reactor facilities holding an OL or CP; research and nonpower reactor facilities; fuel fabrication and processing facilities
85-78	Event Notification	9/23/85	All power reactor facilities holding an OL or CP
85-77	Possible Loss Of Emergency Notification System Due To Loss Of AC Power	9/20/85	All power reactor facilities holding an OL or CP
85-76	Recent Water Hammer Events	9/19/85	All power reactor facilities holding an OL or CP
85-75	Improperly Installed Instrumentation, Inadequate Quality Control And Inadequate Post-modification Testing	8/30/85	All power reactor facilities holding an OL or CP
85-74	Station Battery Problems	8/29/85	All power reactor facilities holding an OL or CP
84-70 Sup. 1	Reliance On Water Level Instrumentation With A Common Reference Leg	8/26/85	All power reactor facilities holding an OL or CP
85-73	Emergency Diesel Generator Control Circuit Logic Design Error	8/23/85	All power reactor facilities holding an OL or CP
85-72	Uncontrolled Leakage Of Reactor Coolant Outside Containment	8/22/85	All power reactor facilities holding an OL or CP

OL = Operating License
CP = Construction Permit

SSINS No.: 6835
IN 86-57

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

July 11, 1986

IE INFORMATION NOTICE NO. 86-57: OPERATING PROBLEMS WITH SOLENOID OPERATED VALVES AT NUCLEAR POWER PLANTS

Addressees:

All nuclear power reactor facilities holding an operating license or a construction permit.

Purpose:

This notice is to advise recipients of a series of valve failures that have occurred recently at several nuclear power plants. It is expected that recipients will review the events discussed below for applicability to their facilities and consider actions, if appropriate, to preclude similar valve failures occurring at their facilities. However, suggestions contained in this notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The NRC has received reports from licensees of operating nuclear power plants involving failures of certain valves that are actuated by solenoid operated valves (SOVs) to operate properly. These failures have adversely affected the intended functions of the main steam isolation system, pressure relief and fluid control systems. Attachment 1 to this information notice describes the failure events and the corrective actions taken.

Discussion:

In most of the cases described in Attachment 1, the cause for triggering the event was attributed to a malfunctioning SOV that served as a pilot valve. This in turn resulted in the malfunction of the associated main valve. The failures of the SOVs can be traced to the following different causes: (1) potentially high-temperature ambient conditions are not being continuously monitored in areas where SOVs are installed and operating in an energized state, (2) hydrocarbon contaminants, probably because backup air systems (e.g., plant service or shop air systems) are being used periodically and are not designed to "oil-free" specifications as required for Class IE service, (3) chloride contaminants causing open circuits in coils of the SOVs, possibly as a result of questionable handling, packaging, and storage procedures, (4) an active replacement parts program associated with the elastomers and other short-lived subcomponents used in SOVs has not been adequately maintained, and (5) lubricants have been used excessively during maintenance. ASCO provides installation and maintenance sheets with all its valves and rebuild kits. For additional information ASCO should be contacted.

Because of the recurring SOV failures discussed above, NRC's evaluation of the problem is continuing. Depending on the results of the evaluation, specific actions may be requested.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate regional office or this office.

E. L. Jordan
Edward L. Jordan, Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contacts: Vincent D. Thomas, IE
(301)492-4755

George A. Schnebli, Region II
(404)331-4875

Attachments:
1. Examples of Solenoid-Operated Valve Failures at Operating Nuclear Power Plants
2. List of Recently Issued IE Information Notices

EXAMPLES OF SOLENOID-OPERATED VALVE FAILURES AT OPERATING NUCLEAR POWER PLANTS

Brunswick Station

1. Main Steam Isolation Valve (MSIV) Solenoid Failures

On September 27, 1985 at Brunswick Unit 2, during the performance of a periodic test to demonstrate operability of the MSIVs, three out of eight isolation valves failed to fast close as designed. The fast-close test was required before returning Unit 2 to full-power operation after the plant had been placed in cold shutdown on September 26, 1985. Two of the three affected valves were installed as inboard and outboard MSIVs in the same main steam line, which would be a significant safety problem in the event of a failure of that steam line.

The licensee's initial investigation isolated the cause for the MSIV failures to the dual SOVs that serve as pilot valves that supply operating air to the MSIV operators to open or close the MSIVs. The faulty SOVs were identified as Automatic Switch Company (ASCO) Model NPL8323A36E. A more detailed review of the problems determined that the causes for failure were attributed to valve disc-to-seat sticking of the SOV and portions of the elastomer disc material plugging the SOV exhaust port. These failures prevented closing the associated MSIV. Ethylene propylene (EP) was the elastomer substance used for seals and valve disc material in this model SOV.

The licensee's failure analysis of the SOVs included technical assessments of the problems from the valve manufacturer (ASCO), the supplier of the EP material (Minnesota Rubber), and Carolina Power and Light's (CP&L's) research center (Harris Energy and Environmental Center, Raleigh, North Carolina). The findings resulting from this joint effort indicated that the SOV failures could have been caused by a combination of hydrocarbon contamination of the air system and high ambient temperature conditions, causing degradation of the EP valve seating and seal material.

The ASCO Model NPL8323A36E SOVs were installed in Brunswick Unit 1 in June 1983 and in Unit 2 in August 1984 to meet the Environmental Qualification (EQ) Program requirements. The Unit 1 SOVs were subsequently replaced during the 1985 outage when modifications were being made to the MSIVs. The new SOVs (NP8323A36V) were identical to the old ones except the valves contained Viton seats and seal materials in lieu of EP. Additionally, the information provided from ASCO shows the following:

a. Ethylene propylene is resistant to higher levels of radiation (200 megarads) than Viton. However, EP absorbs hydrocarbons that can cause swelling and loss of mechanical properties. It is unsuitable in applications where the air system is not designed to "oil-free" specifications.

b. Viton has superior high-temperature performance when compared to EP and is impervious to hydrocarbons. Its major disadvantage is that it is less resistant to radiation than EP by a factor of ten. ASCO recommends Viton for applications that are not oil-free and where radiation levels do not exceed 20 megarads.

On the basis of a licensee review of the Brunswick Station maintenance history, which showed the performance of Viton to be satisfactory in ASCO valves, and the available literature and industry experience, the licensee replaced all Unit 2 dual solenoid valves with valves having Viton seats and seals. Because Viton has a 20-megarad limit, the licensee plans to replace these elastomers every 3.3 years to meet environmental qualification requirements for the MSIV application.

After replacing the faulty valves with valves having Viton disc and seal material, the licensee experienced several SOV failures resulting from open circuits of dc coils on Unit 2. (Brunswick Station employs ASCO NP8323A36V valves that use one ac coil and one dc coil in applications using the subject dual solenoid valve.)

On October 5, 1985, the dc coils of two MSIVs failed during the performance of post-maintenance testing of the MSIVs. Investigation into the failures indicated an open circuit in the dc coils. The coils were replaced and the valves subsequently retested satisfactorily.

On October 15, 1985, an unplanned closure of an MSIV occurred while Unit 2 was operating at 99 percent full power. Closure of the MSIV occurred when the ac solenoid coil portion of the MSIV associated SOV was de-energized in accordance with a periodic test procedure. It was not known then that there was an open circuit in the associated dc solenoid coil portion of the dual SOV. Consequently, when the ac coil was de-energized, closure of the MSIV resulted. The failed dc coil was replaced and then retested satisfactorily.

Investigation into the failures of the dc coil by the licensee determined that the failures appeared to be separation of the very fine coil wire at the junction point where it connects to the much larger field lead. This connection point is a soldered connection that is then taped and lacquered.

Further analysis of the coils (two failed dc coils plus five spares from storage) by the CP&L Research Center indicated the separation might be corrosion induced by chloride contaminants. To date, the licensee and ASCO are unable to determine the source of the chloride. However, followup investigation by the NRC revealed that ASCO had previously experienced similar dc coil open circuit anomalies after a surface shipment of SOVs overseas to Japan. At that time, ASCO believed that the salt water ambient conditions during shipping may have been the source of the chlorine-induced failures. ASCO recommends specific handling, packaging, and storage conditions for spare parts and valves at facilities.

The licensee initiated a temporary surveillance program to monitor operability of the solenoid coils on October 16, 1985. A modification was performed to install a voltage dropping resistor in the individual coil circuits so that they can be monitored directly from cabinets in the control room. This allows continuity of the coil circuitry to be verified by measuring a voltage drop across the resistor. According to the licensee, until the cause for failure can be determined, plans are to check the coil circuitry for continuity on a daily basis.

2. Scram Discharge Solenoid Valve Failure

In November 1985, Carolina Power and Light's Brunswick facility experienced problems with several scram discharge SOVs. The problems were identified during periodic surveillance testing to determine the single rod insertion times and resulted in several rods with slow insertion times. Initial troubleshooting isolated the problem to the SOVs in the scram discharge line for two of the control rods, which were subsequently replaced and tested satisfactorily.

The licensee disassembled the failed SOVs, which were manufactured by ASCO (Model HV-90-405-2A), for failure analysis. When the valves were disassembled, it was noted that copious amounts of silicone lubricant had been applied by the licensee to all gaskets, seals, and diaphragms internal to the valves during previous routine maintenance. The licensee believes that the excessive amount of lubricant may have blocked some of the valves' internal passages or caused sticking of the diaphragms, thereby contributing to the slow insertion times. The technical manual for the subject valves states that body passage gaskets should be lubricated with moderate amounts of Dow Corning's Valve Seal Silicone Lubricant or an equivalent high-grade silicone grease.

The licensee conducted successful scram tests on all other rods. A periodic retest of 10 percent of the control rods every 120 days as required by the Technical Specifications provides sufficient assurance that this problem does not exist in other SOVs. In addition, the licensee stated that maintenance procedures and practices would be reviewed and modified, as required, to prevent the application of excessive amounts of lubricant during repair or overhaul of components.

Haddam Neck Nuclear Power Plant

On September 10, 1985, the Haddam Neck Nuclear Power Plant was operating at 100 percent power when one of the six SOVs in the auxiliary feedwater system (AFW) failed to change state when de-energized. This failure was detected during the performance of a preventive maintenance procedure developed to periodically cycle each of the six SOVs to prevent a sticking problem similar to SOV failures previously experienced on November 2, 1984. In that earlier event, two feedwater bypass valves failed to open automatically and the cause was determined to be sticking SOVs. The faulty SOV was ASCO Model NP8320A-185E and the licensee has been unable to determine the cause of the malfunction. The licensee's plans are to periodically cycle the SOVs until they are either replaced with an upgraded model or the specific cause of the existing sticking problem is determined and corrected.

Millstone Nuclear Power Station, Unit 1

On December 24, 1985, while performing a control rod scram time test at Millstone Unit 1, three control rods failed to insert during the performance of single rod scram time testing. In all cases, the control rod was immediately inserted and electrically disabled.

Investigation into the failures revealed that in the first case the cause for failure of one sticking SOV was attributed to deterioration of the BUNA-N valve disc material within the valve. According to the licensee, this type of failure had been identified by General Electric in their Service Information Letter No. 128, Revision 1, dated March 2, 1984.

The licensee's investigation of the other two control rod drop failures failed to reveal the causes for failure other than a misalignment problem of one SOV's internals, which prevented proper movement. However, in each case, the SOVs were disassembled, overhauled, retested satisfactorily, and returned to service.

Grand Gulf Nuclear Station, Unit 1

Another failure of sticking SOVs occurred at Grand Gulf Unit 1 on February 10, 1985, and was the subject of IE Information Notice No. 85-17, entitled "Possible Sticking of ASCO Solenoid Valves."

Potential Cause

Instrument Air System Quality
(oils, moisture, particulates)

Discussion

This potential cause has been experienced at other plants. This is evidenced by IE Information Notices No. 86-57 and 85-17.

In the likelihood that poor instrument air quality, such as the presence of moisture, particulates, and/or oils, the possibility of failure related to several Main Steam Isolation Valve components would be highly likely. The main concerns would resolve around the Automatic Switch Company (ASCO) solenoid valves. Since the seal and discs internal to these valves are Ethylene propylene, any intrusion of oil into the instrument air system could cause degradation. Degradation of the seals and discs would, in this case, be caused by hydrocarbon contamination that would distort them and could result in malfunction of the valves. However, at Perry this is unlikely because of the "oil free air" compressors. Disassembly and inspection of the ASCO NP8323-20E dual solenoid valve from MSIV F022D did not reveal any hydrocarbon substance which could have been borne from the instrument air (as described below).

A visual inspection of the EPDM parts of the ASCO solenoid valves was conducted. This inspection indicated that the EPDM disc was hard and brittle versus a new EPDM disc which is pliable and resilient. In addition, the discs were handled with white cotton gloves, and no residual was left on the white cotton gloves. The surface of the disc also did not appear to be sticky or tacky while it was being handled with the gloves. This is important since any residual would be an indication of the EPDM breaking down due to hydrocarbon contamination.

The possible intrusion of water or moisture into the air system could cause residue to form on the ASCO valve internals and cause malfunction of the valves over a period of time. The moisture may collect during outage periods and form residue during plant operation when the ambient temperatures are higher. Dewpoint measurements were performed for the supply air to both the inboard and outboard MSIVs. Measured dewpoints were minus 55°F or lower indicating that intrusion of moisture into the air system is not a concern. Grab samples from the instrument air supply to containment were analyzed for hydrocarbons using gas chromatography. Neither sample analyzed revealed detectable condensable hydrocarbons greater than 0.1 ppm.

Twelve particulate air samples were also obtained. The results from all the samples have not been completed. The results that are available show a trend of very low total particle counts with relatively few particles above 40 microns. Results from past air analysis have shown numerous counts for particles below 40 micron with relatively few indications of particles greater than 40 micron.

The disassembly and inspection of the ASCO NP8323-20E dual solenoid valve revealed no traces of moisture or particulate contamination. There was no wear on either the EPDM or the metal components of the solenoid valve. This result, in addition to the very low number of total particles in the air system and the low dewpoint temperatures would indicate that the root cause is not associated with the instrument air quality.

The concerns addressed above also apply to the C.A. Norgren Shuttle Valves; however, the shuttle valves are much more tolerant to poor instrument air quality.

Conclusion

The air samples taken do not reflect a problem with hydrocarbon contamination. The presence of this type of interaction between the valve materials and hydrocarbon contamination would be seen as a swell of the material. This is not the case where the material has been found to be embrittled. The investigation as the cause of failure will be pursued with conversations to be held with Susquehanna, Brunswick and Riverbend. Possible causes of the failure could be related to elevated temperature of the valves due to steam leaks in the vicinity. There will be further investigation to determine the root cause of the failure which could involve destructive testing of the components. The air sample counting will be completed and particles greater than 40 micron will be quantified. Our past experience with higher distribution of total particles indicates that the failure of the component was not attributed to the particle size or quantity since our total results had been low. ASCO has determined that particles less than 50 micron are acceptable for reliable operation of their valves.

We plan to continue our investigation as to the root cause through analysis of the EPDM components. With the technical information we will obtain from the plants mentioned above, our plans are to formulate a testing plan that addresses both embrittlement and hydrocarbon contamination as the failure mechanics. The existing data obtained will allow us to envelop and quantify our failure analysis.

Potential Cause

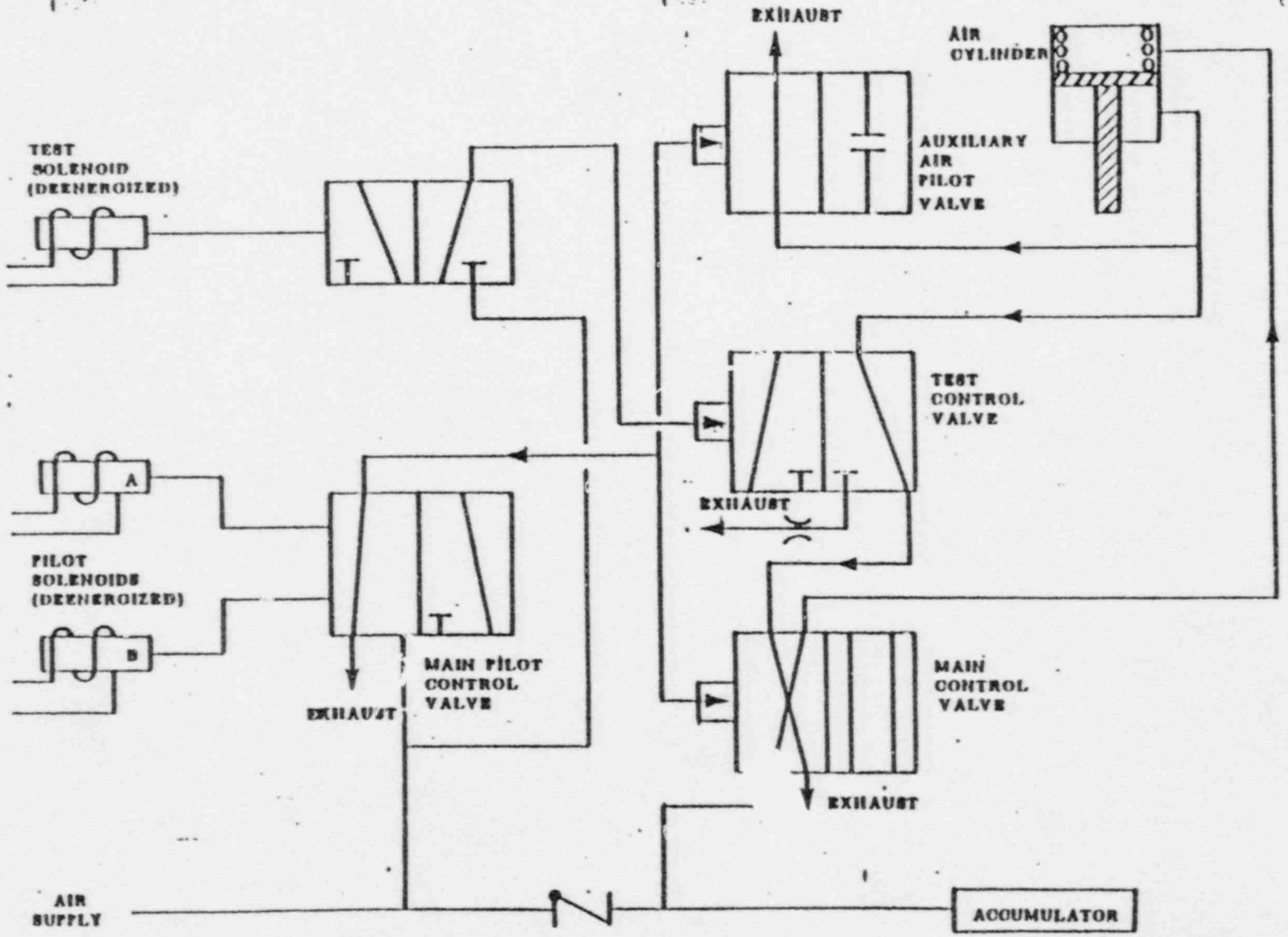
Obstructions/Foreign Materials in Air Lines/Accumulators

Discussion

This potential cause has been experienced a· other plants as evidenced by IE Information Notice 86-57 nd 85-17. Obstructions/Foreign Materials in the air lines/accumulators is a likely cause since it would permit valve failures as experienced. The obstructions may permit periodic operation of the valves and depending on the instrument air cycling could temporarily become dislodged. This could result in the same characteristics discussed in the write-up on "Poor Air Quality".

Conclusion

This item was initially considered to have a high potential as root component failure. Inspections of the air lines and accumulators found no defect that could cause the observed operational pattern, however, so this potential cause is unlikely to be a root component failure.



Closing Operation

Figure B21-12B
MSIV Pneumatic Control

DRAWING UNI
CONFIGURATION
AS OF REV. ____

PARTIAL DWG:
D209-013 sheet 2

(D1) (D2) NUCLEAR S/

NOTES.-

1. FOR GENERAL NOTES, SEE DWG. D-209-001, SHEETS 1 AND 2.
2. TERMINAL BOX LAYOUT, SEE DWG. D-209-001, SHEET 1.
3. FOR PHYSICAL LAYOUT AND WIRING INFORMATION, SEE ATWOOD & MORRILL COMPANY DWG. 13560-01-H, SHEETS 1 THRU 4. (FLD40-003, SHEETS 1 THRU 4) OR G.E. DWG. 105D5228.
4. WIRED BY VENDOR.
5. JUMPERS FIELD TO INSTALL. COLOR PER FIELD CABLE DIVISION.
6. FOR CONAX CONDUIT SEAL ASSEMBLY WIRING DETAILS, SEE DWG D-209-001 SHEETS 7,8,9 & 10.
7. BISCO TYPE LOCA SEAL INSTALLED IN CONDUIT ASSEMBLY FOR EACH SOLENOID TO SERVE AS AN ENVIRONMENTAL MOISTURE SEAL (DCP 85-0618).

6-13-8

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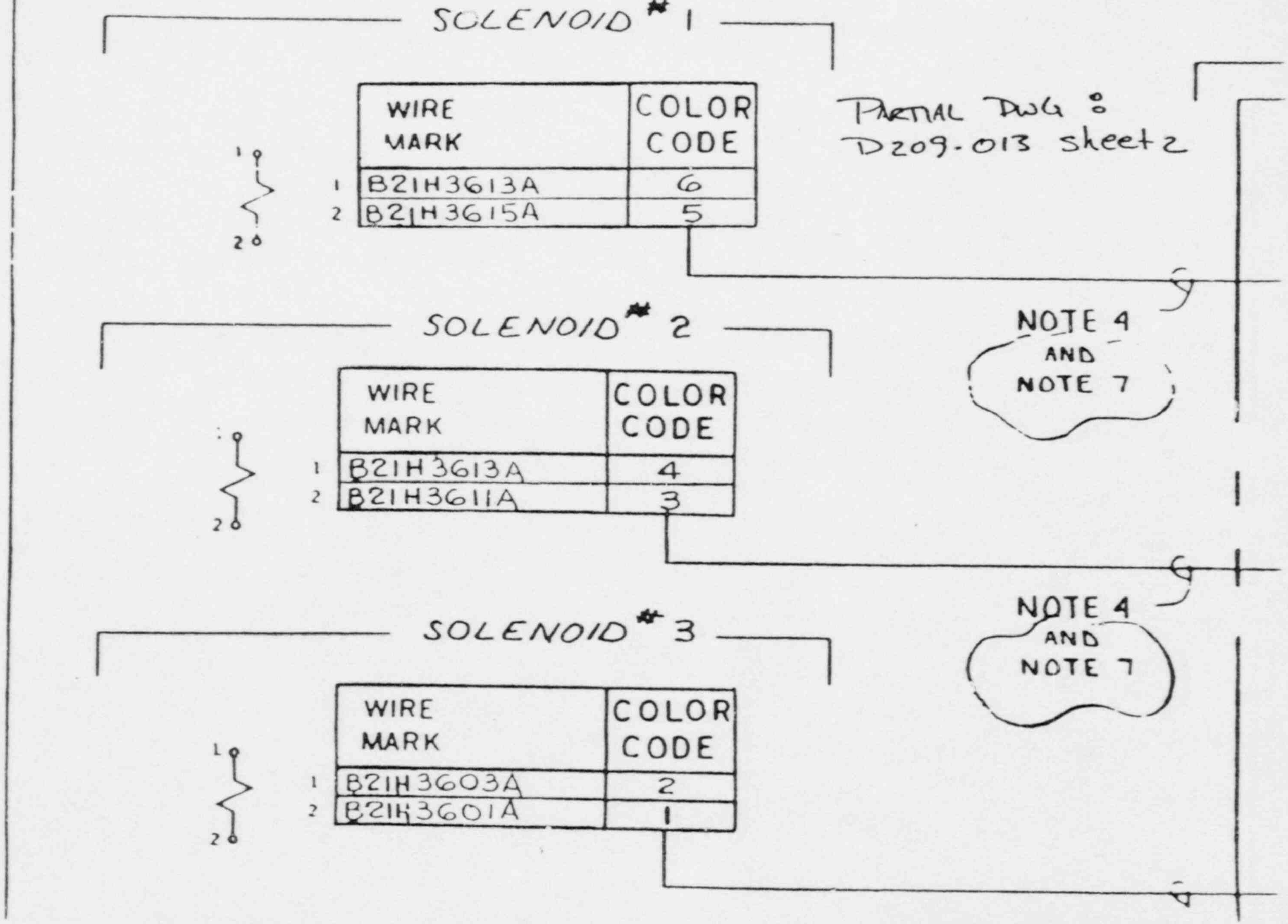
1B21-F0022A
SOLENOID VALVES NOTE 5✓ NOTE 6



Potential Cause

One or both of the pilot solenoid valves for each of the MSIVs failed to decouple (mechanically separate) upon de-energization.

Discussion

Electrical control circuits identify positive de-energization of the respective pilot solenoids. This is verified via the indicating light and any meters as shown per elementary diagrams per B-208-013 H011 and H036. The testing sequence and visual verification has identified that the solenoids have been de-energized, although the MSIVs failed to open or delayed opening. If either solenoid fails to decouple, the MSIVs will not operate. No method exists to remotely determine whether one or both of the solenoids for a particular valve failed to decouple.

The mis-operation (erratic) closure or deferred closure may possibly be attributed to this occurrence. As such it may be a highly susceptible cause. Further evaluation identified that each of the pilot solenoids were sealed with Bisco Locaseal at the conduit entry point. This design change implemented per DCP 850618 is the only change initiated recently. The degradation and/or migration of foreign matter could also be a cause to prevent decoupling of the solenoids.

Conclusion

This item was initially classified as a high potential, and condition of the Bisco Locaseal was evaluated upon solenoid disassembly. Since no interference with the valve operation was noted, this cause has been eliminated from consideration.

Potential Cause

Solenoid valve exhaust port blocked.

Discussion

Blockage of the exhaust port could occur through internal or external contamination. The port is open to the ambient. Particles may fall below the disc preventing shifting of the solenoid valve from its normally energized to normally de-energized position. Subsequent actuation could blow the blockage out of the valve allowing normal operation thereafter. This is considered a potential cause for the Perry delayed MSIV closure experience.

Conclusion

This was initially considered to be a potential cause for the Perry delayed MSIV closure experience. Inspection for blockage was performed, and on one solenoid a piece of tape was discovered to be blocking one port. Subsequent testing determined that this blockage was insufficient to preclude MSIV actuation.

Potential Cause

Failure of the Part #3 Norgren Model B0004A 2-way shuttle valve.

Discussion

The 2-way shuttle valve works in conjunction with the Part #1 4-way shuttle valve to open and close the MSIV. The 4-way shuttle valve provides the primary logic for pressurization and venting of the actuator cylinder. The potential failure mode description is the same as that for the 4-way shuttle valve operation.

The 2-way shuttle valve cannot by itself open or maintain the actuator in the open position unless the 4-way valve is energized or stuck in the energized position.

onclusion

The delayed closure event experienced at Perry is unlikely to have been caused by the 2-way valve failure, since it requires dual mode failure.

Potential Cause

Hydraulic Speed Control Failure

Discussion

The hydraulic cylinder function is to slow the closing speed of the MSIV to specification limits under a wide variation of applied forces.

The closing speed of the MSIV is accomplished through adjustment of the Monatrol needle flow control valves Parts #6 and #7 as shown in the drawing 13560-01-4 hydraulic flow logic schematic.

Should either or both flow control valve(s) and also all other fluid leak paths (e.g. ring gaps in piston) become totally blocked, motion would be prevented.

Such a situation is unlikely because:

1. The amount of contamination would need to be so large that it would not disappear after one cycle.
2. The hydraulic fluid was installed under clean controlled conditions. The system is closed and pressurized, preventing contamination from external sources.
3. Such a failure mechanism is not supported by historical experience.

NOTE: The flow control valves are designed to provide a flow path even at the maximum choked condition.

Conclusion

Unlikely to be occurring.

Potential Cause

MSIV internal binding.

Discussion

Poppet binding against the upper body ribs due to poppet rotation is very unlikely due to poppet concentricity and long length of rib engagement. Binding of the stem against the packing gland edge is considered extremely unlikely by the valve manufacturer. Potential for the lantern ring to cock and bind to the stem is a possibility with inadequate packing compression but is also considered unlikely. The packing compression used in the reassembled valves is estimated to be adequate to prevent lantern ring movement.

Conclusion

The low probability of binding and lack of reported industry cases, is inconsistent with the multiple valve failures or the time factor seen in the free up of some valves. This is unlikely to be occurring.

Potential Cause

Swagelok fittings improper installation/assembly/leakage

Discussion

Excessive fitting leakage would not cause an irregular operation of the valve. This type of leakage would induce a constant operational characteristic, i.e. slow rate of change.

Likewise, the accumulator would close the valve in case of leakage on ASCO pilot control valve tubing.

Conclusion

Unlikely to be occurring.

Potential Cause

Failure of the Part #5 ASCO Model 8320 3-way solenoid valve.

Discussion

The model 8320 3-way solenoid valve is used to slowly stroke the MSIV (close MSIV when energized). When the solenoid valve is energized (opened), pneumatic pressure is routed to the Part #2 3-way air valve. This causes the 3-way air valve to vent the rod side of the actuator through a flow control orifice, while blocking the inlet air from air valve Part #1. The gradual loss of pressure from beneath the piston allows the actuator springs to slowly close the MSIV (up to 60 seconds).

The potential failure modes of the valve are:

a. Stuck open (failure to close when de-energized)
b. Stuck closed (failure to open when energized)
c. Stuck partially opened
d. Catastrophic failure of valve body

The effects of these failure modes are as follows:

a. A stuck open valve prevents reopening of the MSIV.
b. A stuck closed valve prevents operation of the MSIV in the slow closure mode. This is the normal (nontest) mode of the valve and does not affect the normal closure functions of the other subcomponents.
c. A partially opened valve will tend to close the MSIV; however more slowly than the normal fully opened condition. This affect can be visualized in the drawing 13560-01-H schematic. The 3-way solenoid valve, partially opened, would bleed inlet air from the system, e.g., exhausting it. Additionally it could pressurize the 3-way air valve resulting in further exhausting of both inlet and air pressure.
d. A catastrophic failure of the valve body would result in loss of pneumatic pressure resulting in MSIV closure.

None of the above failure modes support the delayed closure event at Perry.

Conclusion

Unlikely to be occurring.

Potential Cause

Valve packing too tight.

Discussion

Grafoil packing has replaced earlier asbestos packing on 7 of 8 MSIVs. While it is likely that the grafoil packing has greater breakaway friction due to increased compression of the softer material, the circumstances of the events showing quick closure after initial release make this somewhat unlikely as the cause.

Conclusion

Because other valves with grafoil packing and equal packing compression requirements showed no effect during fast or slow speed testing and the lack of industry experience of an MSIV being held up due to packing, this cause must be considered unlikely.

Potential Cause

Failure of the Norgren Model F0013A 4-way shuttle valve.

Discussion

The 4-way shuttle valve is energized by the Part #4 3-way dual solenoid valve. Upon energization it routes pneumatic pressure to the rod (bottom) side of the actuator cylinder piston and vents the blind (top) side of the piston. The resulting pressure differential across the piston forces the rod up, opening the MSIV.

The 3-way dual solenoid valve when de-energized, vents (de-energizes) the 4-way shuttle valve, venting the rod side and pressurizing the blind side. The resulting pressure differential across the piston in conjunction with the springs forces the MSIV closed.

The Part #3 2-way air valve is provided in the circuit to eliminate a single mode failure of the 4-way valve.

The failure mode of interest concerns failure of the MSIV to close when the 3-way dual solenoid valve is de-energized. Should the pressure leg of the 4-way valve stick, the pressure is still vented by the Part #3 2-way valve. If the exhaust leg sticks upon de-energization of the valve, the springs alone are capable of closing the MSIVs although at a slower rate.

If either leg partially sticks, the inlet pressure is exhausted, promoting closure of the MSIV.

Conclusion

The only failure of the 4-way valve which can result in delayed closure of the MSIVs as experienced at Perry is sticking of the pressure leg with a concurrent failure of the Part #3 2-way air valve. This is unlikely as it is double mode failure - requiring failure of two separate subcomponents. Thus this is unlikely to be occurring.

Potential Cause

Valve line-up of instrument air header system.

Discussion

Had an improper valve line-up in the instrument air header system occurred, numerous other air users throughout the plant would have been affected. Key valves and the possible consequences had they been advertently closed are listed below.

1) 1P52-F640 (manual drywell isolation). Improper line-up of this valve would have prevented repeated actuation of B21-F022A, B, C, and D. This valve would also isolate the MSR valves as well as the personnel air lock at 599'-0" Elevation.
2) 1P52-MCV-F646 (drywell isolation). Had this valve closed, it would have been indicated by status lights on both H13-P601 and H13-P870 panels in the control room. ERIS points EC-007 and 008 would have also indicated closed.
3) 1P52-MCV-F200 (containment isolation). (A) Had this valve been closed the entire air supply into containment would have been isolated which in turn would have affected instrument air supply to all the air users off of the air distribution manifolds P52-J600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, and 612. (B) Also, had this valve been closed it would have been indicated by status lights on both the H13-P601 and H13-P870 panels in the control room.
4) Manual valves P52-F554 and F605. Had these valves been closed they would have isolated a large number of the air users throughout the containment.

With all of the discussion above the fact remains that the valves did operate as observed. This would not have been the cause since the MSIVs would not have repeatedly functioned.

Conclusion

Unlikely to be occurring.

Potential Cause

Air pack wiring and termination failure resulting in a hot short.

Discussion

The air pack units are self contained for each solenoid and wired to a common junction box. This wiring and associated hardware is provided by the manufacturer. The field wiring is terminated at the respective solenoid valve junction boxes. Refer to drawings D-209-013 Sheets 2 through 9 for each of the MSIV assemblies.

Per review of the interconnection wiring diagrams and corresponding elementary schematics, the wiring and termination information is correct.

The control schematic for operation of the respective solenoids is "fail safe" by design basis, which requires the solenoid coil to be energized to prevent an isolation. De-energization would result in closure of the valve.

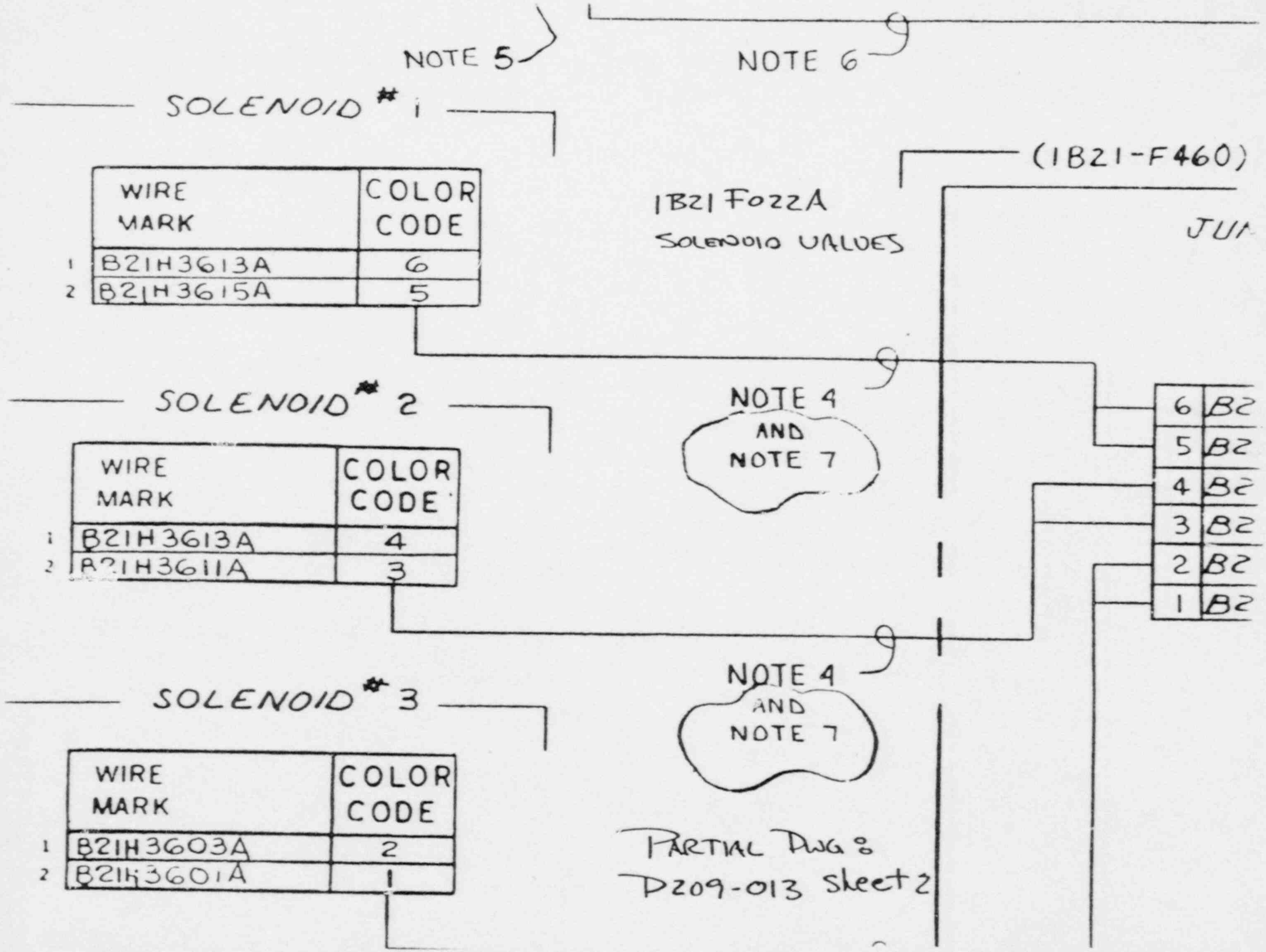
The wiring to each valve is classified as Class 1E. Although the 120VAC power to each of the A & B pilot solenoid valves pairs is contained in a common cable, each conductor is properly sized and meets the separation requirements. The cables are rated for 600 volt insulation, besides having minimum current draw. Therefore, the potential for a hot short is improbable.

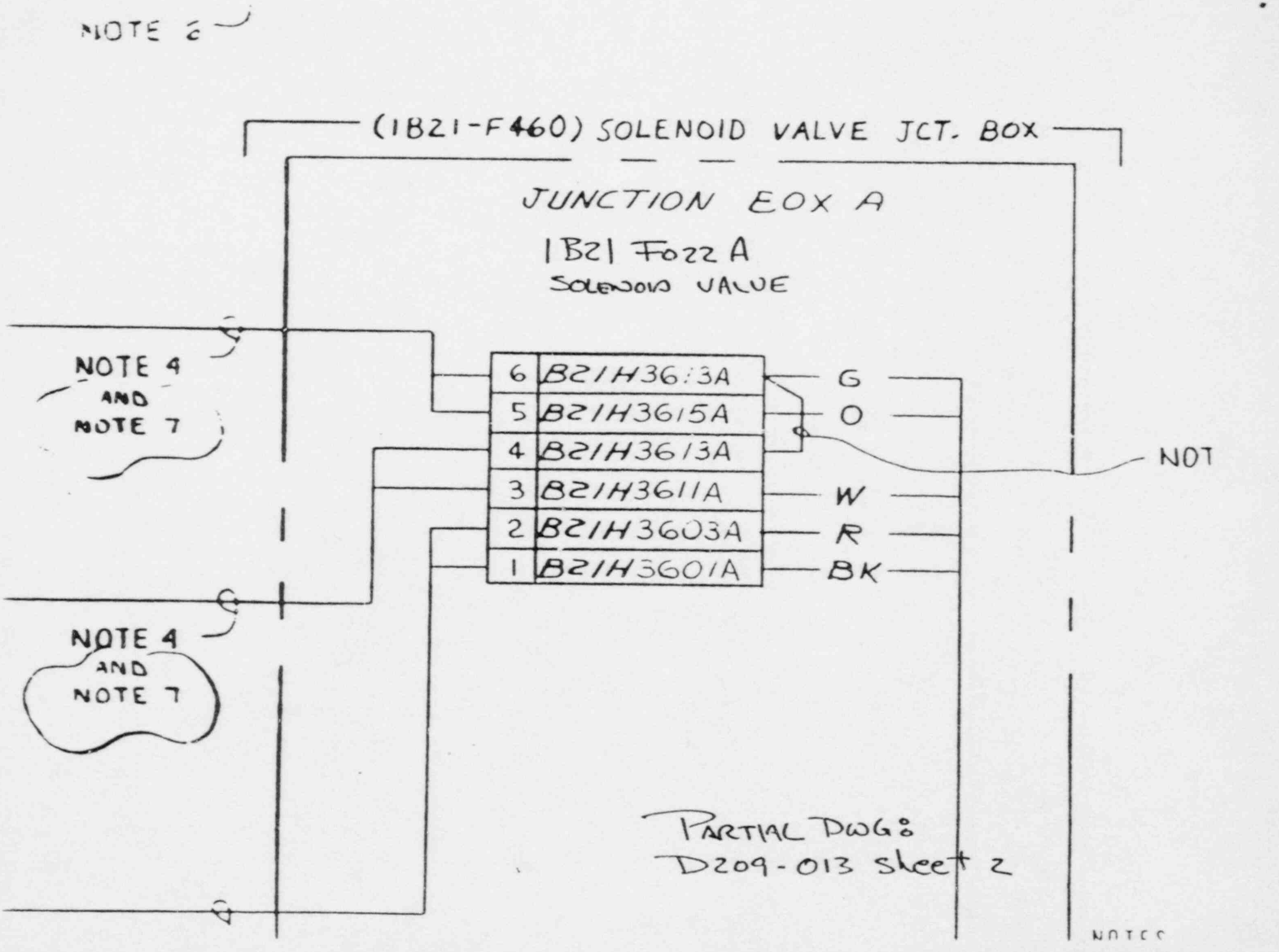
References

D-209-013 Sheets 2 through 9.

Conclusion

Unlikely that wiring or hot short is a potential cause.


NOTE 5
NOTE 6
SOLENOID # 1
WIRE MARK | COLOR CODE
1 B21H3613A | 6
2 B21H3615A | 5
(1B21-F460)
1B21 F022A
SOLENOID VALVES
JUN
NOTE 4 AND NOTE 7
SOLENOID # 2
WIRE MARK | COLOR CODE
1 B21H3613A | 4
2 B21H3611A | 3
6 B2
5 B2
4 B2
3 B2
2 B2
1 B2
NOTE 4 AND NOTE 7
SOLENOID # 3
WIRE MARK | COLOR CODE
1 B21H3603A | 2
2 B21H3601A | 1
PARTIAL DWG:
D209-013 Sheet 2



NOTE 6
(1B21-F460) SOLENOID VALVE JCT. BOX
JUNCTION BOX A
1B21 F022 A
SOLENOID VALVE
NOTE 4
AND
NOTE 7
6 B21H3613A
5 B21H3615A
4 B21H3613A
3 B21H3611A
2 B21H3603A
1 B21H3601A
G
O
W
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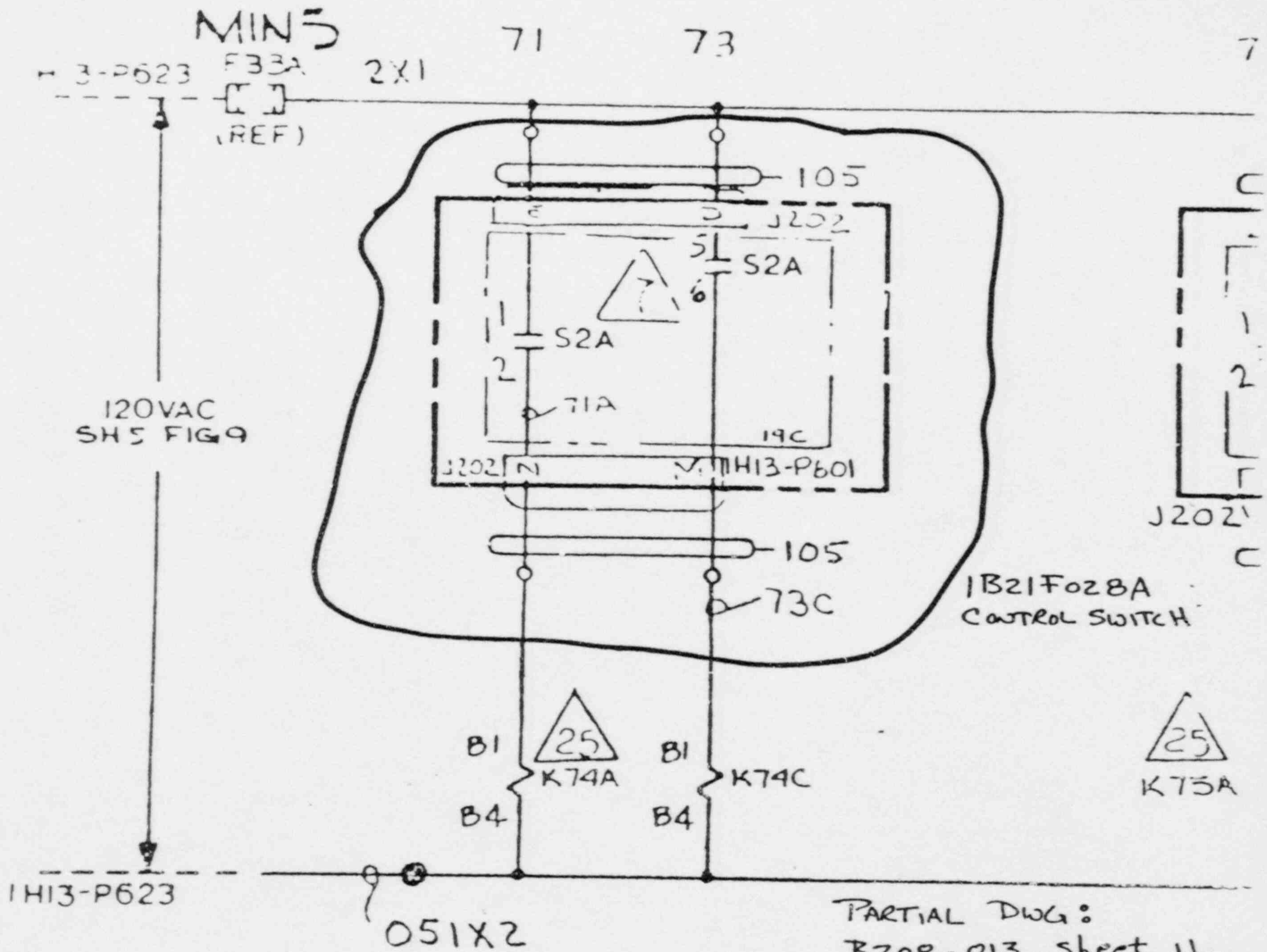
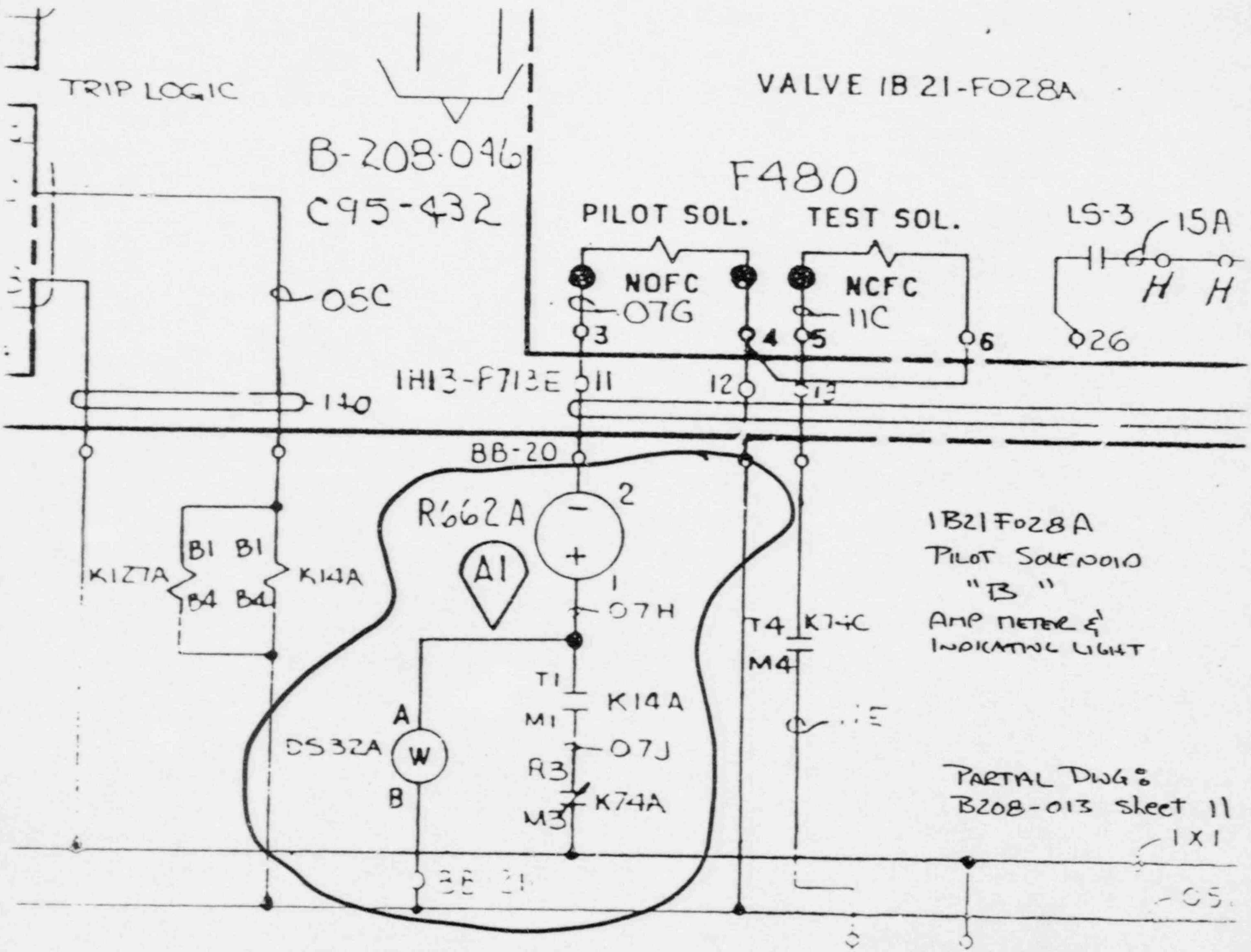
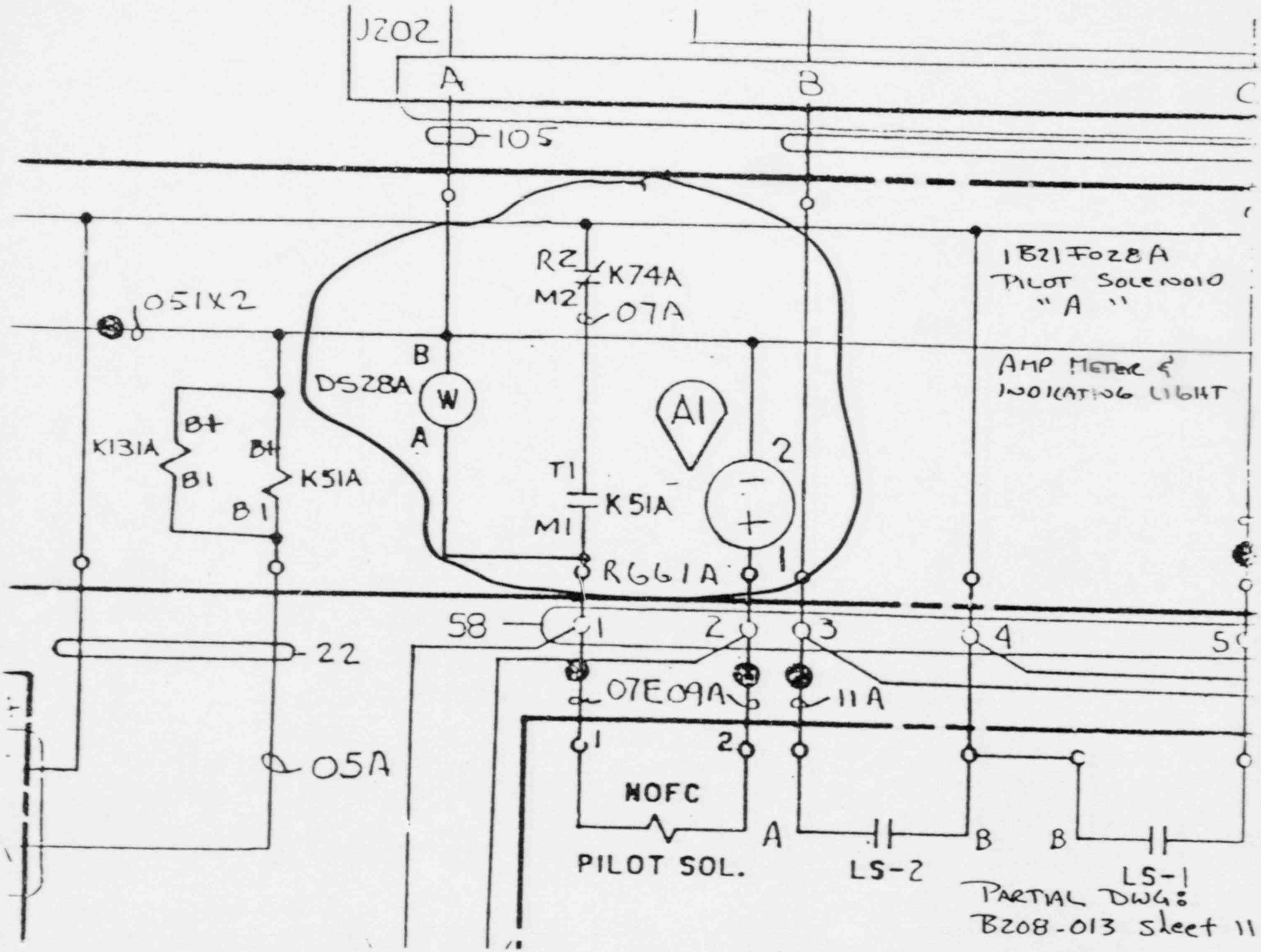
BK
NOT
NOTE 4
AND
NOTE 7
PARTIAL DWG:
D209-013 sheet 2



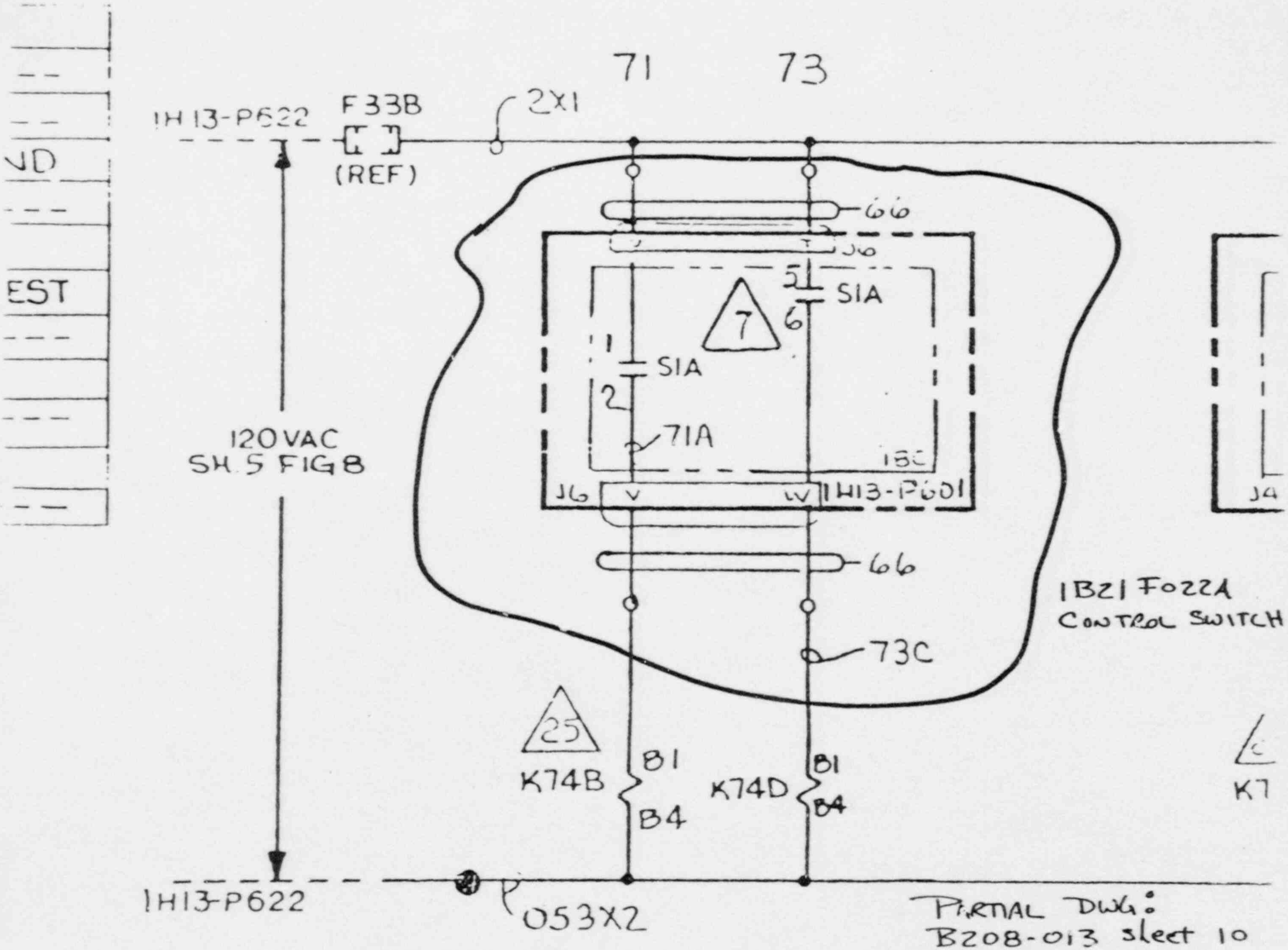
PARTIAL DWG:
B208-013 Sheet 11



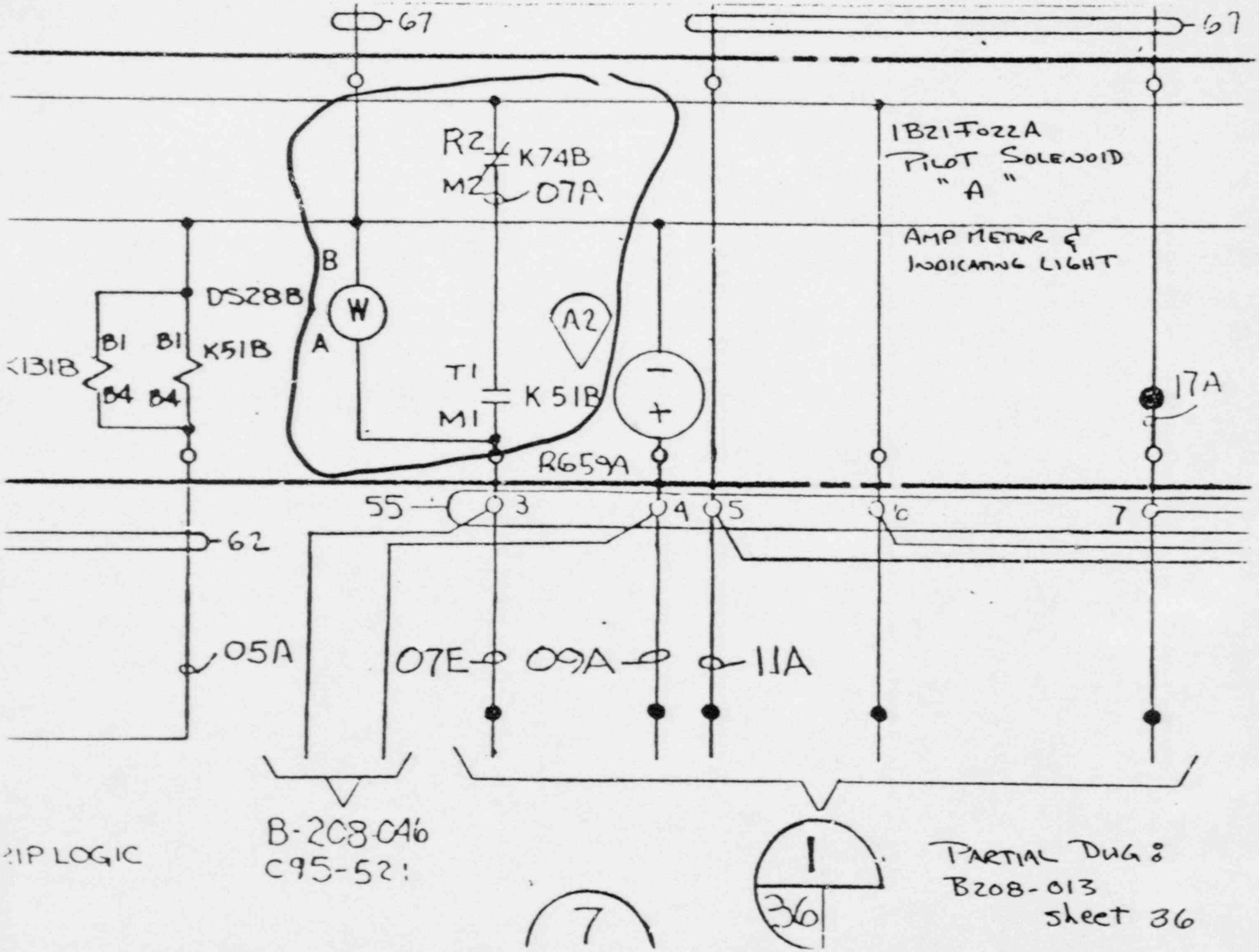
TRIP LOGIC
B-208-046
C95-432
VALVE 1B 21-F028A
F480
PILOT SOL.
TEST SOL.
LS-3
15A
NOFC
NCFC
05C
07G
11C
H
H
3
4
5
6
26
1H13-F713E
11
12
140
BB-20
R662A
2
1
A1
B1
B1
B4
B4
K127A
K14A
07H
T1
K14A
M1
07J
R3
K74A
M3
A
B
DS32A
W
T4
K74C
M4
1B21F028A
PILOT SOLENOID
"B"
AMP METER &
INDICATING LIGHT
PARTIAL DWG:
B208-013 Sheet 11
1X1



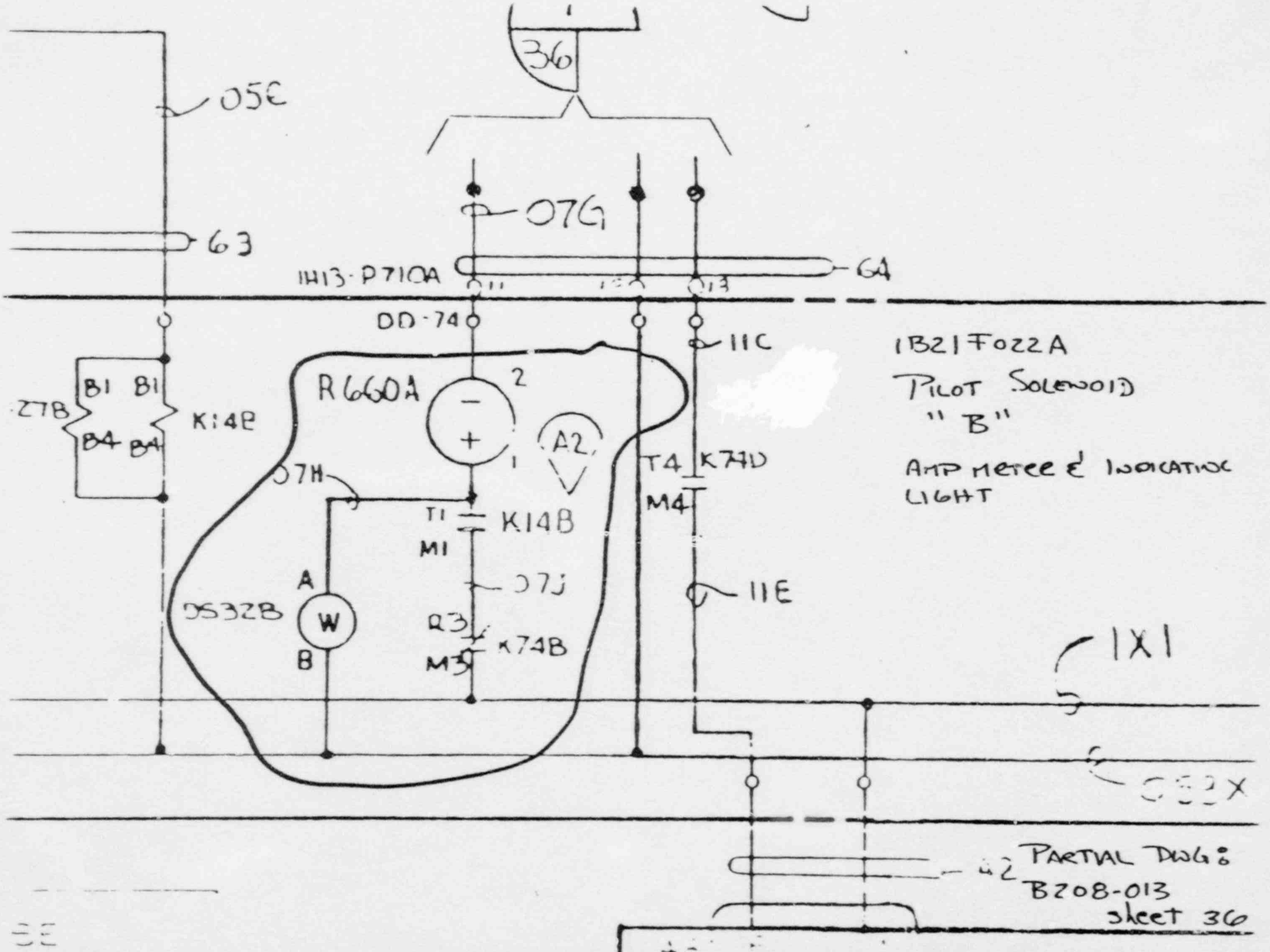
PARTIAL DWG:
B208-013 sheet 11



PARTIAL DWG:
B208-013 sheet 10



67
67
1B21F022A
PILOT SOLENOID
"A"
AMP METER &
INDICATING LIGHT
R2
K74B
M2
07A
B
DS28B
W
A2
A
B1
B1
K131B
K51B
B4
B4
T1
K51B
M1
17A
R659A
55
3
4
5
6
7
62
05A
07E
09A
11A
B-208-046
C95-521
RIP LOGIC
1
36
7
PARTIAL DWG:
B208-013
sheet 36



36
05E
63
07G
64
1H13-P710A
DD-74
11C
1B21F022A
PILOT SOLENOID
"B"
AMP METER & INDICATING
LIGHT
R660A
2
1
A2
B1 B1
27B
K14B
B4 B4
07H
T1
K14B
M1
T4
K74D
M4
A
DS32B
W
B
07J
R3
K74B
M3
11E
1X1
PARTIAL DWG:
B208-013
sheet 36

Potential Cause

Glazed contacts on control and relay components creating a high resistance which would result in discontinuity and potential mis-operation of the MSIV circuitry.

Discussion

Contact integrity and circuit continuity of the respective solenoid valve coils is constantly monitored by measuring the coil circuit current, in addition to an indicating light (white) which relies on actuating contact integrity to remain energized. Refer to attached partial of drawing B-209-013, Sheet 10 and Sheet 11.

The isolation control circuit(s) are a "fail safe" design, which requires the solenoid coil to be energized to prevent an isolation. If contact glazing had occurred resulting in a discontinuity (high resistance at connection or contact points) in the control circuit(s), the resulting effects would cause the lack of voltage to the coil(s). This condition, due to the "fail safe" design, would cause an undesirable isolation (closure of the MSIV valves), rather than a failure to isolate.

References

D-208, Sheets H05, H10, H11 and H36.

Conclusion

Evidence of repetitive tasks to cycle these valves along with the proper configuration for power and control indication does not suggest any potential failure. Also, the control circuitry and electrical components for each of the inboard and outboard MSIVs are identical. In that there is no past or present evidence to support this cause scenario, it is highly unlikely that this is the root cause of the problem.

Potential Cause

Relay failure or incorrect operation resulting in mis-operation of the MSIV valves.

Discussion

The associated control and relay components are located in the PGCC which is designated as a non-harsh environment and is also seismically designed. Furthermore, this area is controlled for relative humidity and temperature. The likelihood of a failure or incorrect operation due to component failure is highly improbable in that this failure would have to occur on three (3) different MSIV logic/control circuits. The proper operation and closure of these valves and repetitive testing positively indicates that relay failure is not the cause. Also, as shown through testing and verification, the control functions and indication was correct.

Conclusion

Unlikely and highly improbable that relay failure is a potential cause.

Potential Cause

Panel control switch failure or mis-operation.

Discussion

The control switches nos. S1A-D and S2A-D are General Electric type CR2940, 3 position maintained contact switches. All of these are located in the PGCC. The control schematics, as shown per drawing B-208-013 Sheet 10 (inboard) and B-208-013 Sheet 11 (outboard), are identical. No test data or evidence has been identified to suggest a failure of the switches. Repetitive testing has demonstrated the proper operation of each of these control switches.

References

B-208-013 Sheet H04, H10, and H11.

Conclusion

Evidence of repeated acceptable testing to cycle these valves does not suggest any potential failure. As such it is highly unlikely that this is a potential root cause of the problem.

Potential Cause

Limit switch settings incorrect or inoperable.

Discussion

The limit switches (total of 6 each) for each of the MSIV inboard and outboard valves are NAMCO type, as furnished by Atwood & Morrill Company. These limit switches are not an active component in the control scheme which initiates opening or closure of the respective MSIV valves, rather they monitor and provide local indication in the control room for valve position. Refer to elementary drawings B-208-013 Sheets H10, H11, and H36.

The potential for inaccurate limit switch settings is possible, but other independent sources can verify and provide indication for closure or opening of the valves via instantaneous steam flow and steam line pressure. Again, this issue would not impact the actual operation of the valves.

References

B-208-013 Sheets H10, H11, and H36.

Conclusion

In that the limit switches are not part of the control circuits, mis-operation would not affect valve closure.

Potential Cause

Miswiring for indication of instrumentation or switches.

Discussion

This potential cause was recently a problem wherein the "A" and "B" solenoid valves were wired to a common Reactor Protection System (RPS) bus. The basis of the design requires that each of the trip solenoids A and B for each of the MSIVs be wired to different RPS buses. This issue was corrected via the preparation and issue of Design Change Package (DCP) 870414. As part of this design package and a prerequisite for start-up, each of the MSIVs were verified and tested for applicable power sources and functional operations. The probability of additional wiring errors is highly unlikely in that repetitive testing of these valves did not indicate mis-operation.

References

B-208-013 Sheets H05, H10, H11, and H36.

Conclusion

Although this item was a problem previously, it is highly unlikely that a similar type of problem could be the root cause. The efforts to resolve this RPS problem, retesting and management exposure significantly rule out this potential cause. Also, recent testing of the specific valves in question indicate that the instrumentation and switches are correct.

Potential Cause

Data acquisition failure.

Discussion

Failure in the data acquisition and recording system could lead to improper assessment of closing speed.

Valve speed data is taken and recorded using the TRA subsystem of ERIS. This system has the capability to sample data from a wide variety of signals for later analysis. Data on reactor power, steam flow, reactor pressure, limit switch position, and solenoid current are all consistent. Measurements exterior to ERIS, main control panel and back panel indicating lights for example, are also consistent with the ERIS data. In summary, multiple concurrent failures necessary for this scenario to occur make it incredible.

Conclusion

Highly unlikely to be occurring.

Potential Cause

Procedural error for testing. Most previous fast speed MSIV closures have been performed using SVI B21-T2001. The first failure was noted while performing the test per STI-B21-025A section 8.3 and the remaining failures were noted while performing the MSIV strokes using the system operating instruction (S.O.I.)

Discussion

Although most previous tests have been performed using the SVI, this is not the first time that an STI has been performed. As early as 10/12/86, STI-B21-025A section 8.1 was used to fast stroke the valves. Additionally, the use of the SOI has been demonstrated before and after the failures. During the B21-F022D, B21-F028B, and B21-F028D failure on 10/29/87 and the B21-F022D and B21-F028D failure on 11/3/87, the SOI was used. However, this is the same SOI that was used for the remaining valves which passed their stroke time.

Conclusion

It is highly unlikely that there is a procedure problem.

Potential Cause

High Steam Flow/High Reactor Power Interaction. All previous low and high speed MSIV closure tests have been performed at low to medium reactor power. The potential exists that the higher steam flows associated with high reactor power could interfere with MSIV closure.

Discussion

Although all previous tests have been run at low power, the valve design basis is closure at full flow, and the capability of the valve to close under full power conditions has been demonstrated numerous times at numerous operating BWRs. The valves that showed delayed closure are identical in design to valves that closed within specifications, and the affected valves closed successfully following cycling. The valve design is such that pressure drop associated with steam flow will actually assist in closing the valve.

Conclusion

It is highly unlikely that this is the cause of the problem.

Potential Cause

Incorrect reassembly and installation of the air pack. The air packs were all removed, but not disassembled, during the September 22, 1987 forced MSIV outage. The purpose for removing all of the air packs was to allow for temporary air supply to be installed and allow local stroking of the MSIV to check stroke measurements.

Discussion

During the September 1987 outage all air packs were removed from the MSIVs to facilitate local stroking of each valve to set the stroke length. After final reinstallation of the air packs there were several fast and slow strokes performed. These strokes were performed using SVI C71-T0039 and SVI B21-T2001. Even though SVI C71-T0039 (slow stroke testing) does not test the same valves as SVI B21T2001 (fast stroke testing) the same air pack is used and the mating surface between the air pack and actuator remains the same, as do all hose connections.

Conclusion

It is highly unlikely that this is the problem due to the number of strokes performed after reassembly.

Potential Cause

Actuator binding/stem binding

Discussion

Binding of the actuator internals for both the hydraulic and pneumatic assemblies is highly unlikely. Neither assembly is subject to external loads to cause stem bending. The hydraulics are not subject to external particulate contamination and contamination within the main air cylinder may score the cylinder but could not likely stop the movement by resisting the air pressure force.

Conclusion

This cause would likely have shown up during prior history of stroking the valves and would not likely apply to multiple valves at one time. Nor would such binding likely apply to the top of stroke only. Thus this cause is estimated to be highly improbable.

SECTION 4

FAILURE ROOT CAUSE DESCRIPTIONS

Potential Cause

Local High temperature has caused deterioration of EPDM seal materials.

Discussion

Perry has experienced drywell and steam tunnel temperatures which have approached the Tech Spec limits during much of the startup test program. Figure 1 gives a history of the bulk drywell temperature since June of this year. In addition, localized temperatures in excess o the bulk drywell temperature during the past year. In addition, localized temperatures in excess of the bulk drywell temperature can be postulated to have occurred due to steam leakage from several valves. In particular, main steam isolation valve B21-F022B had a major steam leak just prior to the actuator/stem separation incident during September 1987. Leakage control system valves E32-F001N has also experienced several body to bonnet steam leaks. Figure 2 shows the physical location of these valves relative to the location of MSIVs B21-F022D, B21-F028B, and B21-F028D. One of the solenoids from B21-F028D was found to have rust and corrosion, indicative of a steam environment.

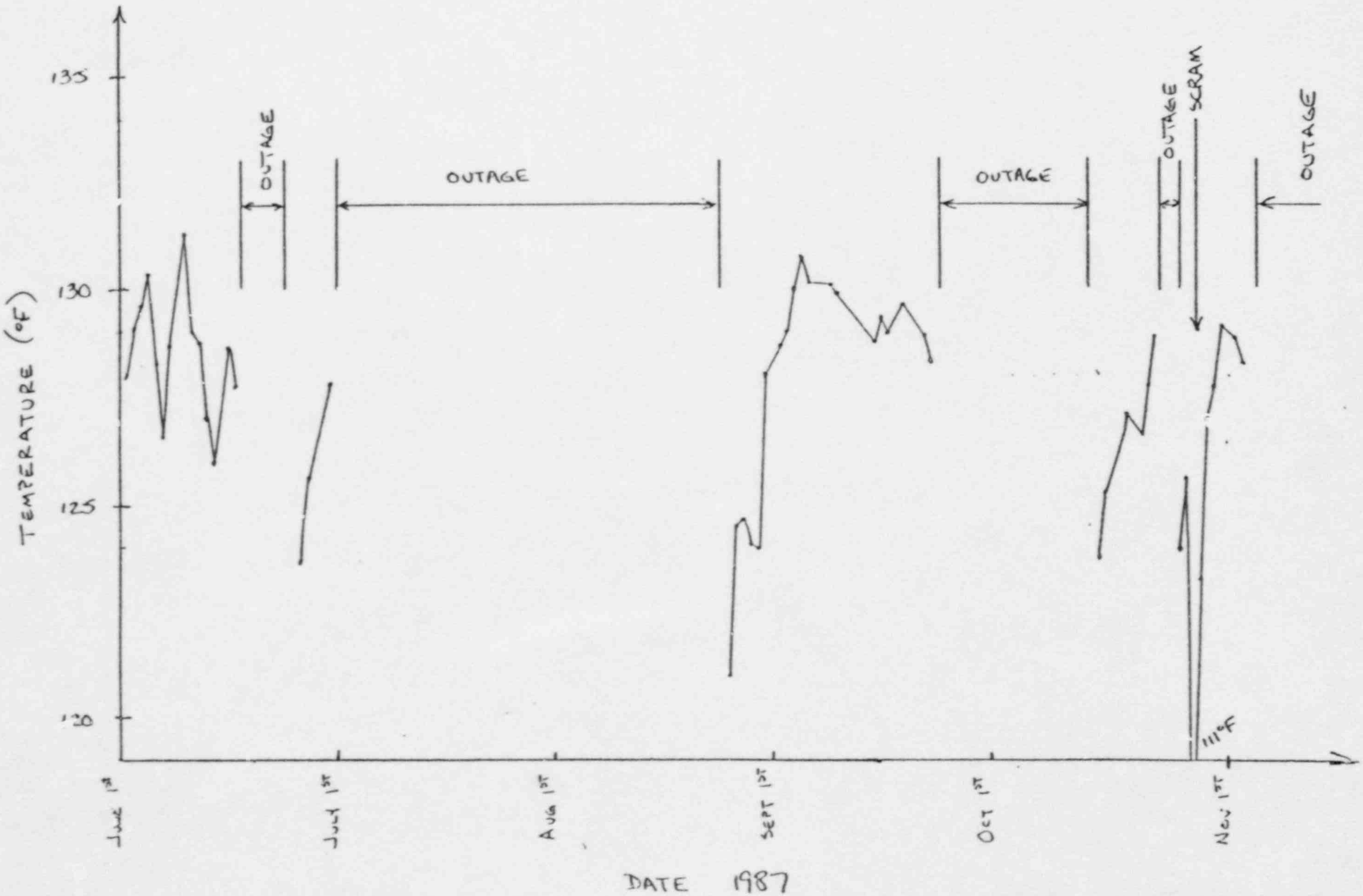
Adiabatic expansion of steam from 1000 psia to 15 psia will result in a steam jet temperature of about 300°F. This jet will, of course, rapidly cool and condense to saturation at drywell conditions. This local condition, along with the proximity of the leaking valves to the MSIVs which failed to close is indicative of a temperature related cause.

Discussions with Automatic Switch Company (ASCO), the manufacturer of the failed component, has indicated that elevated temperature is a potential cause of the hardening of the proprietary EPDM rubber compound used for the valve seals and o-rings. Seals and O-rings taken from MSIV solenoids for valves that had not demonstrated delayed closing do not have the level of degradation seen in seals from the failed valves. In particular, preliminary inspection of the seals from MSIV B21-F028C indicated this valve to have seals in a near-new condition. As shown in Figure 3 arrangement of ventilation in the steam tunnel is such that this valve would be expected to see the lowest ambient temperature, and conversely, F028D & B would see the highest ambient temperature. In combinatin with the previously discussed steam leakage, it is clear that F028D & B have been exposed to higher than expected ambient temperature.

Conclusion

Elevated local temperature is the most probable cause for degradation of the EPDM seals in the ASCO Model 8323 pilot solenoid valve. The material is known to be temperature sensitive, the potential for elevated temperature has been shown to exist, and the best performing valves are in the lowest temperature locations.

FIGURE 1
BULK DRYWELL TEMPERATURES



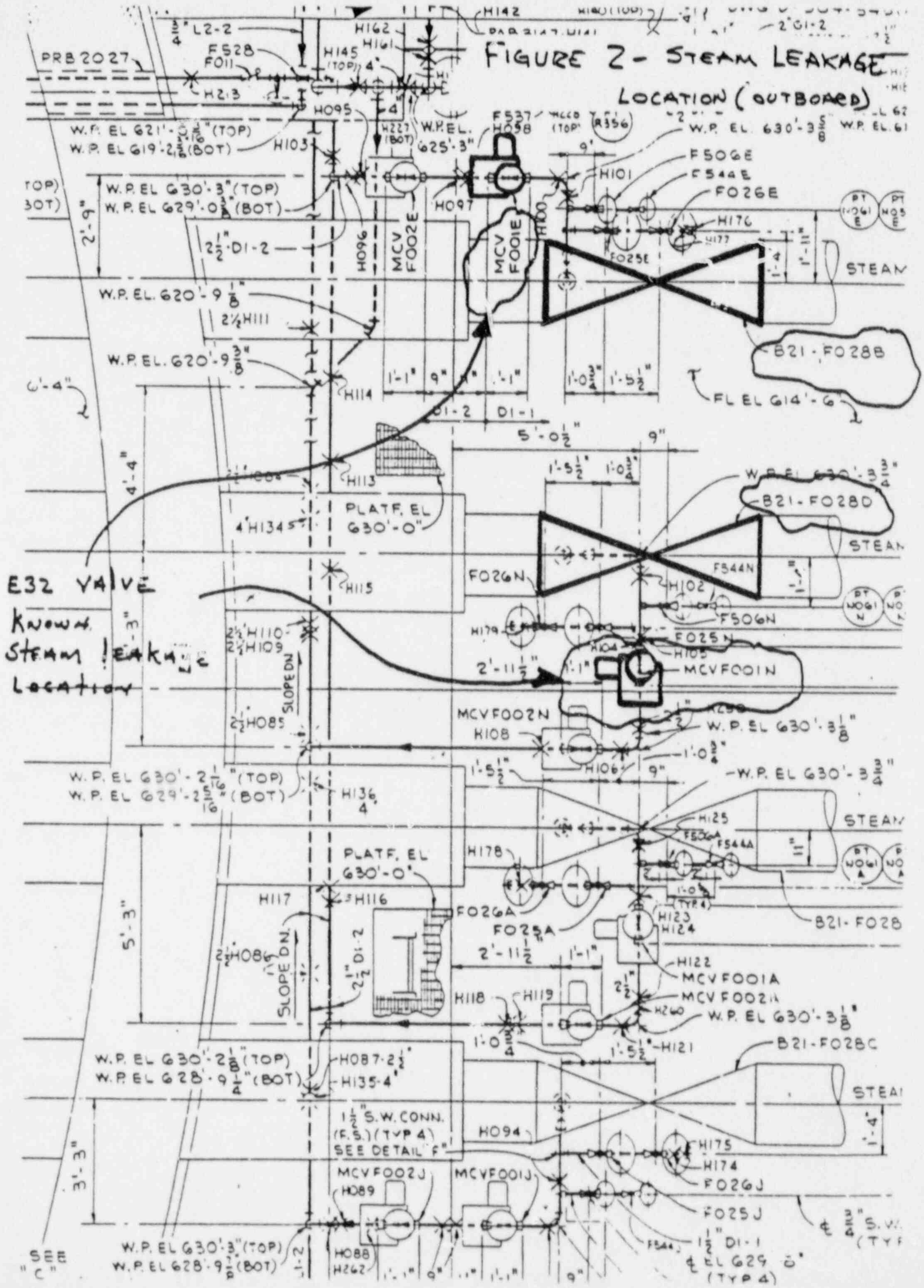
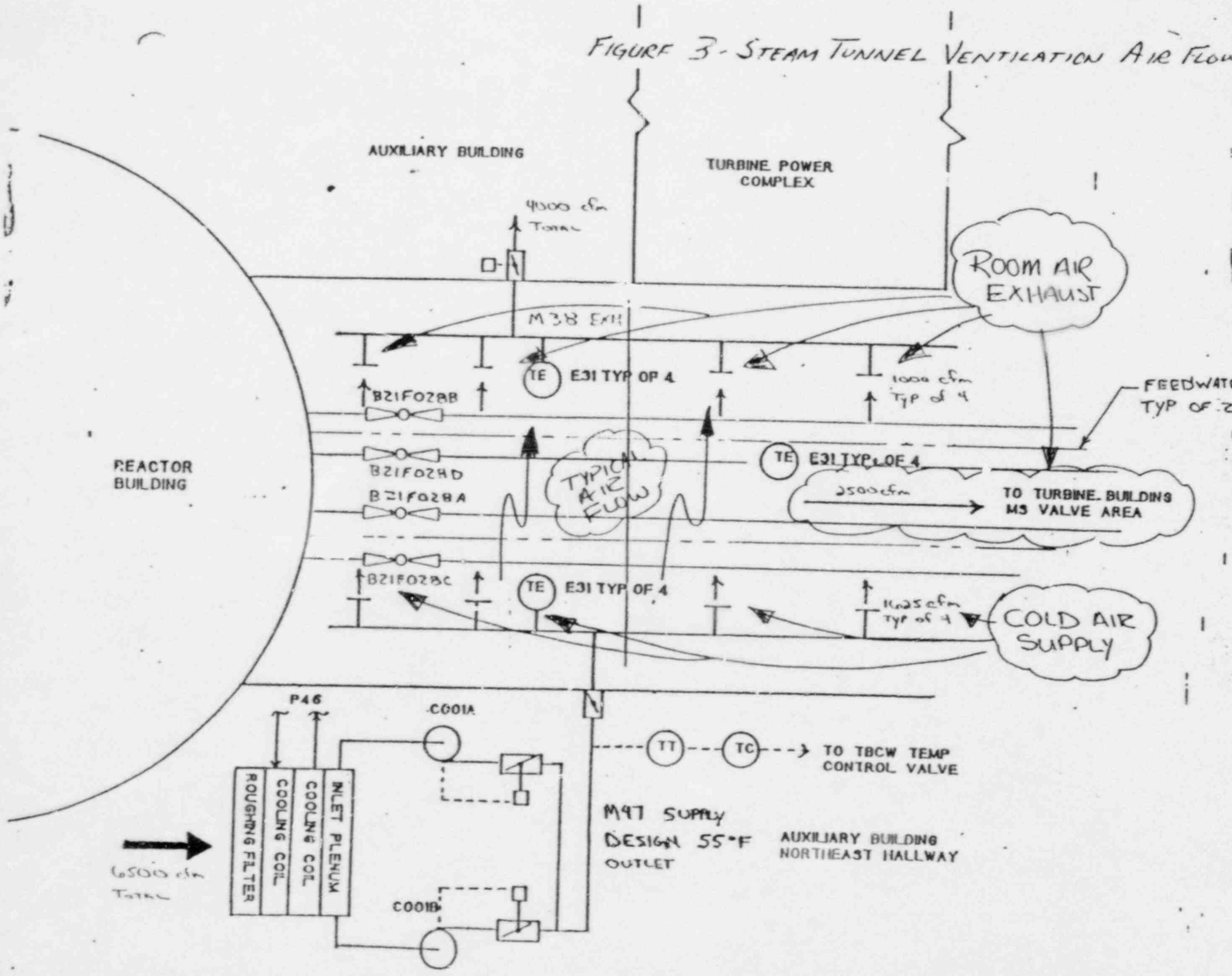


FIGURE 2 - STEAM LEAKAGE LOCATION (OUTBOARD)
E32 VALVE
Known Steam Leakage Location
MCV F001E
MCV F002E
MCVF001N
MCVF002N
MCVF001A
MCVF002A
MCVF002J
MCVF001J
B21-F028B
B21-F028D
B21-F028
B21-F028C
PLATF. EL 630'-0"
FL EL 614'-6"
STEAM
W.P. EL 630'-3 3/4"
W.P. EL 630'-3 1/8"
W.P. EL 630'-3 5/8"
W.P. EL 620'-9 1/8"
W.P. EL 620'-9 3/8"
W.P. EL 630'-3" (TOP)
W.P. EL 629'-0 3/4" (BOT)
W.P. EL 630'-2 1/16" (TOP)
W.P. EL 629'-2 5/16" (BOT)
W.P. EL 630'-2 1/8" (TOP)
W.P. EL 628'-9 1/4" (BOT)
W.P. EL 630'-3" (TOP)
W.P. EL 628'-9 1/2" (BOT)
1 1/2" S.W. CONN. (F.S.) (TYP 4) SEE DETAIL "F"
SLOPE DN.
SEE "C"
PRB 2027
F026E
F506E
F544E
F025E
F026N
F506N
F025N
F026A
F025A
F026J
F025J
1 1/2" D1-1
℄ EL 629'-0" (TYP 4)

FIGURE 3 - STEAM TUNNEL VENTILATION AIR FLOW



Potential Cause

Blockage of the dual solenoid valve exhaust port with tape.

Discussion

During the previous MSIV refurbishment where the air packs were removed, duct tape was used to cover exposed ports, including the solenoid valve exhaust port. On F028D the exhaust port tape had apparently not been removed following the refurbishment. Blockage of the solenoid valve exhaust port could delay the closure of the MSIV.

However, the strength of the tape adhesive is considered weak compared to the pneumatic pressure forces. Typically, the tape will blow outward, remaining connected on one side during de-energization and fall back in place like a flap. Further tests of the F028D valve has verified the tape is not an effective block.

Conclusion

Very unlikely to be occurring.

Potential Cause

Jamming of kinematic components.

Discussion

In order for the valve to shift to the de-energized condition, both solenoid movable cores must slide within their guides. The disc holder assembly is also a guided component which must shift for the valve to operate.

Failure of the components to shift may be caused by foreign material contamination of the sliding surfaces, either particulate or fluid (adhesive in nature), or by physical damage to the valve parts.

Examination of the F022D valve, and the air supply system has not identified any unusual substances or damage which could explain the MSIV delayed closure condition. Considering the proportion of valves which demonstrated the delayed closure (3 of 8), an extremely dirty system would be expected for this effect.

Conclusion

Unlikely to be occurring.

Potential Cause

Oxidation of EPDM rubber compound used in gaskets, seals and disc seal materials.

Discussion

Oxidation of EPDM rubber in the presence of a brass catalyst has been suggested as cause for a similar incident at Brunswick-2. This has been documented in INPO Significant Event Report 57-85. Review of SER 57-85 indicates that although catalytic oxidation is a potential cause for the Brunswick situation, that utility was never able to determine the exact cause for EPDM degradation. There is, however, a relatively large data base for use of EPDM elastomer in brass valve bodies with acceptable results. The solenoid valve supplier has stated that there is no evidence to suggest that catalytic oxidation has ever occurred. The condition of other Perry valves would be expected to be similar if oxidation were at fault. This has not occurred.

Conclusion

Catalytic oxidation of EPDM in the presence of brass cannot be completely ruled out as the root cause for pilot valve failure. While postulated as a failure mechanism, its validity has not been proven. If catalytic oxidation does play a part, it is most likely as a contributing factor, in the high temperature scenario, for example.

Potential Cause

Residual magnetism following coil de-energization.

Discussion

Sufficient residual magnetism of the ferritic steel materials in the region of the coil could cause the valve to remain open following de-energization.

No similar experience has been found elsewhere. The ASCO valve representative has identified that the solenoid valve return spring is sufficiently strong to overcome residual magnetism of the ferritic steel components. Any residual magnetic forces would be low compared to the closure force unless additional magnetic mass was added to the coil vicinity.

Conclusion

Unlikely to be occurring.

Potential Cause

Wrong materials.

Discussion

This failure root cause description considers the use of wrong materials for the disc holder elastomer seal. The potential for wrong lubricant is considered separately.

Dimpling of the disc holder seal in the dual solenoid valve is postulated to result in wedging of the seal in the exhaust to cylinder port. The use of a wrong material could result in the observed dimpling. The proper disc material is an ASCO proprietary EPDM, utilized in their nuclear qualified valves. Material problems may include the following:

- Wrong material of lower strength or thermal capability.
- Improperly cured EPDM.
- Improperly formulated EPDM.

An analysis of the disc material may be performed to identify the material or formulation; however, it is unlikely to determine the relative cure of the compound.

Conclusion

This is not expected to be occurring, and will be confirmed by material analyses.

Potential Cause

Locaseal vapors

Discussion

In order to seal the solenoid housings on the solenoid valves a Locaseal is poured in the opening and allowed to cure. The compounds contain no oils, solvents or reactive materials. Also, the alkylated phenols and aromatic amines are highly cross-linked and polymerized. This configuration does not allow the release of hydrocarbons. Furthermore, the lowest temperature that decomposition takes place would be approximately 500 degrees F. The ambient temperature of the air pack assemblies are greatly below 500 degrees F.

Conclusion

Unlikely to be occurring.

Potential Cause

O-ring/lubricant interaction

Discussion

During the disassembly and inspection of the ASCO dual solenoid valves, the three body gaskets (o-rings) were found to be significantly degraded. Degradation included hardening, flattening and adherence to the mating valve body.

The observed condition of the gaskets could be caused by an improper lubricant. The EPDM gaskets are susceptible to hydrocarbon oils. Normally a silicone oil (Dow Corning 550) is used as a gasket lubricant. EPDM is compatible with silicone fluids.

The degradation of the gaskets could not affect the valve itself, as they are located away from the moving components. However, vapors from the lubricant (no signs of fluid migration were observed) could result in softening of the disc pads resulting in the dimple effect suspected as being the physical cause of adherence.

Conclusion

Possible but unlikely since similar valves have not shown the same condition. The o-rings will be investigated for proper material and lubricant.

Potential Cause

Corrosion within solenoid enclosure.

Discussion

The "B" coil housing in the F028 MSIV dual solenoid valve was found to contain moisture and corrosion. Corrosion within the solenoid coil housing cannot affect the valve internals as the valve body is protected from external contamination through body gasket seals in the vicinity of the coil. The subject coil ("B" side) is the lower coil, such that any corrosion products escaping the coil enclosure would fall down away from the solenoid valve body. Additionally, corrosion products were not found within the valve body.

Conclusion

Very unlikely to affect performance.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

NOV 5 1987

MEMORANDUM FOR: R. D. Lanksbury, Team Leader, Perry Augmented Inspection Team (AIT)

FROM: Edward G. Greenman, Deputy Director, Division of Reactor Projects

SUBJECT: AIT CHARTER

Enclosed for your implementation is the Charter developed for the inspection of the events associated with the Perry MSIV failures which occurred on October 29 and November 3, 1987. This Charter was prepared in accordance with the NRC Incident Investigation Manual and the draft AIT implementing procedure issued for use on October 2, 1987. As stated, the objectives of the AIT are to communicate the facts surrounding this event to regional and headquarters management, to identify and communicate any generic safety concerns related to this event to regional and headquarters management, and to document the findings and conclusions of the onsite inspection. If you have any questions regarding these objectives or the enclosed Charter, please do not hesitate to contact either myself or R. Knop of my staff.

Edward G. Greenman

Edward G. Greenman, Deputy Director
Division of Reactor Projects

Enclosure: AIT Charter

cc w/enclosure:
A. B. Davis, RIII
C. J. Paperiello, RIII
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C. Rossi, NRR
G. Holahan, NRR
W. Lanning, NRR
M. Virgilio, NRR
R. Cooper, EDO
K. Connaughton, SRI

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Perry MSIV Stroke Time Failure

Augmented Inspection Team (AIT) Charter

Investigate:

1. Failure of MSIVs to close/close within Technical Specification limits.
2. Safety Significance, Root Cause(s).
3. Interaction of prior maintenance activities to the event.
4. Safety implications if actual Group I isolation signal had been present.
5. History of any previous problems.
6. Broader implications e.g. other systems, other valve/components.
7. Event Reporting.
8. Conclusions.

Questions for Perry AIT

1. Failure of MSIVs to close/close within Technical Specification limits. (10/29/87 and 11/03/87)

   1.1 What was the sequence of events?
   1.2 What were the closure times generated during the surveillance?
   1.3 What operator actions were taken during the event? Were they appropriate?

   1.4 Is there a history of any previous problems (e.g. 10/29 event, etc) with the MSIVs?
   1.5 Did the RPS logic makeup per design during the surveillances?
   1.6 What additional testing was being performed?

2. Safety Significance, Root Cause(s).

   2.1 Was there any immediate safety significance from this event? If so, what was significant?
   2.2 What was the root cause of the event?

3. Interactions of maintenance activities to the event.

   3.1 What is the past and present maintenance history of the MSIVs?
   3.2. What is the maintenance history of the Service Air (SA) and Instrument Air (IA).
   3.3 What testing was performed as the result of maintenance activities?
   3.4 What is the material condition of the affected valves and interconnected instrument air and control systems as it would affect the valve closure function?

4. Safety implications if actual Group I isolation signal had been present.

   4.1 Does the licensee have procedure in place to handle this event?
   4.2 Are they adequate?
   4.3 Have the operators been trained on them?

4.4 Does the accident analysis bound this event?
4.5 What actions were taken by the operators?
4.6 Was the event properly categorized?
4.7 Was the event reported as required?

5. History of any previous problems.

5.1 Have there been previous events similar to this?
5.2. If there were previous events was the licensee aware of them?
5.3 If not, why not?
5.4 Is there information available on other similar events?
5.5 Have there been any IEIN's or IEB's issued or similar subjects?
5.6 Is there information avaiable from other sites of similar problems?

6. Broader Implications.

6.1 Is a IEIN or IEB warranted or a result of this event?
6.2 Are there other valves or instruments that require investigation?
6.3 If the problem lies external to the MSIV's, are there generic implications? e.g. for other plant systems or other plants with same components.

7. Conclusion.

7.1 What corrective actions are proposed, and are they adequate?
7.2 Examine generic implications to other plants and advise NRC management subsequent to the site inspection.
7.3 Document inspection findings in accordance with draft manual chapter 0325.

R-III

AIT ACTION ITEMS

RESPONSIBLE SECTION	ITEM	DELIVERED	DESCRIPTION
OPS/LCS	1. SEQUENCE OF EVENTS A. CLOSURE TIMES B. OPERATOR ACTIONS TAKEN	X X X	o OPS CHRONOLOGY o UNIT LOGS o STA LOG o CONDITION REPORTS o SUMMARY o STI DATA
LCS	2. ADEQUACY OF REPORTING AND CATEGORIZATION OF EVENT	X	o SUMMARY WRITE UP
NED/LCS	3. IMMEDIATE SAFETY SIGNIFICANCE	X	o HISTORY OF EVENTS SUMMARY
OPS/LCS	4. ADDITIONAL TESTING ACTIVITIES IN PROGRESS	X	o SVI LIST o W.O. LISTS/VARIOUS UNITS
I&C/LCS	5. RPS ACTUATION SIGNALS DURING SURVEILLANCES	X	o SVIs
LCS	6. MANAGEMENT DECISION MAKING PROCESS-INFORMATION AVAILABLE	X	o SUMMARY WRITE UP
LCS	7. PREVIOUS MSIV TIMING PROBLEMS	X	o SUMMARY WRITE UP o CANTLIN MEMO
TECH/LCS	8. MSIV MAINTENANCE HISTORY (OTHER THAN STI/SVI) A. RETESTING PERFORMED	X X	o WO LIST - WO's PROVIDED
TECH	9. AIR SYSTEMS MAINTENANCE HISTORY A. RETESTING PERFORMED B. VENDORS MANUALS	X X X	o WO LIST - WOs NOT PROVIDED (NOT IN BOOK) o VARIOUS P52 W.O.s/CRs o 3 VENDOR MANUALS PROVIDE TO NRC
OPS	10. ADEQUACY OF PROCEDURES IN PLACE TO HANDLE EVENT A. OPERATOR TRAINING	X	o OPS SUMMARY
NED/LCS	11. SAFETY SIGNIFICANCE OF INCIDENT (ACCIDENT ANALYSIS)		o HISTORY OF EVENT SUMMARY o GE; MSIV CLOSURE TESTING

D-85

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NED/LCS	12. ANALYSIS OF LOADING ON STEAMLINES (3 CLOSED, 1 OPEN)	X	o GE -EFFECTS OF ISOLATION
LCS	13. PREVIOUS SIMILAR INDUSTRY EVENTS A. LER 86030	X	o NPRD PRINTOUT (NOT IN BOOK) o SERs 36-84, 57-85, o RELATED LER SUMMARIES o PERRY LER 86030
LCS	14. PREVIOUS NRC INFORMATION- BULLETINS, CIRCULARS, INFORMATION NOTICES	X	o IENs; 80-11,81-29,82-52, 83-57,84-23,84-68,85-08, 85-17,85-17-01,85-84, 86-57,78-14 o IEB; 78-14,79-01A
NED/LCS	15. OTHER APPLICATIONS OF ASCO VALVES	X	o EQ LIST
TECH/I&C	16. TROUBLESHOOTING PLAN A. MATERIAL CONDITIONS AFFECT ON CLOSURE B. ANY FURTHER INVESTIGATIONS	X(REV. 0)	o TROUBLESHOOTING PLAN, AIR SYS. o POINTS SAMPLED o SEQUENCE OF TROUBLESHOOT PLAN o PARTICLE COUNTS
	17. GENERIC IMPLICATIONS		
TECH	18. ROOT CAUSE		o GE; PRELIMINARY ANALYSIS
TECH	19. CORRECTIVE ACTIONS		
TECH	20. PLANS FOR STARTUP		
LCS	21. CLOSURE INFORMATION ON 1985 OPEN ITEM ON FSAR AIR QUALITY CHANGE (3 TO 40 MICRONS)	X	o CEI/NRR LTR 0306 o CEI/NRC LTR NOV. 9, 1984 o VIOLATION FROM 84-15 o IER 85-039 o IER 85-066 o IER 85-088 o SSER SUPP 7 - 9.3.1
TECH	22. MESH SIZE OF FLUSH CLOTHS USED ON AIR SYSTEMS TESTS	CLOSED PER DISCUSSIONS	
RPS	23. ANALYSIS OF AIR SYSTEM FLUSH CLOTHS TO VERIFY LESS THAN 40 MICRON PARTICLE SIZE (OIL, WATER)	CLOSED PER DISCUSSIONS	

NED-MDS	24. BRIEF SUMMARY DESCRIBING RELATIONSHIP BETWEEN COMPONENT SUPPLIERS AND MSIV CONTROL AIR PACK ASSEMBLERS (i.e. HILLER SHEFLER, NORGREN, ETC.)	X	o SUMMARY WRITE UP/LIST
OPLS	25. EQUIPMENT QUARANTINE LIST	X	o POD, NOV. 5

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Murray R. Edelman
SR. VICE PRESIDENT
NUCLEAR

November 9, 1987
PY-CEI/OIE-0288 L

Mr. A. Bert Davis
Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Perry Nuclear Power Plant
Docket No. 50-440
Augmented Inspection Team (AIT)
Status and Commitments

Dear Mr. Davis:

This letter provides a preliminary description on the sequence of events, troubleshooting, and conclusions surrounding the MSIV slow closure problem. It also contains corrective actions and commitments made to the AIT on November 9, 1987. The formal report required by your Confirmatory Action letter dated November 4, 1987 will be submitted on or before December 4, 1987.

Based upon the information provided to date, we plan to restart the plant on November 10, 1987 with your concurrence. If you have any questions, please feel free to call.

Very truly yours,

A. Kaplan for

Murray R. Edelman
Senior Vice President
Nuclear Group

MRE:njc

Attachment

cc: K. Connaughton
T. Colburn
Document Control Desk

D-86

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10

I. Executive Summary

On October 29, 1987 the Perry Nuclear Power Plant was completing the final stages of the Startup Test Program. One of these tests involved fast closing one Main Steam Isolation Valve (MSIV). During this test, the valve (1B21-F028D) failed to stroke closed within the required time. All other MSIVs (7) were cycled in order to verify adequate stroke times. Two of the other MSIVs failed to satisfy the required stroke time.

The three valves that initially failed were stroked satisfactorily upon subsequent demand. Based on industry experience involving MSIV control air, the problem was attributed to a one time deposit of debris in the respective solenoids which was exhausted as shown by the subsequent successful stroke. The debris was believed to have caused a delay in the solenoid responses. Based upon the satisfactory stroke, the valves were considered operable and startup testing resumed. Plant management decided to perform the MSIV stroke tests again prior to the last startup test, the full MSIV isolation scram. This approach was discussed with NRC Region III.

On November 3, in preparation for the final startup test, additional stroke timing tests of MSIVs were performed. During the first stroke attempt, two of the same MSIVs (1B21F022D, 1B21F028D) that previously stroked slowly, again failed to close within the required time. The valves were subsequently recycled satisfactorily within minutes of their first tests. However, because the valves again failed to meet the required closure time on the first attempt, the basis for an isolated failure was no longer considered valid. NRC Region III was informed of the problem. The decision was made to shutdown the plant and troubleshoot the problem.

On November 4, an NRC Augmented Inspection Team (AIT) arrived onsite. A troubleshooting plan was established and implemented. The air actuators of the three valves which had exhibited slow closing times were disassembled and the inspection results documented. The conclusion drawn is that the dual solenoids exhibited sluggish action after operating in localized high temperature conditions. It is felt that steam leaks caused a raised temperature environment in the vicinity of the solenoids. The raised temperatures degraded the Ethylene Propylene Diene Monomer (EPDM) material causing the solenoid to stick or to be sluggish. Corrective actions included disassembling all 8 MSIV's dual solenoids, and replacing or rebuilding the solenoids as applicable.

II. Chronology of Events

On October 29, 1987 at 1837 Startup Test Instruction (STI)-B21-025A, "Main Steam Isolation Valve (MSIV) Functional Test" was being performed on 1B21-F022D, the steam line D inboard MSIV. This valve closed in 22.14 seconds. Technical Specification 3.4.7 requires the MSIVs to close in 2.5 to 5.0 seconds. At 2103 and 2106 the D inboard MSIV was cycled with closure times of 3.24 and 2.94 seconds, respectively. All other MSIVs were then cycled to verify closure times. The B outboard MSIV closed in 11.9 seconds and the D outboard MSIV closed in 77 seconds. Each was cycled again with satisfactory results. Since initial conditions causing MSIV slow closure could not be repeated, all MSIVs were declared operable and plant startup testing continued.

On November 3 at 1150, MSIV fast closure timing was commenced in preparation for the MSIV fast closure scram test in accordance with agreements made with the NRC on October 30. At 1157 the D inboard MSIV closed in 18 seconds and was cycled again at 1159 with a closure time of 3.0 seconds. At 1208 the D outboard MSIV failed to close. A second attempt was satisfactory at 1213 with a closure time of 3.4 seconds. The D inboard and outboard MSIVs were declared inoperable and placed in the closed position in accordance with the requirements of Technical Specification 3.6.4.a. Based on repeat failures a plant shutdown commenced at 1330. The reactor was manually scrammed at 1819.

On November 4, the Nuclear Regulatory Commission (NRC) issued a Confirmatory Action Letter (CAL) detailing various steps Perry management was to take and not to take in preparation for an NRC Augmented Inspection Team (AIT). The team arrived onsite November 4.

III. Troubleshooting Activities

Prior to performing any work in the field, a troubleshooting plan was written. Based on the symptoms shown on October 29 and November 3, it was felt that the component with the highest probability of causing the slow closures was the ASCO model number NP-8323A20E dual solenoid found on each MSIV air actuator. Numerous possibilities existed which could have somehow affected these solenoids. The troubleshooting plan was set up to determine what the root cause was and whether any secondary problems had an impact.

On November 5 "As Found" conditions were documented and a more detailed troubleshooting plan was developed to establish the root cause of the MSIV failures and corrective actions necessary to restore the valves to operable condition. The troubleshooting plan was agreed to by the NRC AIT. On November 5 through November 8 various troubleshooting activities were carried out.

The first MSIV investigated was the 1B21-F022D valve (inboard MSIV on "D" line). Solenoid voltages and solenoid air exhaust port samples were taken as the valve was cycled all results were satisfactory. Next the field wiring and air lines were disconnected from the air actuator or air pack. All connections and pipe openings were inspected and any discrepancies noted. The air pack was then removed from the valve actuator and taken to the I&C hotshop for disassembly.

The above steps were repeated for the 1B21-F028B outboard valve and then the 1B21-F028D outboard valve. Any discrepancy no matter how small was documented for further evaluation. Whenever possible pictures were taken of what was found. The major discrepancies appear to be the following:

1. All dual solenoids disassembled have impact marks on the star shaped disk subassembly and a deep depression (dimple) on the disc holder seal (EPDM), with the solenoids of the B21-F028D indicating the most degradation.

2. Many of the EPDM Body Assembly O-Rings were hard, flattened, and adhering to metal surfaces.

3. In the 1B21-F022D valve rust was found inside the solenoid valve body, and the B solenoid coil was badly corroded.

In addition to the component disassembly three types of air analyses were performed to determine what contribution, if any, instrument air quality may have had in the failure of the MSIV valves. Filter samples were collected to determine particulate matter present in the instrument air system at the solenoid and actuator supply points. Various unknown substances observed in or collected from internal component surfaces were analyzed using infrared spectrophotometry to deduce origin of materials found. Grab samples of the air supply were analyzed by gas chromatography for hydrocarbon content and quantification of organic contaminants if present in significant quantities.

The samples collected on filter paper for particulate were analyzed under a microscope. Very small quantities of particles greater than 40 micron were identified which indicates acceptable air system quality. Therefore, it is a very low probability that the particles had an adverse effect upon the solenoid valve operation. Analyses of the substances collected during disassembly identified the presence of thread sealant and silicone lubricant, both of which are normally used during assembly of solenoid valves and air lines. Air supply grab samples indicated no hydrocarbons present in the instrument air supply. Not True

Based on all the information [observations of disassembled solenoid valves] it appears that the EPDM material used in various parts of the solenoid was interfering with solenoid valve movement. Thus, the decision was made to disassemble the dual solenoids on all 8 MSIVs, and refurbish as necessary.

IV. Root Cause

The cause of the MSIV delayed closures has been isolated to a failure of the ASCO dual solenoid valves. This failure is attributed to EPDM elastomer degradation due to elevated temperatures in the vicinity of the air packs resulting from steam leaks. The observed hardened dimples on the disc holder assembly and core assembly hardened elastomer seals is consistent with high temperature conditions. Other evidence of localized steam effects include degradation of the solenoid valve O-rings and observed rust/moisture discoloration of the 1B21-F022D solenoid coil.

Localized high temperature conditions existed during the plant cycle due to steam leakage and elevated area temperature indications. Steam leakage is known to have occurred in MSIV 1B21-F022B packing and the MSIV leakage control system isolation valves. This leakage was in the direct vicinity of those MSIV's which exhibited slow closure. Steam in excess of 300 degrees F is suspected of leaking in the direct location of the subject MSIV air packs based upon the degredation of the EPDM.

V. Corrective Actions

The following evaluations and actions have been or will be completed prior to plant startup:

1. For the dual (fast closure) solenoid the total air pack will be replaced for the 1B21-F028D valve, and the whole dual solenoid will be replaced on the 1B21-F022D valve. No other solenoids showed significant degradation or required replacement. All of the other MSIV dual solenoids have been rebuilt.

2. For the single (slow closure) solenoid the solenoid will be replaced on the 1B21-F028D, since the whole air pack is being replaced. Based on the inspection results above, no other replacements were necessary.

3. A evaluation has been performed of other ASCO solenoid Class 1E harsh environment applications in the plant, including those which may have been subject to the steam leak environment which affected the MSIV solenoids. The review identified two normally deenergized solenoids which do not serve an active safety function. Work history review of all other applications has shown no solenoid failures.

4. An evaluation will be made of other equipment in the vicinity of the 1B21-F022D, 1B21-F028D, and 1B21-F028B valves, to assess any impact that the steam leaks may have had on these components.

5. Additional temporary temperature monitoring will be installed in the steam tunnel on the preselected sample points in the MSIV area including the dual and test solenoid bodies. This monitoring will be used to evaluate the actual temperature profile of the complete MSIV actuator assembly and the surrounding area. Following completion of the Startup Test Program, temporary temperature indication will also be installed in the drywell for monitoring of the inboard MSIVs.

The following additional evaluations and actions will be performed:

1. Further evaluation will be performed on the exsisting industry experience and efforts on ASCO solenoid valve failure investigations. This evaluation will include such areas as using different metal, and non-metal materials, and the effect of hydrocarbons. Possible design improvements, including an exhaust port screen will be evaluated. Based on these evaluations a determination will be made on future actions including replacement frequencies.

2. A sampling plan for the solenoid elastomer components will be established. Analyses of these components are expected to confirm that hydrocarbons did not contribute to the EPDM degradation. Dew point and particulate sampling of the instrument air system will continue at the existing test frequency.

   A preventive maintenance requirement will be established for periodic replacement of the instrument air system prefilters. The maintenance frequency will be consistent with replacement of the instrument air system after filters. Additionally a generic precaution will be added into air system work orders regarding the use of thread lubricants and sealants.

   An evaluation will also be made of the relative physical location of the air compressors reduction gear vents, and the compressor air intake, to determine the need for modification, and/or periodic replacement of the intake filter.

3. Until the first refueling outage the full closure dual solenoids will be checked for proper operation during the monthly slow closure check. This will be performed by fully closing each MSIV individually utilizing the test solenoid, followed by taking the control switch to close, thus verifying the proper operation of the dual solenoid. Also during this time frame the MSIVs will be cycled individually on a quarterly basis regardless of plant operating conditions, and the fast closure time verified. On an interval not to exceed six months an inspection will be performed on a dual solenoid during an outage of opportunity. This inspection will verify no degradation of the solenoid valve internals.

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PERRY NUCLEAR POWER PLANT

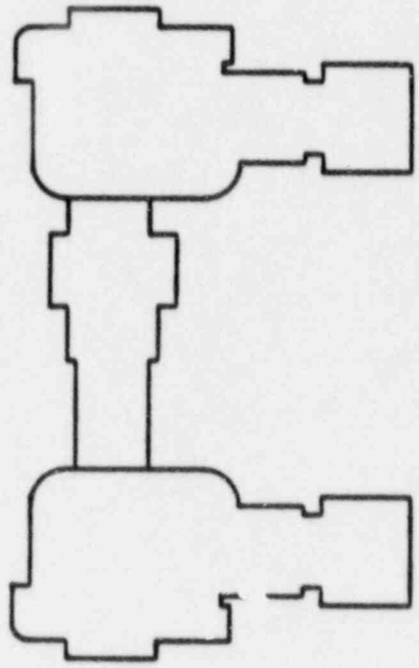
TASK 3 SOLENOID VALVE

ENVIRONMENTAL (THERMAL ENDURANCE) TEST PLAN

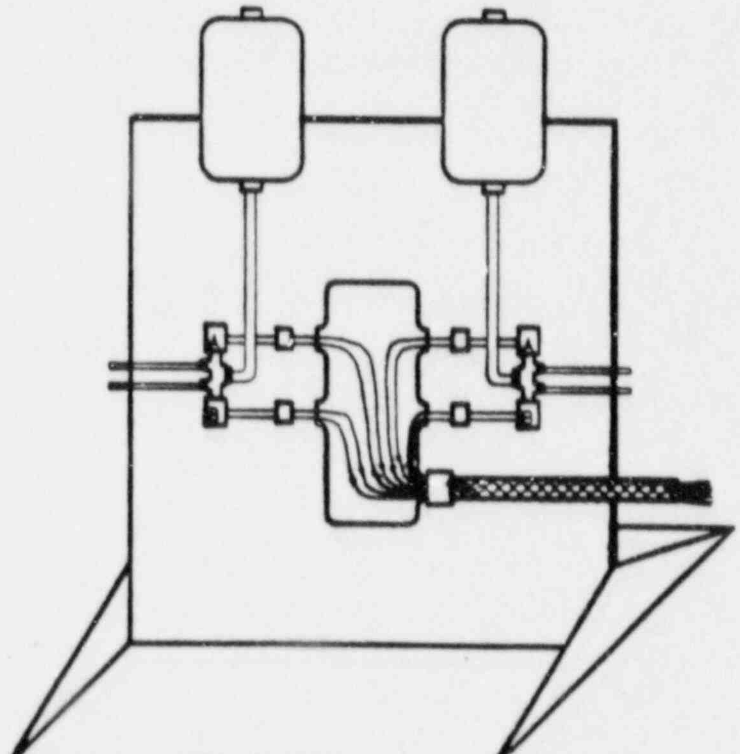
D-54

~~8712040331~~

MSIV EQ VALIDATION
TASK 3, SOLENOID VALVE
ENVIROMENTAL (THERMAL ENDURANCE) TEST PLAN
PERRY NUCLEAR POWER PLANT



TEST STAND PICTURE
FIG. 1



NOVEMBER 23, 1987

MSIV E.Q. VALIDATION

TASK 3, SOLENOID VALVE

ENVIRONMENTAL (THERMAL ENDURANCE) TEST PLAN

FOR PERRY NUCLEAR POWER PLANT

NOVEMBER 23, 1987

Prepared by Gary Elam 11.21.87
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Ken Matheny

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1.0 SCOPE

This test plan describes the requirements, procedures, and acceptance criteria for thermal endurance testing of ASCO NP 8323 A20E solenoid valves for use as MSIV pilot valves at the Perry Nuclear Power Plant (PNPP). This environmental test is required per reference 3.1, page 4, item 1.

2.0 PURPOSE

The purpose of this program is to demonstrate that the solenoid valves will perform their safety function at a variety of elevated temperatures for a specific length of time in a continuously energized state. The ASCO pilot valve's safety function is to vent air pressure and close off supply air from the two-way and four-way Norgren air control valves which causes the 20-inch air cylinder to extend and thus close the MSIV.

3.0 REFERENCES

3.1 Letter PY-CEI/OIE-0289L, November 13, 1987, Murray R. Edelman (CEI) to A. Bert Davis (NRC, Region III).

3.2 ASCO Drawing FV 236843, July 10, 1987, Maximum Temperature of Coil and Critical Elastomers with Valve Energized and No Flow.

3. Maintenance and Instruction Manual for Model SA-A068 Valve Actuator, Ralph A. Hiller Company.

3.4 ASCO Bulletin 8323, Installation and Maintenance Instructions, Form V5972R1, 1981.

4.0 TEST EQUIPMENT

4.1 Test Specimen Description

Six new ASCO NP 8323 A20E solenoid valves shall be utilized for testing and shall be designated as test specimens 1 through 6. The valve description is as follows (see Appendix I):

Three-way, normally closed valve.
Dual solenoids, 120 VAC each.
EPDM seats and elastomers.
Individually serialized.

The valves shall be supplied by The Cleveland Electric Illuminating Company (CEI) complete with pipe fittings installed in the solenoid housing conduit connection and a conduit seal of Bisco sealant. The pipe fittings and conduit seal shall be representative of the valves installed on the MSIVs at PNPP.

4.2 Test Specimen Marking and Labeling

At receipt inspection, each specimen will be labeled with an aluminum or stainless steel tag indicating specimen number. The test lab shall also keep records of the valve serial number versus specimen number.

4.3 Air Supply

The compressed air used for this testing shall be clean, dry, and free of hydrocarbons as follows: maximum particle size, 40 micron; dew point, 40 degrees Farenheight; and hydrocarbon content, less than 1 parts per million. A 50 micron filter shall be installed up-stream of the test specimens. The compressed air shall be sampled for dew point and hydrocarbons prior to testing.

4.4 Power Supply

The specimens shall be supplied with 120 + 5 - 0 VAC uninterruptable power.

4.5 Instrumentation

All test equipment and instrumentation to be used in the performance of this test program must be calibrated in accordance with the test facility's QA program which conforms to ANSI N45.2, 10CFR50/Appendix B, 10CFR21, and Military Standard MIL-C-45662A. Standards used in performing all calibrations shall be traceable to the National Bureau of Standards.

4.5.1 Measurements and Tolerances

Instrument	Tolerance
Pressure Transducer	$\pm$ 3 psi
Thermocouple (Type K)	$\pm$ 4° F
Multimeter	$\pm$ 2%

Note: Whenever possible, use instrumentation within middle third of specified range.

5.0 ACCEPTANCE CRITERIA

The valves shall operate upon demand without sticking or binding. When de-energized, the valves shall vent the 27-cubic-inch air tank from 90 to 30 psig in 2.0 seconds or less. Otherwise, the data collected will be analyzed by CEI personnel in accordance with the requirement for the MSIV to fast close within 5 seconds.

6.0 TEST PROGRAM

6.1 Test Sequence

Testing shall be conducted in the following sequence:

Baseline Tests
Thermal Endurance Test
Post-thermal Test
Disassembly and Inspection

6.2 Baseline Tests.

6.2.1 Visual Inspection

The valves shall be visually inspected and photographed. Any damage shall be noted and reported to the CEI representative. Verify specimens are properly tagged.

6.2.2 Functional Tests

Configure the specimens as shown in Figures 1, 2, and 3, except do not heat the oven. Clean and blow out all air system components prior to test to reduce the risk of contamination entering the specimens. Consult Appendix I for installation requirements. Energize both solenoid coils for each specimen, allowing the air tanks to pressurize to 90 to 100 psig. Measure the voltage, in-rush current, and the steady-state current for each solenoid. Allow the specimens to remain energized four hours in order to stabilize their temperatures. Record the specimen and ambient temperatures (Figure 2) hourly. Measure leakage at the vent in accordance with paragraph 6.2.2.1. De-energize both solenoids together and plot the tank's pressure decay curve versus solenoid switch signal. The tank should be exhausted in 2 to 4 seconds. Time shall be measured to within 0.05 seconds and pressure shall be accurate to $\pm$ 3 psi.

Immediately following the initial de-energization, repeat the above process twice in the following sequence:

1. Energize both solenoids. Measure voltage, in-rush current, and steady-state current for each solenoid.

2. Perform leakage measurement at vent per paragraph 6.2.2.1.

3. At 30 minutes after energization (step 1), de-energize both solenoids. Plot pressure decay versus solenoid switch signal.

If a specimen exhibits leakage greater than 1 cc per minute, that specimen must be repaired or replaced and the baseline test repeated.

6.2.2.1 Leakage Measurement

Leakage measurements are performed as an indicator of specimen degradation. Leakage measurements shall be performed using an inverted graduated cylinder as shown in Figure 4. Leakage shall be measured in ml per minute (cc/min) of air and shall be of five-minute duration. Leakage measurements are for information only; therefore, calibrated equipment for leakage measurements is not required.

6.3 Thermal Endurance Test

The six test specimens shall be tested in three groups of two specimens each per Table 1. Each set of two specimens will be placed in a separate oven. The oven temperature will be maintained continuously for 92 days. Specimen and oven temperatures (Figure 2) shall be recorded hourly. The air pressure to the specimens shall be maintained at 90 to 100 psig during the entire 92-day test. The solenoids will remain energized at 120 + 5 - 0 VAC during the entire 92-day test except for de-energization during cycle tests. The odd-numbered specimens will be cycled (de-energized/energized) every 30 days to simulate the monthly surveillance tests being conducted at PNPP. Specimen 4 will be cycled (de-energized/energized) at 42 days and once every seven days thereafter. Specimens 2 and 6 will not be cycled (de-energized/energized) until after the 92nd day.

Air tank pressure decay plots will be generated for each de-energization as described in paragraph 6.2.2. Perform a leakage test per paragraph 6.2.2.1 on each specimen each working day (Monday through Friday) and after each de-energization/energization cycle. At the end of the 92 days, notify CEI for approval to proceed to paragraph 6.4, Post-thermal Functional Test.

If a specimen fails to operate upon demand or otherwise exhibits anomalous behavior, contact the CEI representative for disposition.

6.4 Post-thermal Functional Test

At the conclusion of the testing specified in paragraph 6.3, turn off the ovens, open the oven doors, allow the ovens to cool to room ambient conditions, and repeat the baseline tests specified in paragraph 6.2.

6.5 Test Documentation

A test log and data sheets shall be maintained to provide a complete history of testing. Each log sheet and data sheet shall be identified by the project number and shall be signed and dated by the person making the measurements. Interim test results will be provided to CEI biweekly. CEI must approve the data sheets prior to testing.

A final report will be issued providing a complete description of the requirements, procedures, and results associated with the test program.

7.0 POST-TEST INSPECTION

At the conclusion of testing, the test specimens will be disassembled, inspected, and photographed. In addition to overall specimen photos, closeup photos of the EPDM discs and seals and their mating metal parts will be made. The use of oil, lubricant, or any potential contaminant is prohibited during the disassembly and inspection. All personnel handling the valve parts shall wear clean rubber gloves. Individual valve parts will be labeled and stored in plastic bags. All specimens are to be returned to CEI for possible further chemical and physical analysis.

8.0 QUALITY ASSURANCE

The test program will be conducted in accordance with the test facility's QA program which shall meet the requirements of ANSI N45.2, 10CFR50/Appendix B, and 10CFR21.

8.1 Notices of Anomaly

If, at any time during the test program, an anomaly occurs, CEI will be notified by telephone within 24 hours and in writing within five working days. The details of the anomaly shall be fully described including date, time, duration, etc.

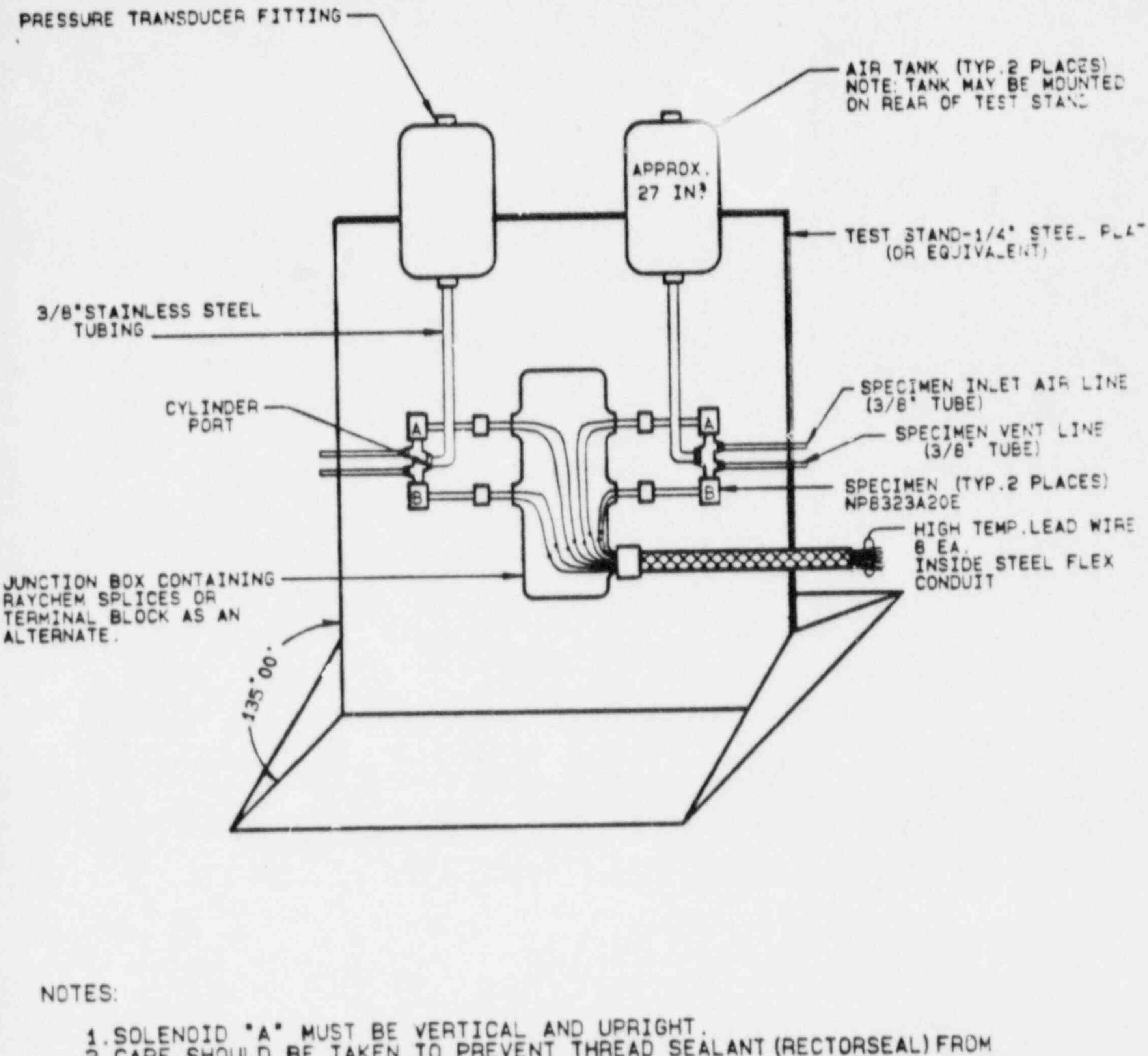
TABLE 1

OVEN TEMPERATURE REQUIREMENTS

Specimens	Oven Temperature (°F)	Comments
1 and 2	140	Maximum postulated PNPP ambient for mid-drywell and steam tunnel (see reference 3.2, Appendix I).
3 and 4	190	This oven temperature should produce a core disc temperature of 284°F (see Appendix II). Adjust the oven temperature as required to attain TC2 (valve body) equal to 284°F. This simulates the original qualification test aging temperature of 284°F for 42 days with solenoids de-energized (see NEDC-30800).
5 and 6	225	This temperature will challenge the limitations of the specimens.

NOTES:

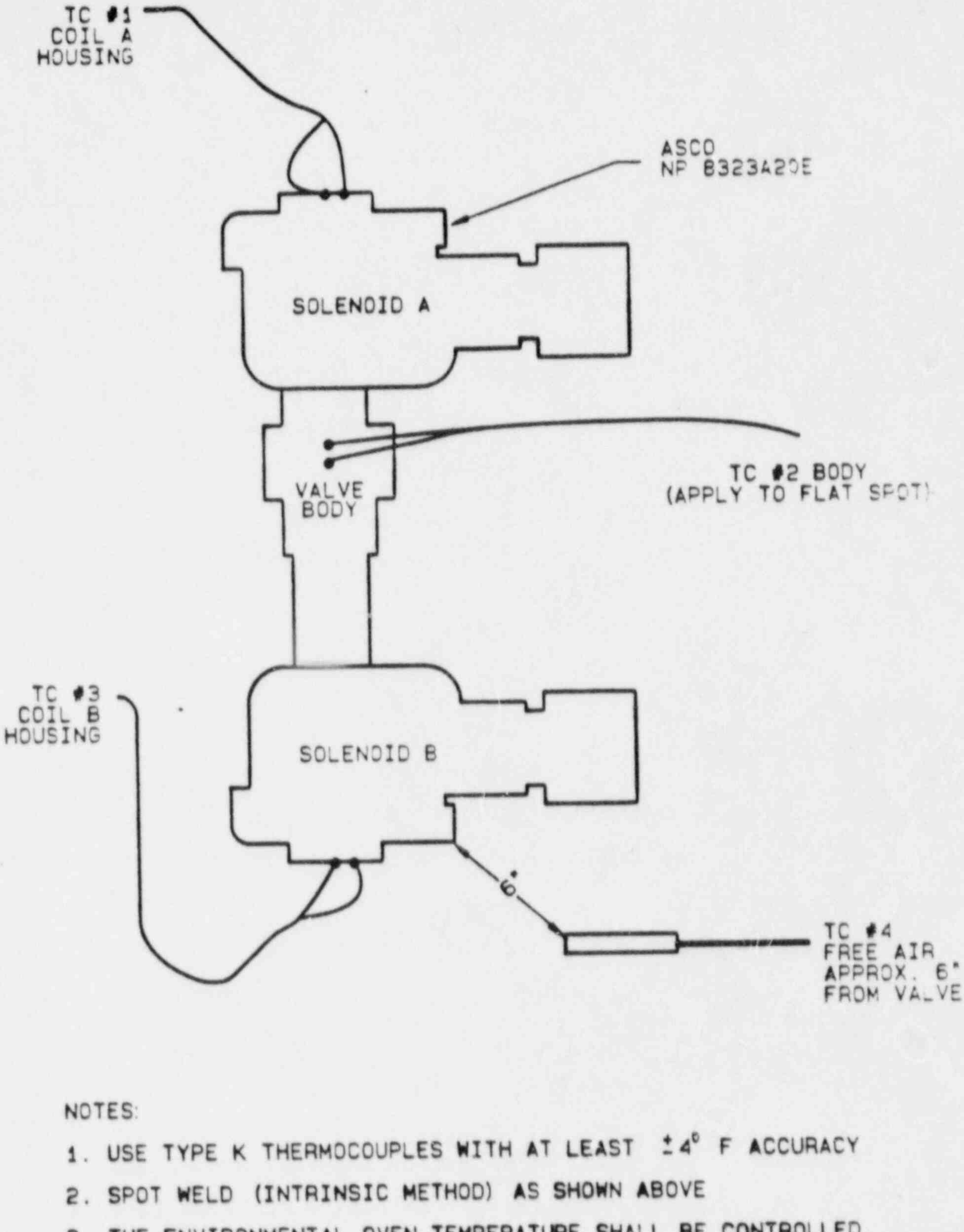
1. Oven temperatures shall be maintained and recorded every hour within +5 to -0°F of temperature setting.



NOTES:

1. SOLENOID "A" MUST BE VERTICAL AND UPRIGHT.
2. CARE SHOULD BE TAKEN TO PREVENT THREAD SEALANT (RECTORSEAL) FROM ENTERING AIR LINES.
3. TUBING FROM SPECIMEN CYLINDER PORTS TO AIR TANKS AND TUBING FROM SPECIMEN VENT PORTS MUST BE OF UNIFORM SIZE AND LENGHT, WITH GOOD QUALITY BENDS FREE OF CRIMPS OR KINKS.
4. THE TEST LAB WILL SUPPLY ALL MATERIALS FOR THE TEST STAND WITH THE EXCEPTION OF THE ASCO NP83223A20E TEST SPECIMENS. THREE TEST STANDS WILL BE REQUIRED, WITH THE TEST LAB MAKING ALL THREE TEST STANDS IDENTICAL.

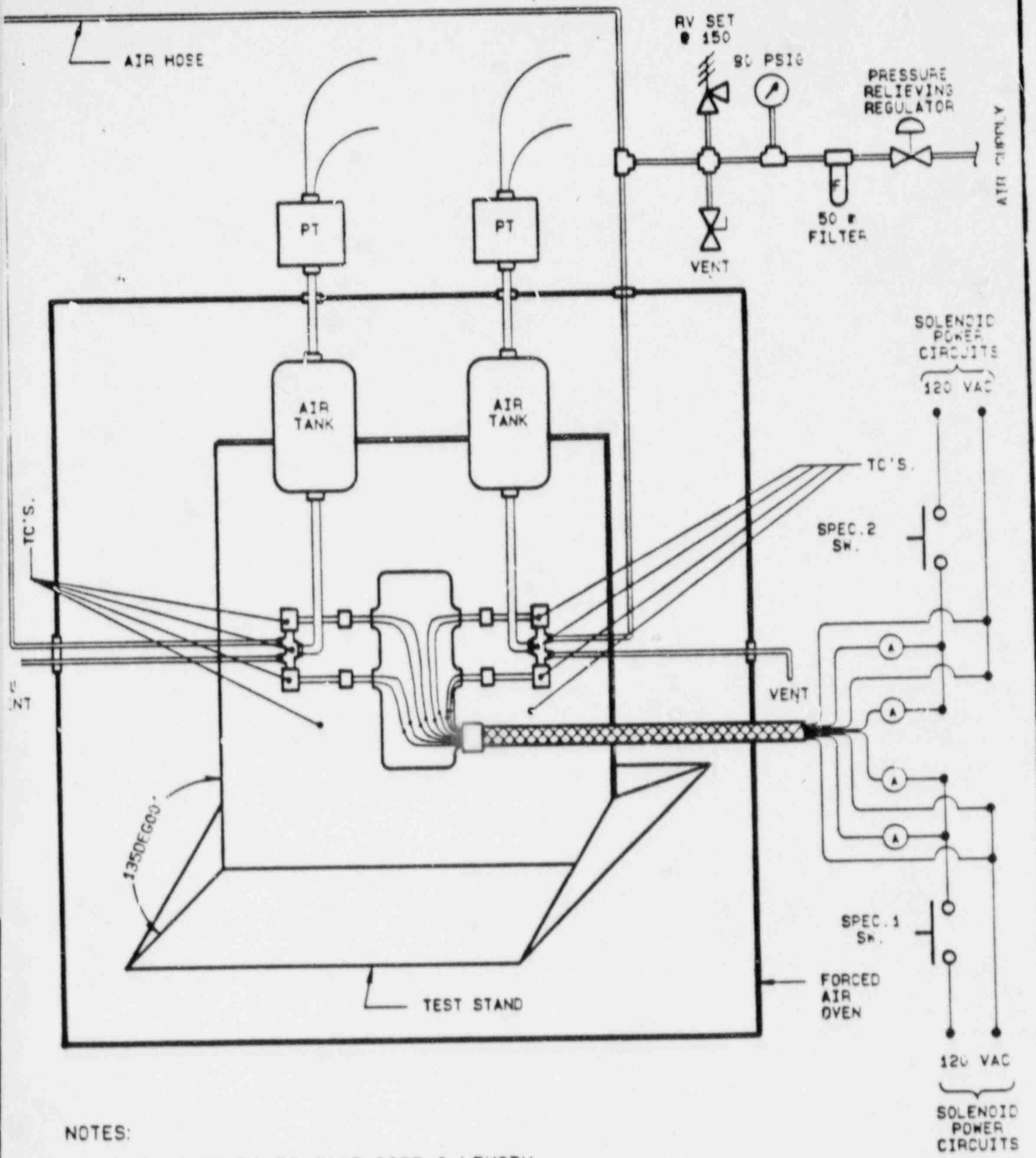
FIG.1 TEST STAND



NOTES:

1. USE TYPE K THERMOCOUPLES WITH AT LEAST ±4° F ACCURACY
2. SPOT WELD (INTRINSIC METHOD) AS SHOWN ABOVE
3. THE ENVIRONMENTAL OVEN TEMPERATURE SHALL BE CONTROLLED FROM TC #4.

FIG. 2 THERMOCOUPLE
MOUNTING INSTRUCTIONS



NOTES:

1. VENT LINES TO BE SAME SIZE & LENGTH.

2. CONNECT SWITCH INDICATION AND PT'S TO PLOTTER TO RECORD SWITCH VS. PRESSURE DECAY.

3. SHROUD THE SOLENOIDS FROM AIR DRAFTS.

FIG.3 THERMAL ENDURANCE TEST SET-UP

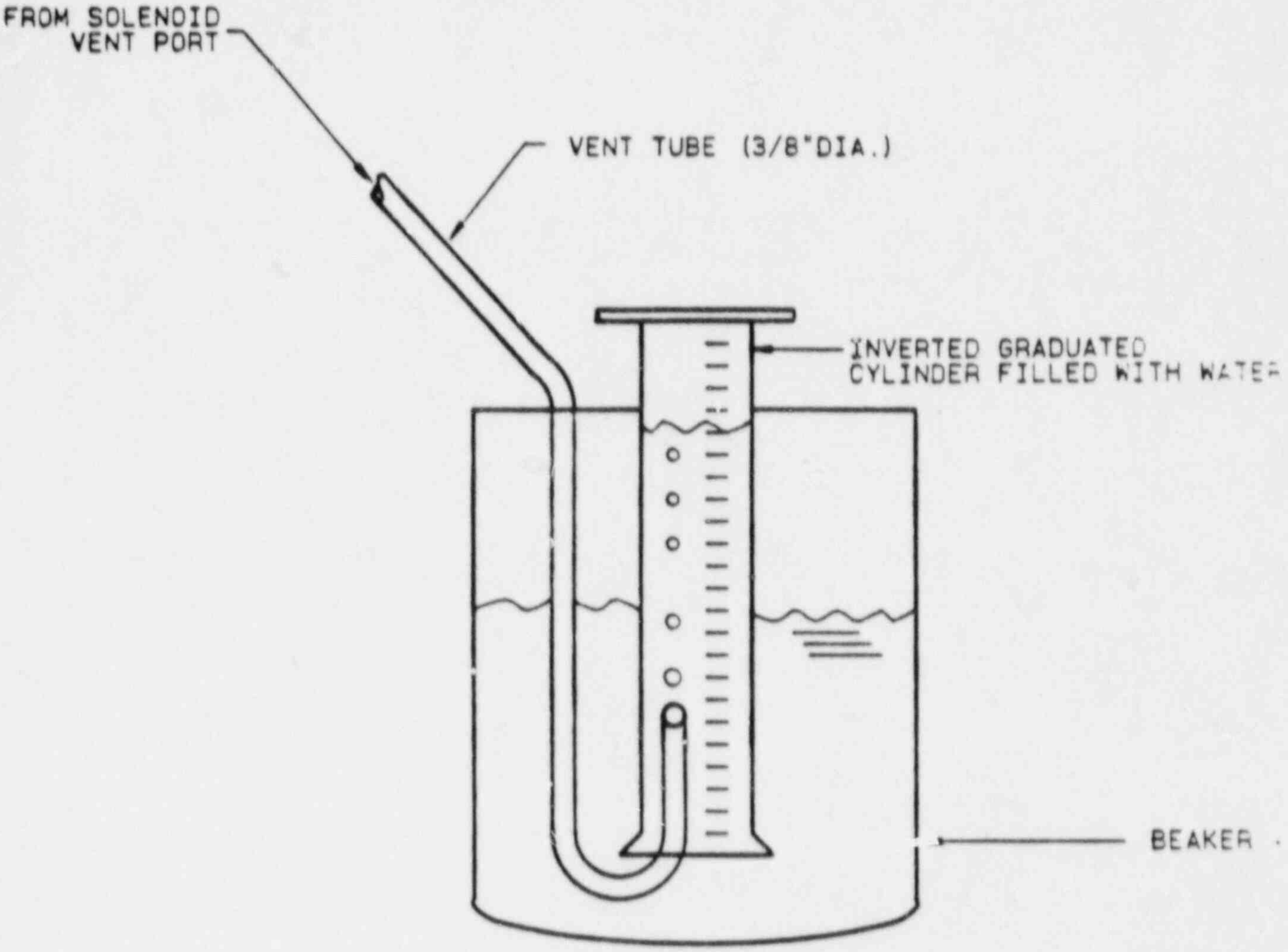


FIG. 4
LEAKAGE TEST SET UP

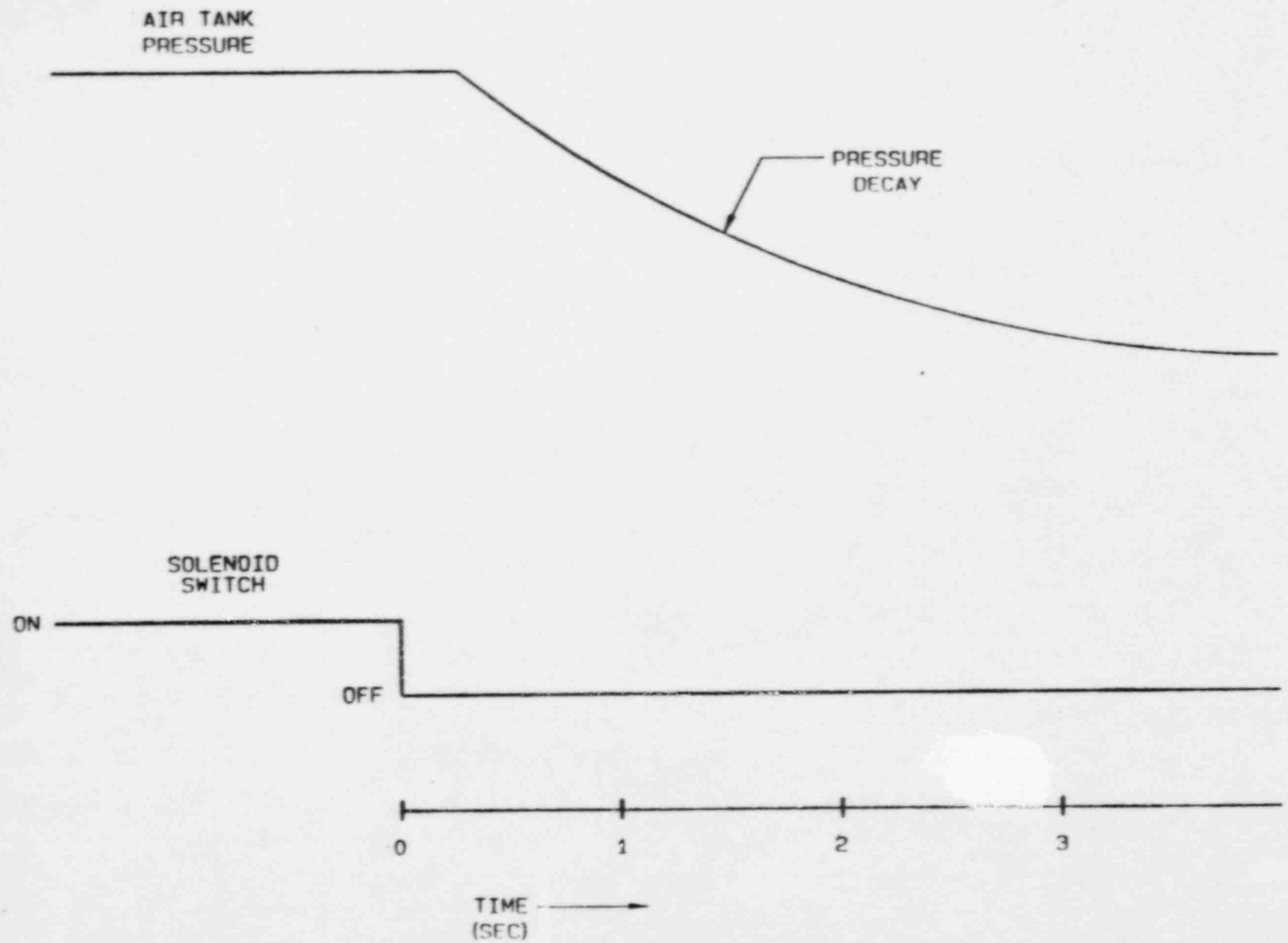


FIG. 5 TYPICAL PRESSURE
DECAY PLOT

APPENDIX I

NP 8323 A20E

DRAWINGS, INSTALLATION, AND MAINTENANCE INSTRUCTIONS

INSTALLATION AND MAINTENANCE INSTRUCTIONS

3-WAY NUCLEAR POWER PLANT SOLENOID-OPERATED PILOT VALVES
NORMALLY CLOSED AND NORMALLY OPEN OPERATION
1/4 NPT – 1/16, 3/32 AND 1/8 ORIFICES
INSTRUMENT AIR SERVICE

BULLETIN 8323

ASCO

Form No. V5972R1

DESCRIPTION

Bulletin 8323 valves with Prefix "NP" in the catalog number are 3-way, direct acting solenoid valves designed as nuclear power plant pilot valves. Valves are of brass construction with two independent solenoids each or both capable of operating the valve when energized. Valve elastomers are ethylene propylene (Suffix "E") for oil-free or VITON* (Suffix "V") for non-oil-free instrument air service. Standard valves have a Watertight, NEMA Type 6 Solenoid Enclosure. Valves may also be equipped with an Explosion-Proof/Watertight Solenoid Enclosure which is designed to meet NEMA Type 4 – Watertight, NEMA Type 7 (C or D) Hazardous Locations – Class I, Groups C or D and NEMA Type 9 (E, F or G) Hazardous Locations – Class II, Groups E, F or G. Installation and Maintenance Instructions for this solenoid enclosure are shown on Form No. V5380.

OPERATION

NORMALLY CLOSED (Pressure at Connection "2")

Both Solenoids De-energized: Flow is from Connection "1" to Connection "3."

Either or Both Solenoids Energized: Flow is from Connection "2" to Connection "1."

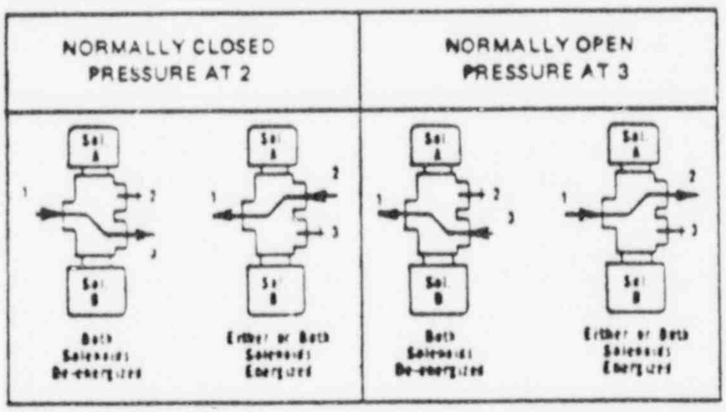
NORMALLY OPEN (Pressure at Connection "3")

Both Solenoids De-energized: Flow is from Connection "3" to Connection "1."

Either or Both Solenoids Energized: Flow is from Connection "1" to Connection "2."

NOTE: To change from normally closed to normally open operation, consult ASCO.

FLOW DIAGRAMS



INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

POSITIONING

Valve must be mounted with Solenoid "A" in a vertical and upright position (see Figure 2).

MOUNTING

For body boss mounting dimensions refer to Figure 2.

PIPING

Connect piping or tubing to valve according to markings on valve body. Refer to flow diagrams provided. CAUTION: Valves supplied for oil-free instrument air service are equipped with ethylene propylene elastomers which can be attacked by oils and greases. Wipe the pipe threads clean of cutting oils. This precaution does not apply to valves with Viton elastomers (Suffix "V" in catalog numbers). Piping to all valve ports should be oriented such that any accumulated moisture (particularly LOCA chemical spray) will not enter the internal areas of the valve. For applications where exhaust piping is not required, install a downward-directed street elbow in the valve exhaust port. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain on valve body should be avoided by proper support and alignment of piping. When tightening connections, do not use valve body or solenoid as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point.

IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on service conditions. See Bulletins 8600 and 8601 for strainers.

As an additional precaution against malfunction on start-up, resulting from large particles of pipe scale, weld splatter or other debris in pipe line, these valves have a large-mesh screen (not a filter) at inlet. This screen is not a substitute for the strainers or filters recommended above, whose function is to provide continuous straining or filtration of the line fluid.

WIRING

Wiring must comply with all applicable Local and National Electrical Codes. Housings are provided with a 1/2 NPS or 3/4 NPT conduit connection. Connect wiring through conduit of suitable quality for the expected environment to a vented electrical junction box located in the same area as the valve. The conduit/junction box system should be oriented such that any accumulated moisture or LOCA spray will not run into the solenoid enclosure. The watertight solenoid enclosure may be rotated to facilitate wiring. Refer to Form No. V5380 for the method used to rotate the explosion-proof/watertight solenoid enclosure.

NOTE: Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert Solenoid "B" from one to the other, it is necessary to change the complete solenoid.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous-duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary depending on medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean valve strainer or filter when cleaning solenoid valve.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible. Use instrument quality air, oil-free for Suffix "E."
2. While in service, operate valve periodically to insure proper opening and closing.
3. Periodic inspection (depending upon medium and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.
4. The valves may require periodic replacement of the coils and all resilient parts during their installed life to maintain qualification. The exact replacement period will depend on ambient and service conditions. Spare Parts Kits and Coils are ordered separately (see Ordering Information). Consult ASCO for specific recommendations in connection with the replacement of parts.

IMPROPER OPERATION

1. Faulty Control Circuit: Check the electrical system by energizing the solenoid. A metallic click signifies solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or grounded coil, broken lead wires or splice connections.
2. Burned-Out Coil: Check for open-circuited coil. Replace coil if necessary.
3. Low Voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating for A-C and non-battery operated D-C valves. Voltage must be at least 72% of nameplate rating for battery-operated D-C valves.
4. Incorrect Pressure: Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. Excessive Leakage: Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT

Refer to Form No. V5380 for Explosion-Proof/Watertight Solenoid Enclosure.

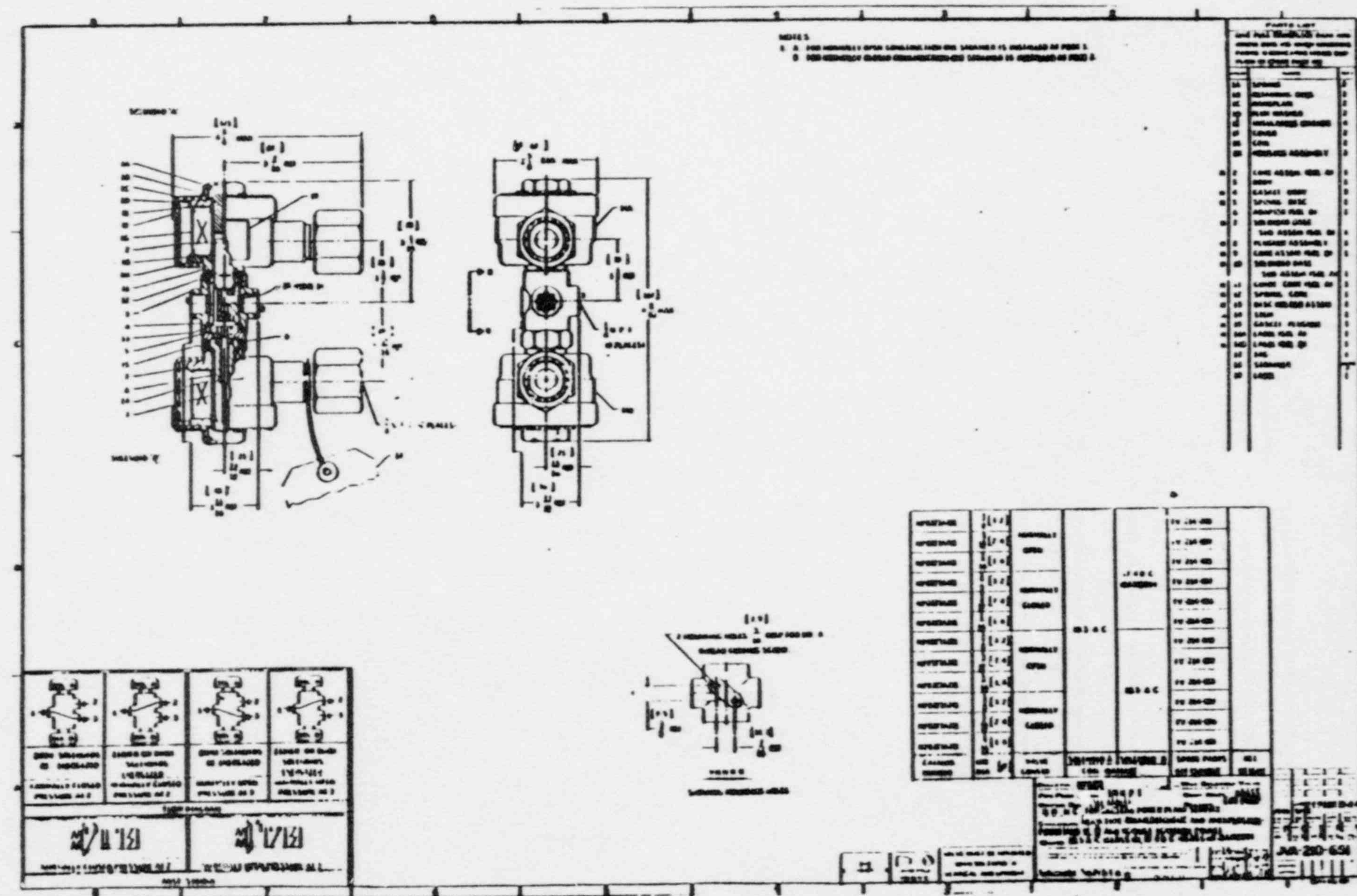
Turn off electrical power supply and disconnect coil lead wires. For A-C (Alternating Current) Construction, refer to Figures 2 or 3. For D-C (Direct Current) Construction, refer to Figure 1. Proceed in the following manner:

1. Loosen cover screws (3) and remove cover with screws, cover gasket and nameplate.
2. Unscrew and remove retaining clip from solenoid base sub-assembly.
3. For A-C Construction, remove yoke containing spring washer, coil and insulating washers (2). For D-C Construction, remove coil washers

*DuPont's registered trademark.

ASCO Valves ASCO

FLORHAM PARK, NEW JERSEY 07932



975-30507

(2), coil and insulating washers (2). Insulating washers (2) are omitted when a molded coil is used.
4. Reassemble in reverse order of disassembly, paying careful attention to exploded view provided for identification and placement of parts.
5. When replacing retaining clip, tighten until retaining clip is not free to rotate, approximately 9/32 of an inch between screw head and nut.
6. Torque cover screws evenly to 10 inch-pounds [1,1 newton meters] to insure proper gasket compression.

CAUTION: Solenoid must be fully reassembled, as the housing and internal parts are part of and complete the magnetic circuit. Place an insulating washer at each end of coil, if required.

VALVE DISASSEMBLY (Refer to Figures 1, 2 and 3.)

Depressurize valve and turn off electrical power supply.

1. Disassemble valve in an orderly fashion paying careful attention to exploded views provided for identification and placement of parts.
2. Starting with Solenoid "A," loosen cover screws and remove cover with screws, cover gasket and nameplate. For explosion-proof/watertight solenoid enclosure, refer to Installation and Maintenance Instructions, Form No. V5380.
3. Unscrew and remove retaining clip from solenoid base sub-assembly.
4. Slip yoke containing spring washer, coil and insulating washers (2) off the solenoid base sub-assembly. NOTE: Insulating washers (2) are omitted when a molded coil is used.
5. Unscrew solenoid base sub-assembly with special wrench adapter supplied in Spare Parts Kit (Wrench Adapter Order No. 206-400-1).
6. Remove solenoid base sub-assembly, upper solenoid base gasket, housing, retainer gasket, retainer and core assembly with core spring and core guide.
7. Remove body gasket from valve body.
8. For Solenoid "B," loosen cover screws and remove cover with screws, cover gasket and nameplate.
9. Unscrew and remove retaining clip from solenoid base sub-assembly.
10. For A-C (Alternating Current) Construction, slip yoke containing spring washer, coil and insulating washers (2) off the solenoid base sub-assembly. For D-C (Direct Current) Construction, slip coil washers (2), insulating washer, coil and insulating washer off the solenoid base sub-assembly. NOTE: Insulating washers (2) are omitted when a molded coil is used.
11. Unscrew solenoid base sub-assembly with special wrench adapter supplied in Spare Parts Kit.
12. Remove solenoid base sub-assembly, upper solenoid base gasket, housing, retainer gasket, retainer, core, plugnut gasket, plugnut assembly and stem engaged in solenoid base sub-assembly. Remove adapter gasket from adapter.
13. Unscrew adapter and remove disc holder spring, disc holder sub-assembly and body gasket.
14. All parts are now accessible for cleaning or replacement. Clean all internal passageways thoroughly before valve reassembly. Replace worn or damaged parts with a complete Spare Parts Kit for best results. When installing a complete Spare Parts Kit, it is recommended that the coils also be replaced.

VALVE REASSEMBLY

1. Reassemble in reverse order of disassembly, paying careful attention to exploded views provided for identification and placement of parts.
2. Lubricate all gaskets (except cover gasket) with a light coat of DOW CORNING® 550 Fluid lubricant (supplied in Spare Parts Kit).
3. Starting with Solenoid "B," install body gasket, disc holder sub-assembly and adapter. Torque adapter to 175 ± 25 inch-pounds [19,8 ± 2,8 newton meters].
4. Replace upper solenoid base gasket on solenoid base sub-assembly.
5. Position solenoid base sub-assembly in housing and install core, (small end in first), plugnut gasket, plugnut assembly and stem (small end into core).
6. Replace retainer gasket, retainer, body gasket and position disc holder spring.
7. Holding the solenoid base sub-assembly securely, engage the solenoid base sub-assembly into the adapter using special wrench adapter provided in Spare Parts Kit (Wrench Adapter Order No. 206-400-1). Torque solenoid base sub-assembly to 175 ± 25 inch-pounds [19,8 ± 2,8 newton meters].
8. For A-C (Alternating Current) Construction, position insulating washers (one at each end of coil), coil and spring washer in yoke. Slip the yoke over the solenoid base sub-assembly. For D-C (Direct Current) Construction, replace insulating washer, coil, insulating washer and coil washers (2).
9. Replace retaining clip and tighten until retaining clip is not free to rotate, approximately 9/32 of an inch between screw head and nut.
10. Replace cover gasket and cover with nameplate and screws. Torque cover screws evenly to 10 inch-pounds [1,1 newton meters] to insure proper gasket compression.
11. Install solenoid base gasket on solenoid base sub-assembly.
12. For Solenoid "A," position solenoid base sub-assembly in housing and install retainer gasket, retainer at base of solenoid base sub-assembly.
13. Install body gasket and position core assembly with core spring and core guide into solenoid base sub-assembly.
14. Install solenoid base sub-assembly using special wrench adapter provided in Spare Parts Kit. Torque solenoid base sub-assembly to 175 ± 25 inch-pounds [19,8 ± 2,8 newton meters].
15. Position insulating washers (one at each end of coil), coil and spring washer in yoke. Slip yoke over solenoid base sub-assembly.
16. Replace retaining clip and tighten until retaining clip is not free to rotate, approximately 9/32 of an inch between screw head and nut.
17. Replace cover gasket and cover with nameplate and screws. Torque cover screws evenly to 10 inch-pounds [1,1 newton meters] to insure proper gasket compression.
18. After maintenance, operate the valve a few times to be sure of proper operation.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves.
Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number, Voltage and Hertz A-C, or D-C.

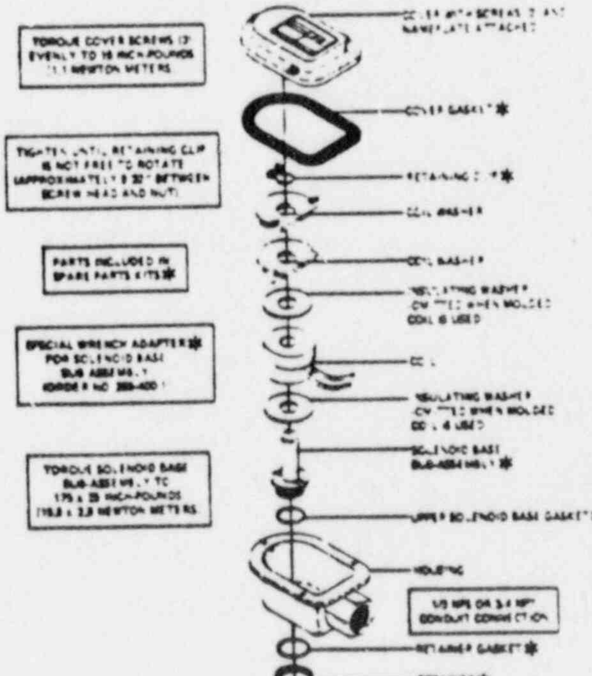
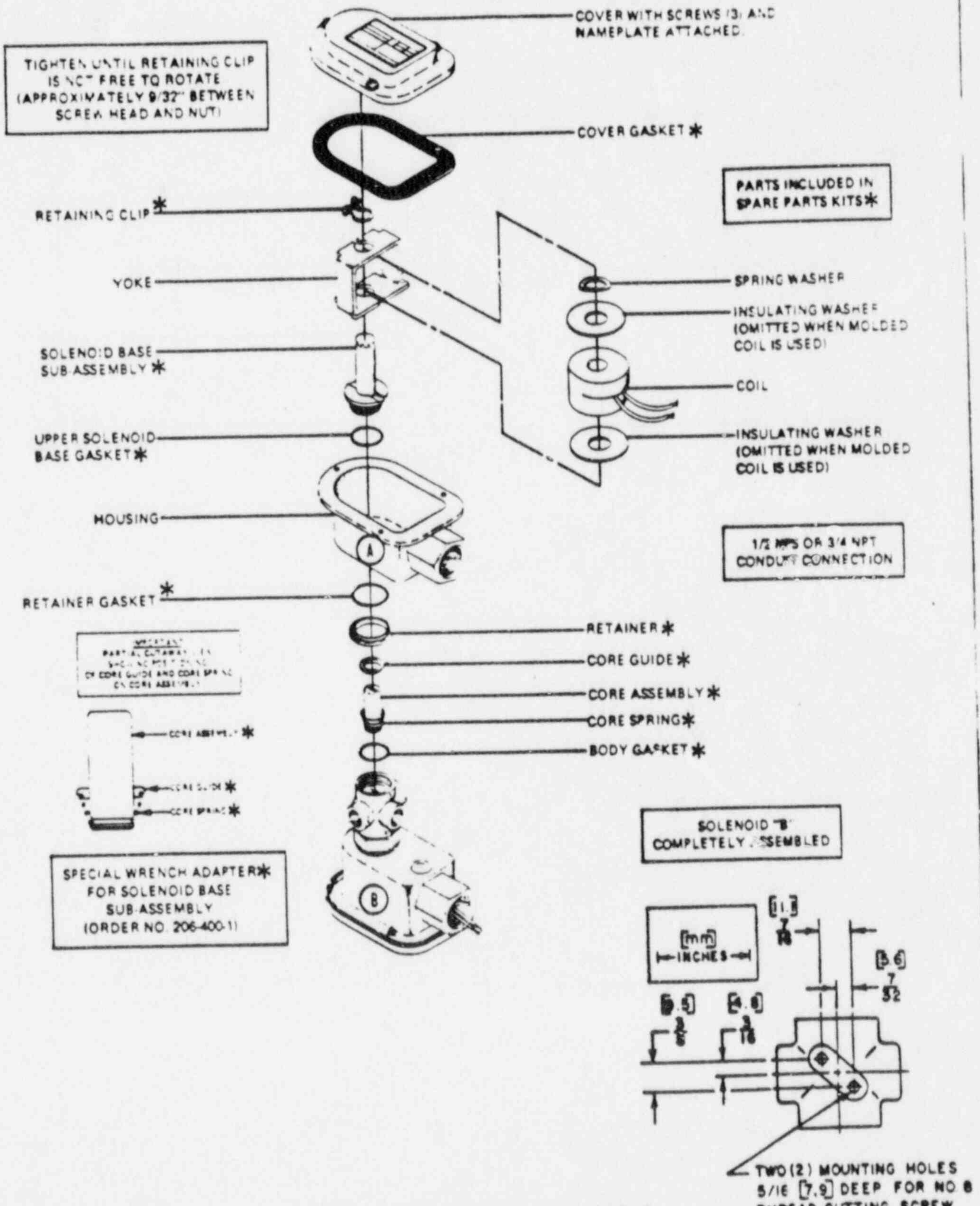


Figure 1. Bulletin 8323 – Partial View Showing D-C (Direct Current) Construction

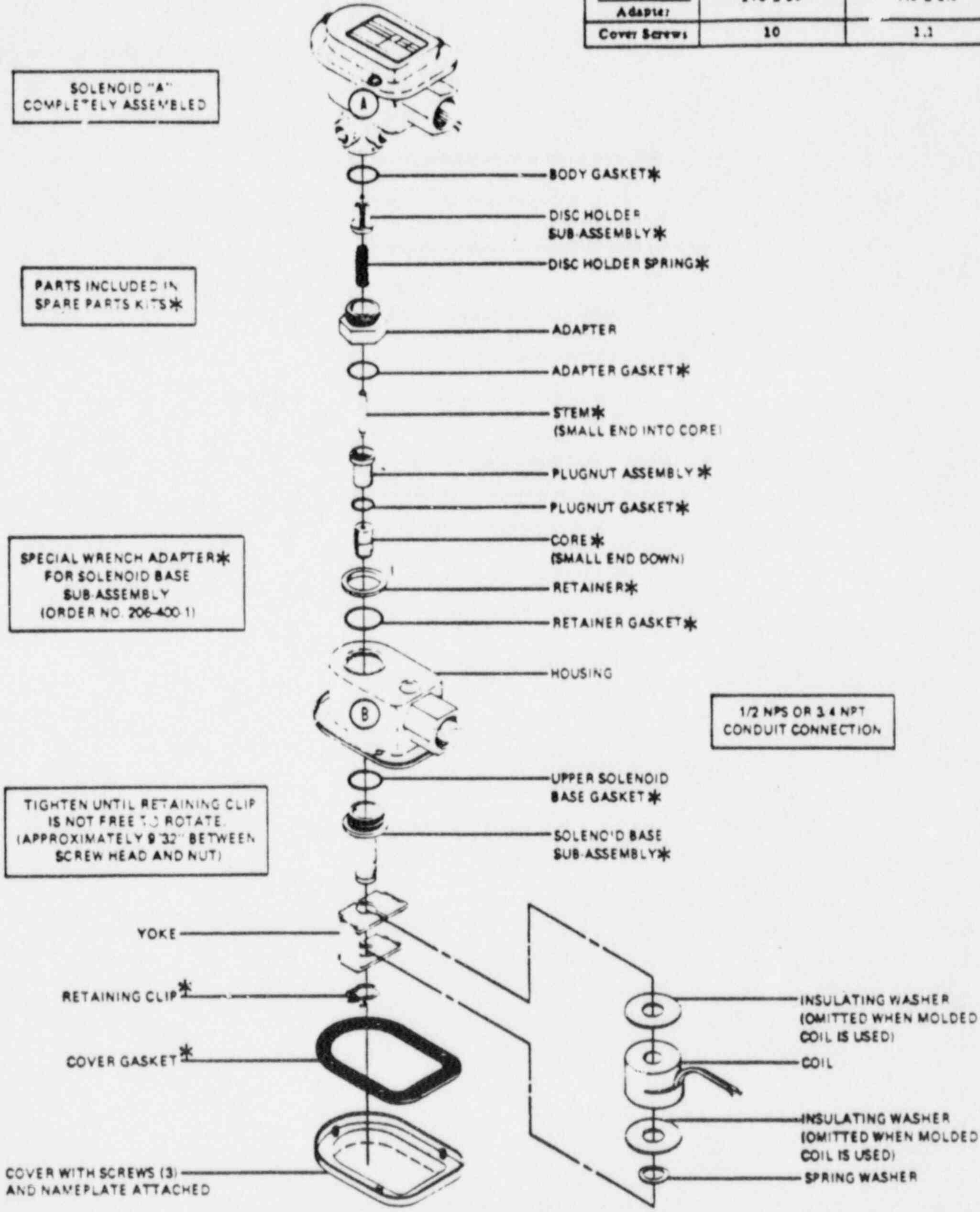
TORQUE CHART		
PART NAME	TORQUE VALUE INCH-POUNDS	TORQUE VALUE NEWTON METERS
Solenoid Base Sub-Assembly Adapter	175 ± 25	[illegible]
Cover Screws	10	1.1



Bulletin 8323 — Partial View Showing Solenoid "A."
Watertight Solenoid Enclosure Shown.
For Explosion-Proof/Watertight Solenoid Enclosure, See Form No. V-5380.

Figure 2.

TORQUE CHART		
PART NAME	TORQUE VALUE INCH-POUNDS	TORQUE VALUE NEWTON METERS
Solenoid Base Sub-Assembly / Adapter	175 ± 25	19.8 ± 2.8
Cover Screws	10	1.1



Bulletin 8323 — Partial View Showing Solenoid "B."
Watertight Solenoid Enclosure Shown.
For Explosion-Proof/Watertight Solenoid Enclosure, See Form No. V-5380.

Figure 3.

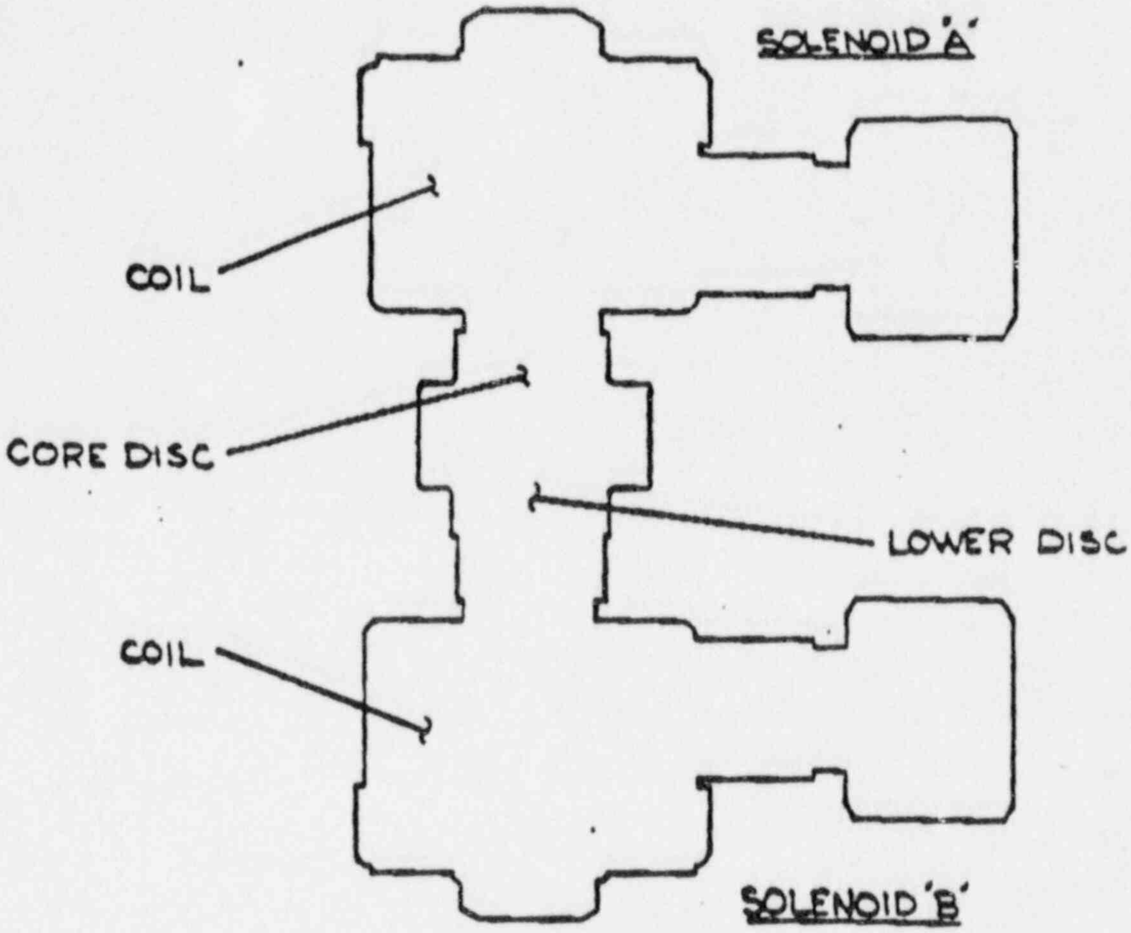
APPENDIX II

NP 8323 A20E

TEMPERATURE DATA

FV 236843

CATALOG NUMBER NP 8323 A20E AC/AC



AMBIENT TEMP.	COIL - SOL. 'A' *	COIL - SOL. 'B' *	CORE DISC	LOWER DISC
	MAXIMUM TEMPERATURE			
131°C	219°C	227°C	176°C	170°C
66°C	163°C	175°C	121°C	113°C
49°C	147°C	160°C	108°C	99°C
25°C	126°C	141°C	88°C	77°C

ITEM * 5°C ADDED FOR HOT SPOT

MAXIMUM TEMPERATURES OF COIL AND CRITICAL ELASTOMERS WITH VALVE ENERGIZED AND NO FLOW

	BY	DATE
DRAWN	BWB	7-7-87
PROJ. APP.		
CHECKED	G.V.	7-7-87
DFT. APP.		
ENG. APP.	JCF	7/7/87
	QRS	7/10/87

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP3-003

SCALE: NONE

ASSEM. REF. NO: 210651

ER NO. | BY | DATE | APP

AE AN AL AM AJ CH AV AR AA FS AG

CRT

FILE

FV 236843

CHANGE LETTER

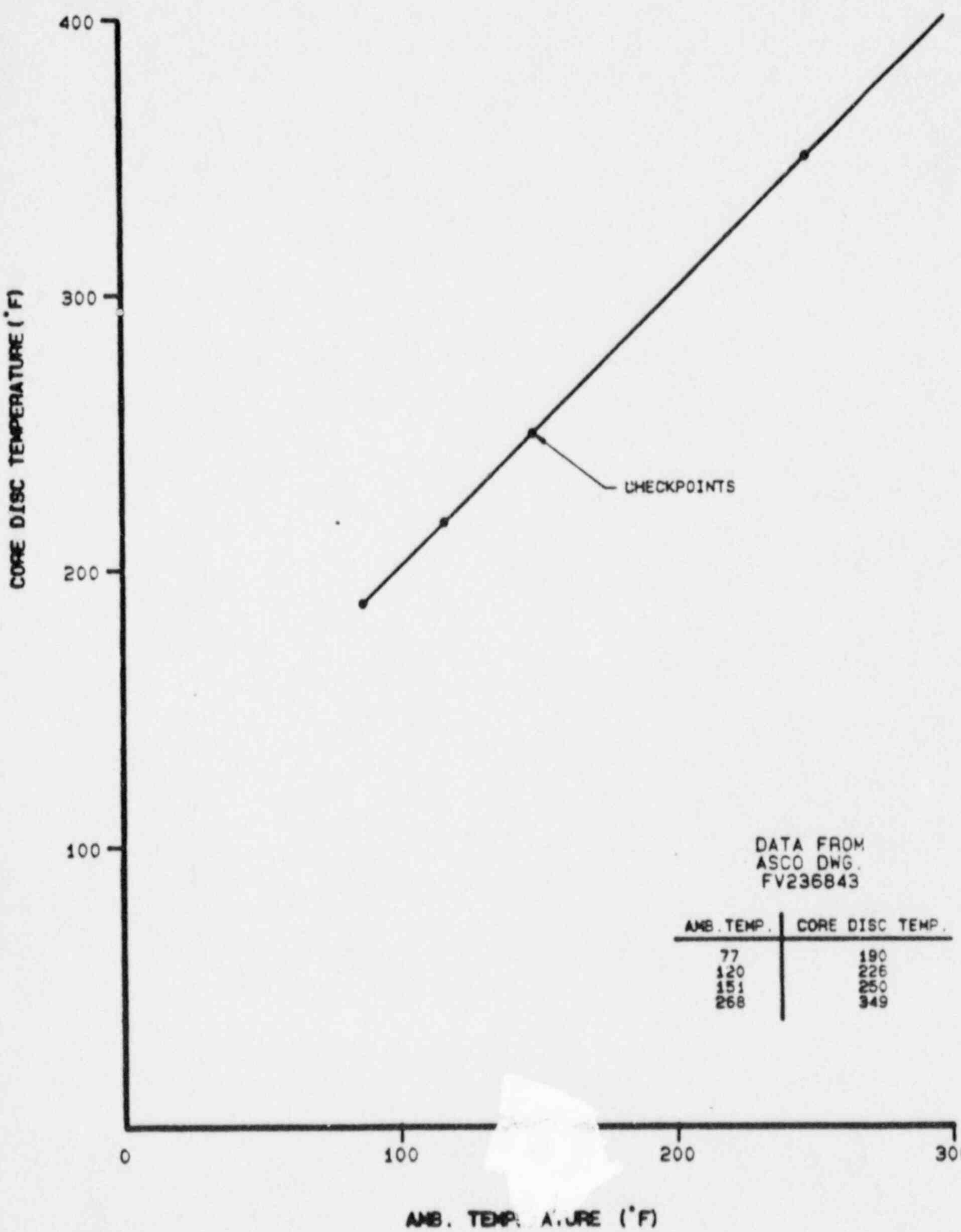
Automatic Switch Co.

FLORHAM PARK, NEW JERSEY 07932 Printed in U.S.A.

Form V. Orig. 3700 R11

APP. II

TITLE PLOT OF CORE DISC TEMP. VS. AMB. TEMP.



PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-III-87-138 Date November 3, 1987

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region III staff on this date.

Facility: Cleveland Electric Illuminating Company
Perry
Perry, OH 44081

Docket No. 50-440

Licensee Emergency Classification:
____ Notification of an Unusual Event
____ Alert
____ Site Area Emergency
____ General Emergency
__X__ Not Applicable

Subject: SHUTDOWN BECAUSE OF EXCESSIVE MSIV CLOSURE TIMES

At 1:38 p.m. (EST) on November 3, 1987, the licensee initiated an orderly reactor shutdown from 83 percent power after two Main Steam Isolation Valves (MISVs) failed to close during testing within the required Technical Specification limits. The remaining six MSIVs closed within the 3 to 5 second requirement. There are two valves in sequences on each of the four Main Steam Lines, one valve inside the reactor containment and one valve outside the containment. The valves that did not meet the closure time were both on the "D" steam line -- the inboard valve closed in 18 seconds and the outboard valve had not closed within the two minutes after the control switch was in the close position. The tests were observed by the Resident Inspectors.

Subsequent tests of the two valves resulted in closure times within the Technical Specification limit.

During testing on October 29, three valves did not meet the closure limit -- the two valves on the "D" line and the outboard valve on the "B" line. Subsequent cycling of the valves provided acceptable time responses.

An Augmented Inspection Team (AIT) is being dispatched to the plant site to review the circumstances and possible causes of the MSIV closure problems. The team will consist of the resident inspectors and personnel from Region III (Chicago) and the Office of Nuclear Reactor Regulation. A Region III Supervisor will head the team.

Region III will issue a Confirmatory Action Letter to the licensee documenting the licensee's agreement not to resume operation of the plant without concurrence of the Regional Administrator.

The State of Ohio will be notified.

Region III was informed of the test results and shutdown at 1:15 p.m. (EST) by the licensee. This information is current as of 2:30 p.m. (EST).

CONTACT: R. Knop (FTS 388-5547)   M. Ring (FTS 388-5602)

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PDR	RIII Resident Office				
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D-82

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Region III

CONFIRMATORY ACTION LETTER

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

NOV 4 1987

Docket No. 50-440
Docket No. 50-441

The Cleveland Electric Illuminating
Company
ATTN: Mr. Murray R. Edelman
Vice President
Nuclear Group
Post Office Box 5000
Cleveland, OH 44101

Gentlemen:

This letter confirms the telephone conversation on November 3, 1987, between Mr. Greenman and others of this office and Mr. A. Kaplan of your staff regarding the Main Steam Isolation Valve (MSIV) failures occurring at the Perry Nuclear Power Plant Unit 1 on November 3, 1987. With regard to the matters discussed, we understand that you will:

1. Take those actions necessary to ensure that complete documentary evidence of the "as found" condition of equipment being inspected is maintained.

2. Provide a step by step troubleshooting program to establish the root cause of the MSIVs failure to meet acceptance criteria.

3. Not disturb any components that offer a potential for being the root cause including power sources, switches, solenoids, and the air system directly feeding the MISVs until that action is approved by the NRC AIT team leader.

4. Except as dictated by plant safety, advise the NRC AIT Leader prior to conducting any troubleshooting activities. Such notification should be provided soon enough to allow time for the team leader to assign an inspector to observe activities.

5. Submit to NRC Region III a formal report of your findings and conclusions within 30 days of receipt of this letter.

None of these actions should be construed to take precedence over actions which you feel necessary to ensure plant and personnel safety.

We also understand that Perry Nuclear Power Plant Unit 1 will not be made critical without the concurrence of the Region III Regional Administrator or his designee.

D-83

The Cleveland Electric Illuminating Company   2 NOV 4 1987

Please let me know immediately if your understanding differs from that set out above.

Sincerely,

A. Bert Davis
Regional Administrator

cc: F. R. Stead, Manager, Perry Plant Technical Department
M. D. Lyster, Manager, Perry Plant Operations Department
Ms. E. M. Buzzelli, General Supervising Engineer, Licensing and Compliance Section
DCD/DCB (RIDS)
Licensing Fee Management Branch
Resident Inspector, RIII
Harold W. Kohn, Ohio EPA
Terry J. Lodge, Esq.
James W. Harris, State of Ohio
Robert M. Quillin, Ohio Department of Health
State of Ohio, Public Utilities Commission
J. M. Taylor, DEDO
T. E. Murley, NRR
J. Lieberman, OE
R. Cooper, EDO
W. Lanning, NRR
F. Miraglia, NRR
G. Holahan, NRR
M. Virgilio, NRR
J. Partlow, NRR
K. Connaughton, SRI
J. Strasma, RIII

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY
P.O. BOX 97 ■ PERRY, OHIO 44081 ■ TELEPHONE (216) 259-3737 ■ ADDRESS-10 CENTER ROAD

Murray R. Edelman
SR. VICE PRESIDENT
NUCLEAR

Serving The Best Location in the Nation
PERRY NUCLEAR POWER PLANT

November 13, 1987
PY-CEI/OIE-0289 L

Mr. A. Bert Davis
Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Perry Nuclear Power Plant
Docket No. 50-440
Updated Information to
letter PY-CEI/OIE-0288 L

Dear Mr. Davis:

This letter provides additional information regarding the commitments made in our letter, PY-CEI/OIE-0288 L, dated November 9, 1987. Based upon the discussions held with members of you staff on November 10, 1987, enclosed is a description of committed actions, established parameters to be monitored and appropriate action statements if predetermined threshold values are exceeded.

Following receipt of your concurrence, we plan to restart the plant to complete the remaining tests in the Startup Test Program. If you have any questions, please feel free to call.

Very truly yours,

M. D. Lyster for

Murray R. Edelman
Senior Vice President
Nuclear Group

MRE:cab

Enclosure

cc: K. Connaughton
T. Colburn
Document Control Desk

D-89

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The following evaluations and actions have been or will be completed prior to plant startup:

1. As previously stated in PY-CEI/OIE-0288 L, for the dual (fast closure) solenoids, the total air pack has been replaced for the 1B21-F028D valve, and the whole dual solenoid has been replaced on the 1B21-F022D valve. Additionally, the 1B21-F[illegible]A solenoid valve has been replaced due to a frayed wire at the termination. No other solenoids showed significant degradation or required replacement. All of the other MSIV dual solenoids have been rebuilt.

2. As previously stated in PY-CEI/OIE-0288 L, the single (slow closure) solenoid was replaced on the 1B21-F028D valve since the whole air pack was replaced. Additionally, the 1B21-F028B solenoid valve has been replaced due to a frayed wire at the termination. Based on the inspection results above, no other replacements were necessary.

3. As previously stated in PY-CEI/OIE-0288 L, an evaluation has been performed of other ASCO solenoid Class 1E harsh environment applications in the plant, including those which may have been subject to the steam leak environment which affected the MSIV solenoids. The review identified two normally deenergized solenoids which were subject to the same conditions as the MSIV solenoids. Since the solenoids are in a normally deenergized state, no further action was considered necessary. The two solenoids were 1B21-F0451 (solenoid for valve 1B21-F0069) and 1M14-F0063A (solenoid for valve 1M14-F0060A). Work history review of all other applications has shown no solenoid failures, indicating the ASCO solenoid degradation appears to be limited to the MSIV solenoid valves. Further reviews are described in item 4 of the post startup actions.

   The 1M14-F0060A valve is a normally closed valve and has no safety function to mitigate an accident. It is associated with a Drywell Purge system damper that is closed during normal operation with a water seal in place for shielding purposes. The 1B21-F0069 valve is a one inch before seat drain valve that is closed at greater than 50% main steam flow (at which time the solenoid is deenergized). The valve was recently cycled on November 7, 1987 with no deficiencies identified. In addition, this valve will be cycled again during this plant startup.

4. An evaluation has been performed of other equipment in the vicinity of the 1B21-F022D, 1B21-F028D, and 1B21-F028B valves, to assess any impact that the steam leaks may have had on other components. This evaluation revealed that there were six valve actuators in the steam tunnel and two in the drywell that were in close proximity to the known steam leaks. These actuators were inspected and no steam/heat degradation was observed. Wiring, terminal blocks, torque switches, limit switches, splices, gaskets, and limit switch gear box lubricants were inspected by a team that included EQ personnel.

There was no evidence of a thermal degradation from a steam environment that would affect valve operability. It should be noted that the Limitorque actuators do not contain EPDM material. A review for qualified life adjustment will be included in the further review described in the post startup item 4. There is no short term concern of Limitorque motor operators qualified life in the drywell or steam tunnel areas.

5. The historical readings of the existing permanent steam tunnel and drywell temperature elements in the vicinity of the MSIVs have been reviewed, and a baseline has been determined for each element (see Attachment 1). Until the temporary temperature monitoring baseline values have been determined, the existing permanent temperature elements will be used. It has been determined that a 10% rise above these baseline values may be indicative of a localized steam leak and would require investigation. This value was conservatively selected since it is approximately one half of the temperature rise expected for the Technical Specification trip value for leak detection. It is sufficiently conservative for the interim period until the MSIV area and surface temporary temperature element readings have been fully baselined. This temperature rise would have indicated the steam leaks which impacted the inboard MSIV (24 degrees F differential temperature) A lower threshold temperature rise could result in unnecessary actions or reduction in power operation due to minor temperature fluctuations.

(5a.) A procedure will be established specifying necessary actions to be taken upon exceeding the interim temperature values. The interim temperature thresholds are, area temperature plus a 10% rise or a selected 225 degrees F for the temporary temperature elements in the area surrounding the MSIVs for both the steam tunnel and drywell. The Senior NRC Resident Inspector will be notified if any of the following corrective actions are to be taken:

- Reduce power, as necessary, to perform a visual inspection to determine the equipment affected.
- Immediately repair the leakage or shield the adjacent Class 1E components to limit the impact until a repair is possible.
- Note components being affected and assess the thermal impact (EQ). Evaluate and determine the necessary time frame for taking additional action, such as increasing surveillance frequency or changing replacement interval.

- o At least 1 temporary temperature element in the area of each MSIV will be maintained in service in Operating Conditions 1, 2 and 3. If all temporary temperature elements fail for a specific MSIV, the adjacent temperature elements will be utilized in an interim period not to exceed 7 days. In the interim a correlation will be established between the adjacent temperature elements and the specific MSIV without individual monitoring. After 7 days, reactor power will be reduced in order to repair/replace the failed element within 24 hours or the plant will be placed in Hot Shutdown within 12 hours and Cold Shutdown within the following 24 hours.

- o If the local temperature monitoring in the area of an MSIV exceeds 284 degrees F, the affected MSIV will be declared inoperable in accordance with Technical Specification 3.6.4.a or cycled daily consistent with the EQ test parameters. This remains in effect until the additional environmental testing is completed (see Attachment 2).

6. Additional steam tunnel temporary temperature monitoring has been installed on the preselected sample points in the MSIV area including on the dual and the test solenoid bodies. Baseline data will be obtained on the temporary temperature elements in the steam tunnel during the next full operating period of sufficient duration to allow temperatures to stabilize. From our experience, this will be several days after the plant is at full power. Until the baseline data is established, a value of 225 degrees F will be utilized for the temporary temperature elements in the areas surrounding the MSIV to initiate the actions described in 5a. Inspections will be performed during startup to assure that the initial temperature reading are not being effected by steam leaks. Once it has been determined that the readings have stabilized, the procedure outlined in item (5a) above will be revised to use the temporary temperature elements in lieu of the permanent elements. The temporary temperature monitoring program will continue until the final analysis results of the environmental testing (see Attachment 2) is fully evaluated. At this time, possible design improvements will be evaluated and a determination will be made on future actions, including replacement frequencies or correlation to permanent area temperature elements. The NRC will be notified prior to removal of the temporary temperature elements.

   Nine drywell temporary temperature elements have been installed with at least one on each of the dual solenoids on the inboard MSIVs, typical of what was done with the temporary steam tunnel temperature elements. A baseline will be established after the startup following the outage as described above for the temporary steam tunnel temperature elements. These baseline values will then be incorporated into the program, along with the respective acceptance criteria. In the interim, a selected threshold of 225 degrees F will be used for temperature elements in the area surrounding the inboard MSIVs to initiate the actions described in 5a.

7. A test has been performed which verified that air does not flow between the air compressor reduction gear vents and the air compressor intake. Consequently, it was determined that there was no need for any equipment modification, or change in the intake filter replacement frequency.

Following startup, these additional evaluations and actions will be performed:

1. To further substantiate the high temperature root cause, laboratory analyses will be performed to confirm the failure mechanism of the EPDM degradation. A review of industry experiences and discussions with various industry sources will continue to be conducted in order to input into our analysis plan. Our preliminary analysis plan, which included these industry contacts, is completed, and a summary is provided in Attachment 2.

   We have completed an initial evaluation of industry experience. The initial industry review did not change our preliminary conclusion that the root cause of the problem was primarily localized elevated temperatures near the ASCO solenoid valves. The visual inspection of the EPDM did not exhibit the normal signs of hydrocarbon degradation (stickiness, sponginess, or swelling), however, we have not eliminated the potential of hydrocarbons having a deleterious effect. We plan to use data obtained from other plant experiences as described in IEN 86-57, along with our own analysis, to confirm the root cause.

   Our preliminary schedule is to have initial infrared analysis for hydrocarbon degradation by the end of January 1988 with the remaining results and analyses by end of the first quarter 1988. Any further analyses required will be determined at that time. We plan to use a local research laboratory, as our primary analyses contractor. Results will be provided to the NRC. With respect to environmental testing, a test plan will be provided to the NRC by November 23, 1987. Interim test results will be provided to the NRC as they become available during the 92 day test duration.

   Following completion of the analysis program, possible design improvements, will be evaluated and a determination will be made on future actions, including replacement frequencies.

2. Presently, in order to minimize the potential for introducing hydrocarbons to the air system, a preventive maintenance requirement will be established for periodic replacement of the instrument air system prefilters. The maintenance frequency will be consistent with replacement of the instrument air system after filters. Additionally, a generic precaution will be added into air system work orders regarding the use of thread lubricants and sealants. If the outcome of the chemical analyses indicates the presence of hydrocarbons, we will immediately implement an appropriate

hydrocarbon sample and analysis program for the instrument air system. This will include weekly sampling of the supply lines to the MSIV's at the containment penetration connection as well as other main J-headers throughout the air supply system. The Senior NRC Resident Inspector will be notified upon implementation of this action.

Dew point and particulate sampling of the instrument air system will continue in accordance with the existing plant administrative procedure. Any unacceptable results will be evaluated and system blowdowns will be conducted until satisfactory results are obtained.

3. Until the first refueling outage, the fast closure dual solenoids will be checked for proper operation during the monthly slow closure check. The existing monthly surveillance instruction will be revised prior to startup to reflect the following test procedure. The test will be performed by fully closing each MSIV individually utilizing the test solenoid, followed by taking the control switch to close. Performance of this test will verify the proper operation of the dual solenoid, since the MSIV will only remain closed if the dual solenoid deenergizes and properly repositions. If any MSIV should reopen during the test, indicating failure of a dual solenoid, the associated MSIV will be declared inoperable and the plant will be placed in Hot Shutdown within 12 hours and Cold Shutdown within the following 24 hours. The NRC will be notified upon discovery of such a failure.

Also during this time frame the MSIVs will be cycled individually on a quarterly basis regardless of plant operating conditions, and the fast closure time verified. As a result of a failure of this quarterly test due to temperature related problem with a dual solenoid, or other air pack component, the plant will be shutdown and the NRC will be notified as described above. The monthly test described above, will not be performed during those months when the quarterly fast closure test is performed.

Prior to exceeding a six month period an inspection will be performed during an outage of opportunity, on the dual solenoid experiencing the highest temperature profile. This inspection will verify no degradation of the solenoid valve internals. If accelerated heat degradation is observed, a complete investigation will be initiated and the NRC notified.

4. A review has been completed of all known steam leaks in the plant which could have affected Class 1E equipment. For all of the potentially affected equipment identified, there is no configuration where elastomer compression set or degradation could result in the equipment not being able to perform its intended function. However, these components will be evaluated to determine if there has been any affect on their long term qualified life based on the environment under which they were subjected. The results of this evaluation will be completed and submitted to the NRC by November 30, 1987. A further review will be conducted for potentially high temperature area environments of all Class 1E solenoids and other equipment with EPDM subcomponents where elastomer compression set or degradation could result in equipment not being able to perform its intended function. This review will be completed by the end of the first quarter 1988.

Attachment 1

TEMPERATURE MONITORING FOR DETECTION OF STEAM LEAKS

	TEMPERATURE SENSOR NUMBER	NORMAL OPERATIONAL BASELINE TEMPERATURE	ACTION PLAN IMPLEMENTATION TEMPERATURE
UPPER DRYWELL AREA	D23-K102 A D23-K102 B M13-R110-2 M13-R110-16	140° F 140° F 150° F 135° F	154° F 154° F 165° F 148° F
MIDDLE DRYWELL AREA	D23-K112 A D23-K112 B M13-R110-3 M13-R110-4 M13-R110-14 M13-R110-15	135° F 131° F 136° F 124° F 136° F 127° F	148° F 144° F 150° F 136° F 150° F 140° F
LOWER DRYWELL AREA	D23-K122 A D23-K122 B M13-R110-5 M13-R110-7 M13-R110-8 M13-R110-11 M13-R110-12	130° F 128° F 114° F 122° F 122° F 110° F 127° F	143° F 141° F 125° F 134° F 134° F 121° F 140° F
STEAM TUNNEL AREA MONITORS	E31-N604 A E31-N604 B E31-N604 C E31-N604 D	125° F 134° F 130° F 128° F	138° F 147° F 143° F 141° F
STEAM TUNNEL DELTA-T MONITORS	E31-N605 A E31-N605 B E31-N605 C E31-N605 D	80° F 80° F 82° F 82° F	88° F 88° F 90° F 90° F

Attachment 2.

ANALYSIS PLAN FOR EPDM SOLENOID COMPONENTS

I. INTRODUCTION

To determine the cause for failure of solenoid pilot valves which resulted in the slow closing of MSIV'S, two approaches will be taken. Both approaches involve analyses of the EPDM elastomer gasket material. The physical properties of the elastomeric material which was in service will be compared to new material to observe degradation, loss of material, deformation, anomolies in surface characteristics, and reducéd performance. In addition, the gasket material will be subjected to chemical analyses to discover changes from original material at the molecular level. Data obtained from the analysis regimen along with data from a similar failure experienced at Brunswick in 1985 will be used to determine cause.

II. PERSONNEL CONTACTED

Interviews with the Harris Research Personnel and NRR provided information regarding analyses performed and resulting postulations. PNPP analyses will include methods to confirm or deny these failure postulates. The full Brunswick Failure Analysis Report has been sent and will be used as guidance. A meeting with Ricerca, Inc. Personnel regarding this failure analysis program resulted in the following proposed course of testing.

III. ANALYSIS PROGRAM

A. Samples

1. Unused Elastomer Gasket material
2. Used Elastomer from pilot solenoids which did not fail.
3. Used, degraded Elastomer Material from failed pilot solenoids.
4. Pilot Solenoid valve bodies with elastomer residue.

Attachment 2.

B. Physical Testing
   1. Profilimetric analysis to compare indentations in EPDM discs (sample nos. 3, and 2)
   2. Optical Microscopy to determine the presence of foreign material, or loss of material from surfaces.
   3. Hardness testing to compare with original specifications.
   4. Compression set to compare with unused material and note performance degradation.

C. Chemical Testing
   1. Infrared survey to determine carbonile content. This will provide information about mode of attack (organic acids from the presence of hydrocarbons) and extent of oxidation.
   2. Scanning Electron Microscopy/X-Ray dispersion Spectrometry to confirm or negate copper-catalyzed accelerated oxidation. (Which was a postulated Failure Mode at Brunswick)

D. Environmental Testing

Six new dual coil solenoids will be sent to a laboratory for additional environmental testing. The solenoids will be placed in three separate environmental chambers (two per chamber) at various elevated temperatures in an energized condition. The solenoids will remain energized for predetermined times in an attempt to determine the temperature and continuously energized time at which the solenoids do not perform their function.

IV. <u>SUMMARY</u>

The above analyses and their results will provide evidence of failure mode and will describe any further confirming analyses which may be needed. In addition, recommendations will be made in order to preclude recurrence.