SALP I

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 12, 1990

Docket Nos. 50-528, 50-529
and 50-530

MEMORANDUM FOR: Roy P. Zimmerman, Director
Division of Reactor Safety
and Projects, Region V

THRU: James E. Dyer, Director
Project Directorate V
Division of Reactor Projects III/IV/V

FROM: Charles M. Trammell, Senior Project Manager
Project Directorate V
Division of Reactor Projects III/IV/V

SUBJECT: PALO VERDE SALP INPUT

Enclosed is the NRR input for the SALP request for Palo Verde Nuclear Generating Station.

NRR staff who had substantial contact and involvement with the licensee during the evaluation period and the NRR Project Managers for Palo Verde provided the basis for the evaluation. As discussed in the enclosure, our evaluation was conducted according to NRR Office Letter No. 907, Revision 1, dated April 18, 1990, NRC Manual Chapter 0516, Systematic Assessment of Licensee Performance, and guidance contained in your November 20, 1990 memorandum.

Charles M. Trammell
Charles M. Trammell, Senior Project Manager
Project Directorate V
Division of Reactor Projects III/IV/V

Enclosure:
NRR SALP Input

6/2

92-407

NOV 08 1989 DK Grump I

MULTIPLE EQUIPMENT FAILURES FOLLOWING LOAD REJECT AND REACTOR TRIP

EVENT FOLLOWUP REPORT 89-038
50.72 #14912, 14927, AND 14938
EVENT DATE- 3/3/89
PLANT-PALO VERDE UNIT 3
PROJECT MANAGER-M. DAVIS
COGNIZANT ENGINEER- J. THOMPSON

RECEIVED NRC REGION V
89 NOV 14 AM 10: 02

PROBLEM
Unit 3 experienced a full load rejection followed by a reactor trip. The turbine bypass valves opened but the bypass valve controller malfunctioned, causing excessive steam relief and overcooling of the RCS. The reactor tripped on low steam line pressure in the Number 2 Steam Generator. Subsequent to the trip, the atmospheric dump valves (ADVs) could not be opened from either the control room or the remote shutdown panel. The emergency lighting system also did not operate properly.

CAUSE
The initiating event was the separation of the switchyard from a faulted offsite line and subsequent opening of the generator output breakers in the switchyard. Lack of management attention to procedural maintenance and testing and to expeditiously resolve problems contributed to this event.

SAFETY SIGNIFICANCE
The AIT evaluation of the event showed that the licensee was not properly maintaining important safety equipment.

Failure of the safety-related atmospheric dump valves left the operators dependent on the two nonsafety-related turbine bypass valves which dump to the atmosphere to perform a controlled cooldown of the plant in preparation for continued cooldown using the RHR system.

DISCUSSION
On March 3, 1989, Palo Verde Unit 3 was at 100% power. All three units were on-line when a fault in a California substation caused the breakers in the Palo Verde switchyard to open. Shortly thereafter, a Unit 3 turbine generator trip and reactor trip occurred.

Subsequent to this event, the staff formed an Augmented Inspection Team (AIT) which went to the site on March 4-10, 1989. The AIT report numbers are 50-528/89-13, 50-529/89-13, and 50-530/89-13.

Complications and further contributing factors, identified from the staff's AIT report findings, are listed below.

(1) A fast transfer of power for buses NAN-S01 and NAN-S02 did not occur (the RCPs are energized from these buses due to inadequate synchronization of the buses to the grid)
(2) Loss of reactor coolant pumps
(3) Indications of RCS leakage (about 2 gpm)
(4) The atmospheric dump valves (ADV) did not operate as designed when called upon. Contributing factors were:

- the ADVs have a history of poor reliability and problems which were never adequately evaluated and finally resolved by the licensee;

89-382

- recommendations for design modification by the manufacturer, architect engineer, and consultants to correct ADV reliability problems were not implemented by the licensee;
- the nitrogen pressure regulators, supplying nitrogen for ADV operation, have a history of unreliability and problems which were never adequately resolved by the licensee;
- annual preventive maintenance recommendations by the vendor had not been implemented;
- the simulator does not effectively model plant ADV response, providing negative operator training;
- Auxiliary Operators (AOs) were inadequately trained in the manual operation of ADVs;
- AOs should not have been requested to operate the Remote Shutdown Panel, an activity requiring an NRC reactor operator license;
- procedures for local manual operation of the ADVs were not adequate;
- the handwheel operating directions for valves at the local operating station were not consistent and were confusing to operators;
- important valves were not labeled or adequately location-referenced in the procedure creating operator confusion.

(5) The emergency lighting system did not operate as designed when called upon. The ADV rooms were dark on initial entry because the emergency lighting units did not operate until operator action was taken. Contributing factors were:

- preventive maintenance tasks have a history of being waived and not accomplished for more than a year;
- even if the battery operated emergency lighting units had operated, the lighting was not adequate for operators to perform the manual ADV operation tasks;
- emergency battery operated lighting units were not tested to verify conformance to eight hour requirements.

(6) The Steam Bypass Control System (SBCS) had a history of poor reliability at the site which the licensee had not adequately resolved. For example:

- a previously observed failure of the same SBCS timer card in July 1988 was not resolved by the licensee;

- except for monthly exercise of the valves, calibration and functional testing of the system electronics is only performed at an 18 month frequency, diminishing the opportunity to identify electronic failures or misadjustments until the system is called upon to operate; and

- certain critical preventive maintenance tasks are only performed at biannual intervals.

(7) Repeated interruptions of forced reactor coolant flow have occurred. The design of the electrical distribution system for the reactor coolant pumps may need to be reassessed.

(8) Communications between the control room staff, auxiliary operators, and radiation protection staff were either not accomplished, not crisp and clear, hampered by high noise levels in the ADV areas, or hampered by a high traffic volume on the single radio channel in use.

A letter from the atmospheric dump valve vendor (Control Components Inc.) to the Palo Verde utility dated April 4, 1989 indicates the potential for valve failures due to a significant design deficiency that may be reportable under 10 CFR Part 21. (see Enclosure 1)

The licensee has filed a Part 21 report based on the CCI ADV design deficiency. CCI has recommended to their customers (listed in Enclosure 2) that modifications to their valves could be made to prevent excessive valve bonnet pressures preventing the valve actuator from overcoming the pressure forces on the main piston. The high bonnet pressures result from leakage past a piston ring on the main plug. The modification would use a more leak-resistant piston ring and a larger flow area to relieve steam above the piston more rapidly.

Information Notice 89-38, "Atmospheric Dump Valve Failures at Palo Verde Units 1, 2, and 3," dated April 5, 1989, describes the event with emphasis on the potential for ADV failures.

On April 13, 1989, the staff met with CCI at NRC headquarters to discuss and provide information on certain models of CCI ADVs. The meeting was for information only. A meeting summary dated April 2?, 1989 was issued and is given in Enclosure 3.

STATUS ON ADVs

Seabrook 1, SONGS 2 & 3, Catawba Units 1 & 2, Vogtle Units 1 & 2, and Waterford Unit 3 have CCI ADVs with minor design differences from those at Palo Verde. These plants were informed by the staff of the ADV design deficiencies at Palo Verde and were requested to determine the operability of their ADVs with respect to the Palo Verde experience. The current status of the ADV issue at these plants is discussed below. Feedback from the licensees indicates that some of the improvements suggested by CCI have been incorporated.

The NRR Director's Highlight for May 10, 1989 included the status of the atmospheric dump valves at these plants. Some excerpts from the May 10 highlight are provided and updated below.

Catawba Units 1 and 2

For Unit 2, the licensee has performed a limited operability test on all four valves to demonstrate their ability to open up to 30% against steam pressure using manual control from the control room with nitrogen supply (as opposed to instrument air). All four valves passed this test successfully. The licensee plans to continue to perform this test on a weekly basis until the modifications recommended by CCI are completed on all four valves.

For Unit 1, the licensee has implemented the valve internal modifications recommended by CCI.

Palo Verde Units 1, 2, 3

Units 1 and 3 are currently incorporating vendor recommended modifications to all 8 ADVs. Modifications will be implemented prior to startup of each respective unit. Unit 2 has completed the modifications. The licensee plans to submit technical specification changes to increase the testing frequency of the valves.

Seabrook

The licensee plans to implement the internal valve modifications recommended by CCI.

San Onofre Units 2 and 3

San Onofre Units 2 and 3 have not experienced operational difficulties with the ADVs in the past with the exception of one anomaly due to a maintenance error during valve reassembly. Nonetheless, the licensee plans to implement the vendor recommended modifications. In the interim, the licensee has increased the pneumatic pressure to the valve actuators, revised the routine surveillance test frequency of these valves to a biweekly basis, conducted enhanced operator training regarding abnormal operation of ADVs, and revised the procedures related to ADV operation to include abnormal operation instructions.

Waterford 3

All ADVs have been satisfactorily tested for operability. The licensee plans to implement the vendor recommended modifications during the Fall outage (November 1989). The air actuators used on the ADVs are of a different design than those used at Palo Verde; Waterford's air actuation scheme provides a more constant pneumatic pressure than Palo Verde's. On April 15, 1989, a Region IV inspection (see Inspection Report Number 50-382/89-08) identified procedural discrepancies concerning manual operation of the ADVs. The inspector noted that the valves were about 25 feet overhead and virtually inaccessible to manual operation without scaffolding. It was possible, however, to erect scaffolding in sufficient time to manually operate the ADVs during an event if the procedures provided the proper guidance for manual handwheel valve operation. Procedural enhancement and additional operator training for operation and use of the ADVs have been completed.

CCI stated that there are eleven plants with ADVs made by CCI which are similar in design to Palo Verde. Three of the eleven plants, South Texas 1 and 2, and Shearon Harris are plants with similar ADVs but with a different potential design deficiency. In a letter to the staff dated April 4, 1989, CCI stated that "there was no concern" at these three plants that they could have the same problems that occurred with the Palo Verde ADVs. Subsequently, the staff received copies of letters (dated June 28, 1989) sent to the licensees for those plants notifying them of a different potential Part 21 issue. These plants may have a deficiency in the amount of actuator force needed to overcome a potential high load resisting the opening of the ADV. The value assumed by CCI for the capability of the actuators was 20,000 lbs for the ADVs on the three plants. This was in error since the three plants had significantly less actuator force than assumed by CCI in the design basis.

FOLLOWUP
The Vendor Inspection Branch will consider an inspection of CCI.

EAB considers this event to be closed.

John W. Thompson

John Thompson
PWR Section
Events Assessment Branch

Enclosures:
1. CCI letter to Mr. Ben Mendoza
   Arizona Public Services, Palo Verde, dated April 4, 1989
2. Summary of Staff Meeting with CCI on ADV's dated 4-13-89
3. Table 1, "Plants identified by CCI as having ADV design deficiencies similar to Palo Verde"

cc: M. Davis
J. Thompson
D. Kirsch, RV
M. Reardon
C. Rossi
V. Nerses, NRR
K. Jabbour, NRR
J. Hopkins, NRR
D. Hickman, NRR
T. Chan, NRR
C. Dick, NRR
E. Baker, NRR

Enclosure 1

Control Components Inc.
An IMI valve company

April 4, 1989

Mr. Rich Lobel
Nuclear Regulatory Commission
Events Assessments Group

Subject: Atmospheric Dump Valves
Arizona Public Service - Palo Verde

Dear Mr. Lobel:

Attached for your information is a copy of a letter in which CCI expresses a concern for a potential significant deficiency under 10CFR-21. The letter identifies which plants were of a concern and other plants for which we have no concern.

If you have any questions, please call.

Sincerely,

CONTROL COMPONENTS INC.

H.L. Miller
Vice President, Engineering

/jf

cc: CGSterud
REAdams
EJVillalva

Attachment

8904070002

22591 Avenida Empresa ☐ Rancho Santa Margarita, California 92688
Telephone: (714) 858-1877 ☐ FAX: (714) 858-1878 ☐ Telex: 685500

Control Components Inc.
An IMI valve company

April 4, 1989

Mr Ben Mendoza
APS
Palo Verde

Subject: Atmospheric Dump Valves
Potential Significant Deficiency Under 10CFR-21

Dear:

We are hereby notifying you of a potential significant deficiency that may be reportable under the requirements of 10CFR-21. We are not reporting this directly to the Nuclear Regulatory Commission (NRC). We at CCI do not have the systems expertise that would permit us to decide if this is a significant deficiency. However, because of the NRC's interest and their prior contact for information regarding plants with a similar design, we have sent a copy to Rich Lobel of the Events Assessments group in Washington D.C.

CCI has completed it's analysis of the Atmospheric Dump Valves for your site. This analysis was prompted by the failure of the APS-Palo Verde valves to open. The Palo Verde valves are similar in design and rely upon the same principle of operation.

The analysis has been aimed at calculating a worst case bonnet pressure after the pilot valve has been opened. If the leakage by the piston ring is larger than the ability of the pilot plug to drain the bonnet, excessive pressure remains in the bonnet. If the pressure is too high, the actuator cannot overcome the forces holding the main plug on the seat.

Our calculation indicates that the atmospheric dump valves at your site may fail to open. The cause of the failure is speculative but the result is a piston ring that fails to seal. The high bonnet pressure resulting does not permit the actuator to open the valve. That is; the actuator force with the current air pressure supply available is not large enough to overcome the pressure force holding the plug closed.

As noted above, the cause of failure is not known. The condition cannot be made to occur on demand and in fact appears randomly. Our speculation is that pipe scale and other dirt particles get into the piston ring cavity and prevent the ring from sealing. Until the recent Palo Verde testing in March 1989, we have been unable to verify that an excessive bonnet pressure existed.

22591 Avenida Empresa ☐ Rancho Santa Margarita, California 92688
Telephone: (714) 858-1877 ☐ FAX (714) 858-1878 ☐ Telex 685500

The resolution to this problem is to increase the pilot valve capacity. This requires rework of the plug to enlarge the pilot flow area and a new stem to seal the pilot valve when closed.

A second change is to use a two piece wedge style piston ring to assure a good seal. This change is not as significant as increasing the pilot capacity but adds extra margin.

Plants for which there is a concern that a random failure may occur and to whom this letter was sent are:

1) Arizona Public Service - Palo Verde 1, 2 & 3 - 4 Valves Each
2) Louisiana Power & Light - Waterford 3 - 2 Valves Each
3) Duke Power - Catawba 1 & 2 - 4 Valves Each
4) Southern California Edison - San Onofre 2 & 3 - 2 Valves Each

Plants for which there is no concern are:

1) Florida Power & Light - St. Lucie 2 - 6 Valves Each
2) Houston Power & Light - South Texas Project 1 & 2 - 4 Valves Each
3) Georgia Power - Vogtle 1 & 2 - 4 Valves Each
4) Carolina Power & Light - Shearon Harris 1 - 3 Valves Each

This list of eight plants are the only ones that have designs similar to the Palo Verde valves. Other atmospheric dump valves exist at other plants but their design is not the same as for the plants noted above.

The plants for which there is no concern have also been analyzed. Our findings are that the valves have sufficient actuator force and plug pilot flow capacity to assure opening of the valves. An information copy of this letter has been sent to these plants.

Please contact myself, Ron Adams, or Curtis Sterud at CCI if you have any questions or for additional information.

Sincerely,

CONTROL COMPONENTS INC.

H.L. Miller
Vice President, Engineering

/jf

cc: CGSterud
REAdams
EJVillalva
RETopping

TABLE 1

Plants identified by CCI as having ADV design deficiencies similar to those at Palo Verde Units 1, 2, and 3

San Onofre Units 2 and 3

Catawba Units 1 and 2

Waterford Unit 3

Seabrook

Enclosure 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 21 1989

VENDOR: Control Components Incorporated

SUBJECT: SUMMARY OF MEETING HELD APRIL 13, 1989, TO DISCUSS OPERATION OF ATMOSPHERIC DUMP VALVES

On April 13, 1989, the staff met with Control Components Incorporated (CCI) at NRC headquarters One White Flint North, Rockville, Maryland. CCI had requested this meeting to provide the NRC staff with information on the design and operation of certain models of CCI atmospheric dump valves. Enclosure 1 lists the meeting attendees. A telephone bridge was provided for NRC regional personnel from Regions II, IV and V, resident inspectors and affected licensees. The meeting agenda is provided in Enclosure 2.

A representative of CCI, Mr. Herb Miller, Vice President, Engineering, discussed valve operation, design, and failure analysis. Enclosure 3 contains the slides used during the meeting for valve description and worst case model assumptions.

The main discussion centered on problems arising from failure of the atmospheric dump valves at Palo Verde Unit 3 to open from either the control room or remote shutdown panel on March 3, 1989. Mr. Miller stated that CCI has advised their customers that modifications to their valves could be made to increase the reliability to open by eliminating excessive bonnet pressure. This would be done by use of a more leak-resistant piston ring and a larger flow area to relieve steam above the piston more rapidly. Calculations done by CCI show that, even for worse case analyses, sufficient actuator force should exist to allow the valve to open when these modifications are made. Mr. Miller displayed a modified piston ring which CCI believes reduces leakage.

At the end of the presentation, Mr. Miller opened the floor to questions. The meeting was for information only and therefore there were no conclusions or action items identified as a result of this meeting.

Richard Lobel, Section Chief
PWR Section
Events Assessment Branch
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc: See next page

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C	:EAB:NRR	:EAB:NRR	:	:	:	:	:
ME	:JThompson:db	RLobel for	:	:	:	:	:
TE	: 4/ /89	: 4/21/89	:	:	:	:	:

OFFICIAL RECORD COPY

Enclosure 1

Attendance List for the Control Components Incorporated
NRC Meeting on April 13, 1989

Name	Organization
Richard Lobel	NRR/NRC
John Thompson	NRR/NRC
Jay R. Ball	NRR/DRIS
K. N. Jabbour	NRR/PDII-3
Mary Wegner	AEOD
Walter Haass	NRR/VIB
Angel Sistos	Southern California Edison
Clay E. Williams	Southern California Edison
Steven M. Matthews	NRR/VIB
Michael J. Davis	NRR/PDV
Michael R. Johnson	OEDO
Terence L. Chan	NRR/PDV
Tim Collins	NRR/SRXB
L. B. Marsh	NRR/EMEB
Ted Sullivan	NRR/EMEB
Jack Bailey	Arizona Public Service/ANPP
Carter Rogers	Arizona Public Service/ANPP
J. G. Partlow	NRC/NRR
D. E. Hickman	NRR/PDV
G. W. Knighton	NRR/PDV
D. L. Wigginton	NRR/PDIV
William A. Cross	LP&L/STS
Horace K. Shaw	EMEB

CONTROL COMPONENTS INC.
At
NUCLEAR REGULATOR COMMISSION

AGENDA
(4/13/89)

1. Explanation of valve operation

2. Explanation of valve worst case model

3. Model vs. APS tests

4. Results of worst case analysis

5. [illegible]rences between plants

6. [illegible]perating experience

7. [illegible]sign change recommendations for increased margin

8. Information items:

   -Ocassional jumpyness at APS

   -Positioner output versus error signal

   -Manual override

Enclosure 2

Enclosure 3

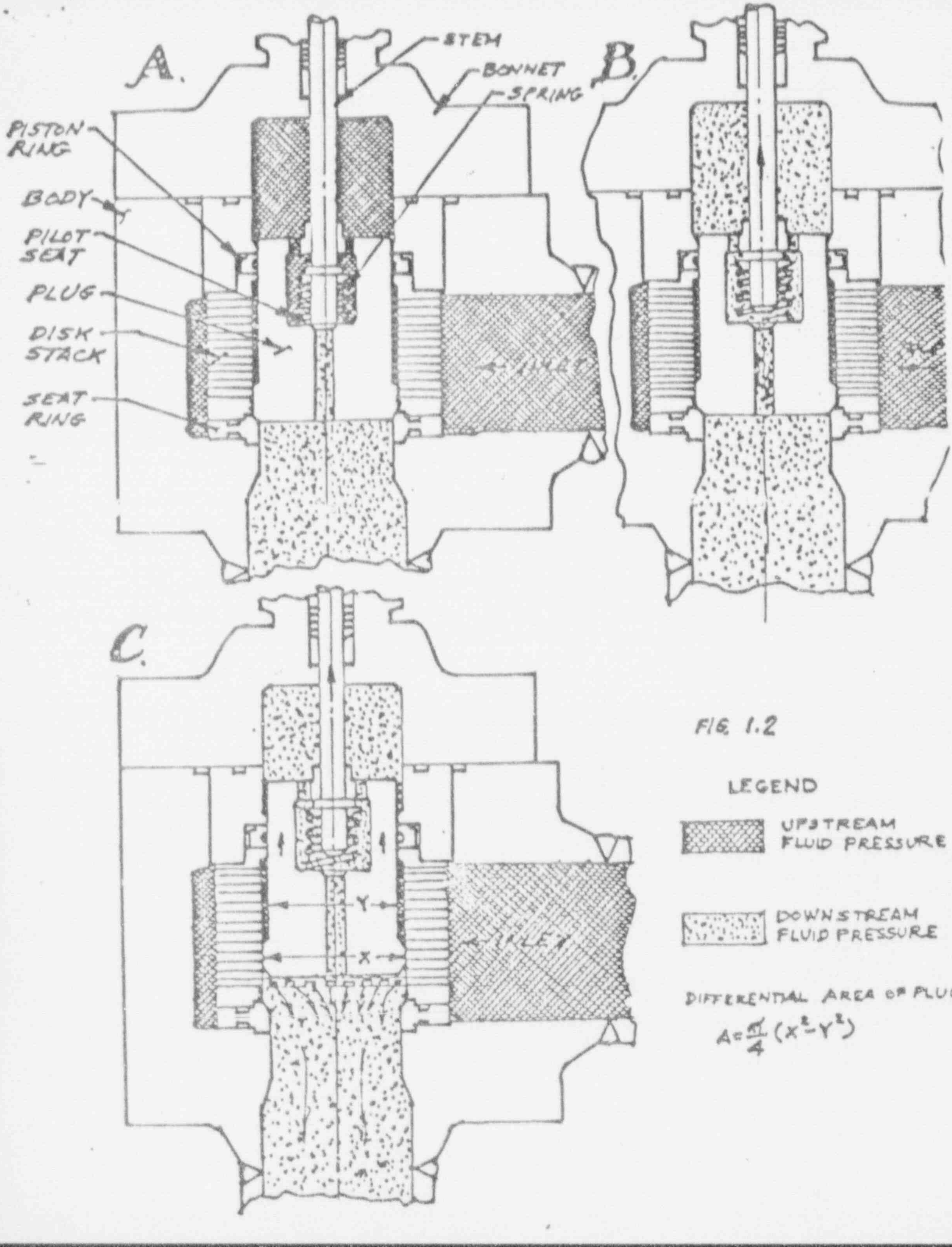
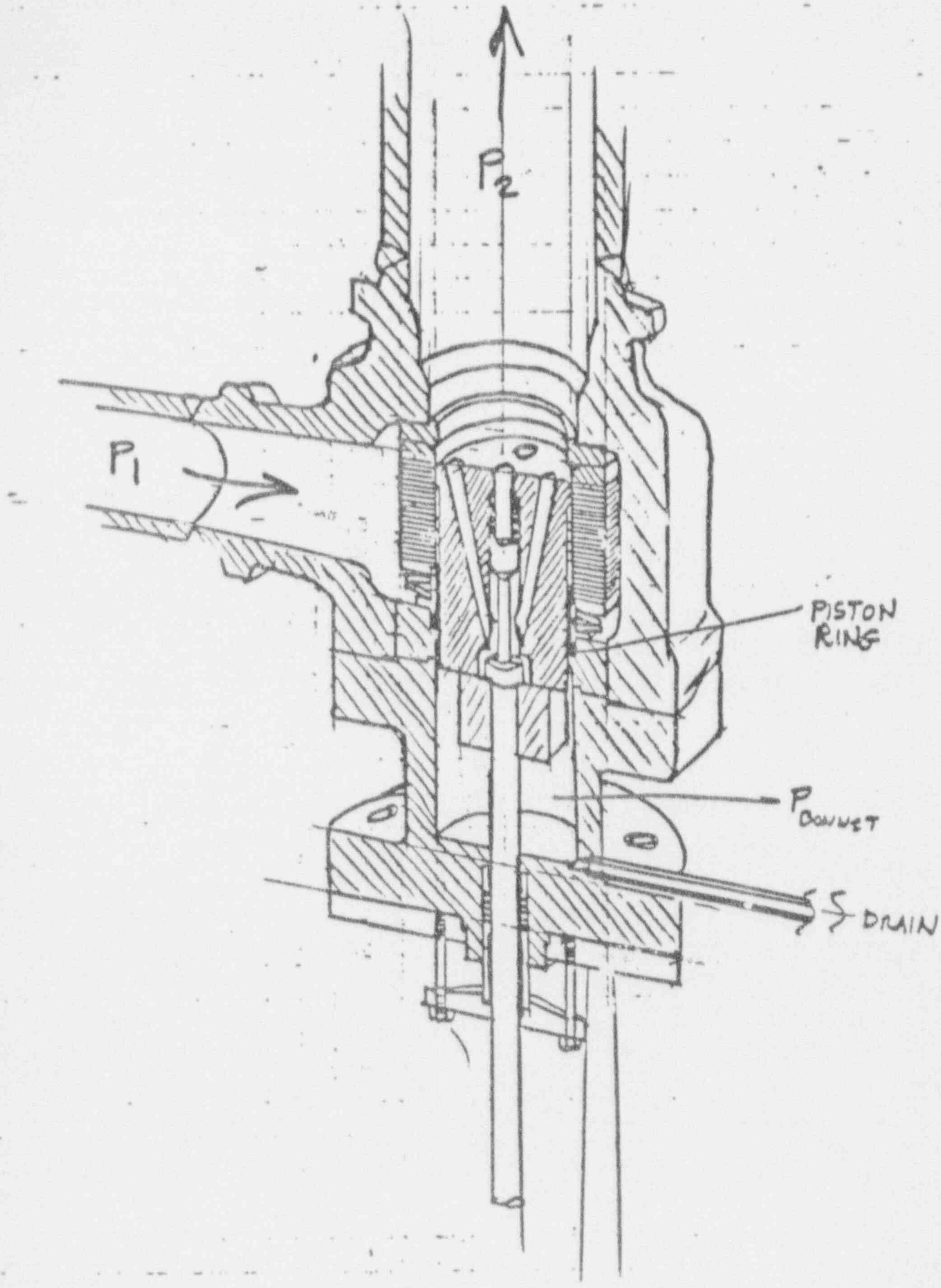
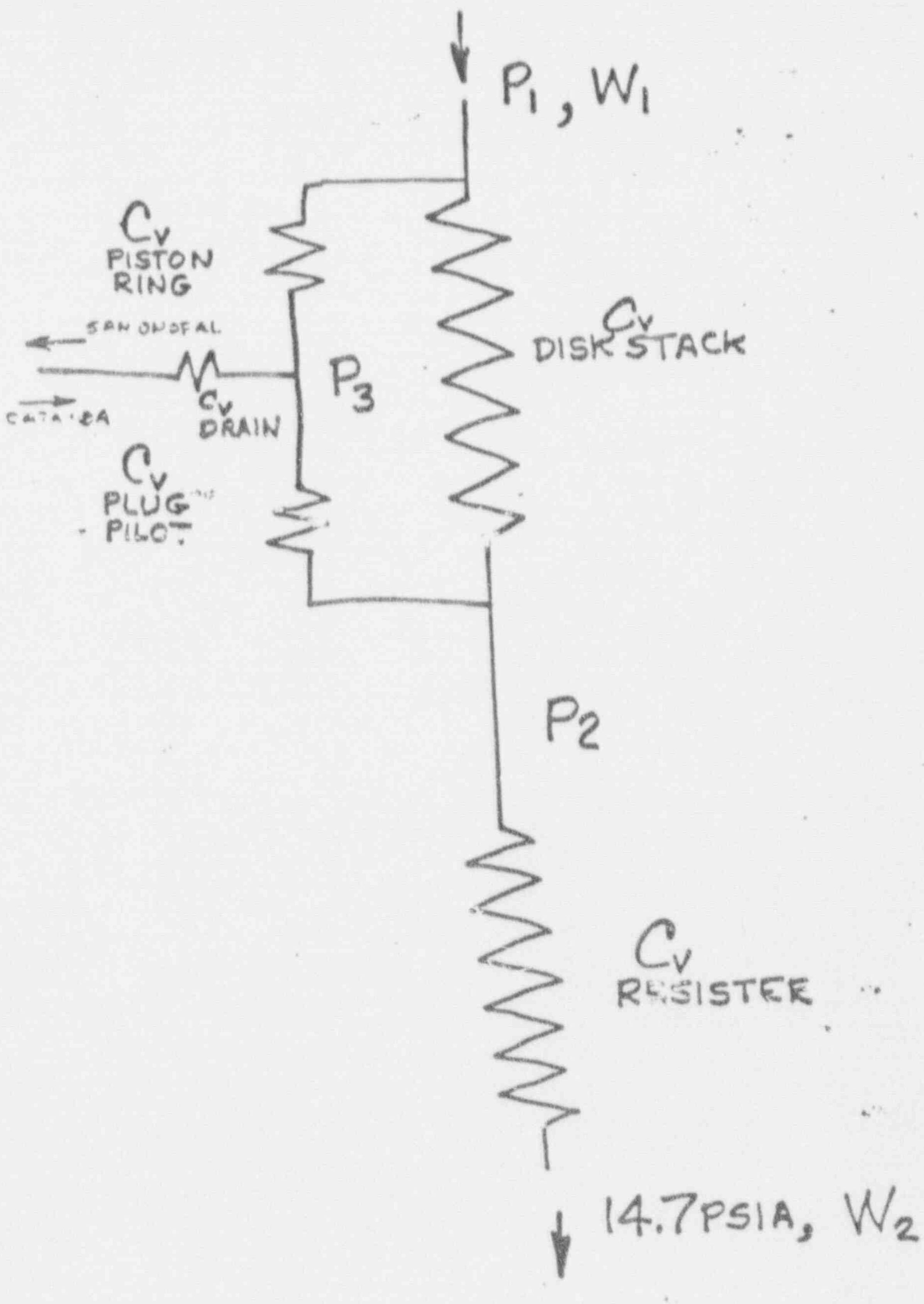


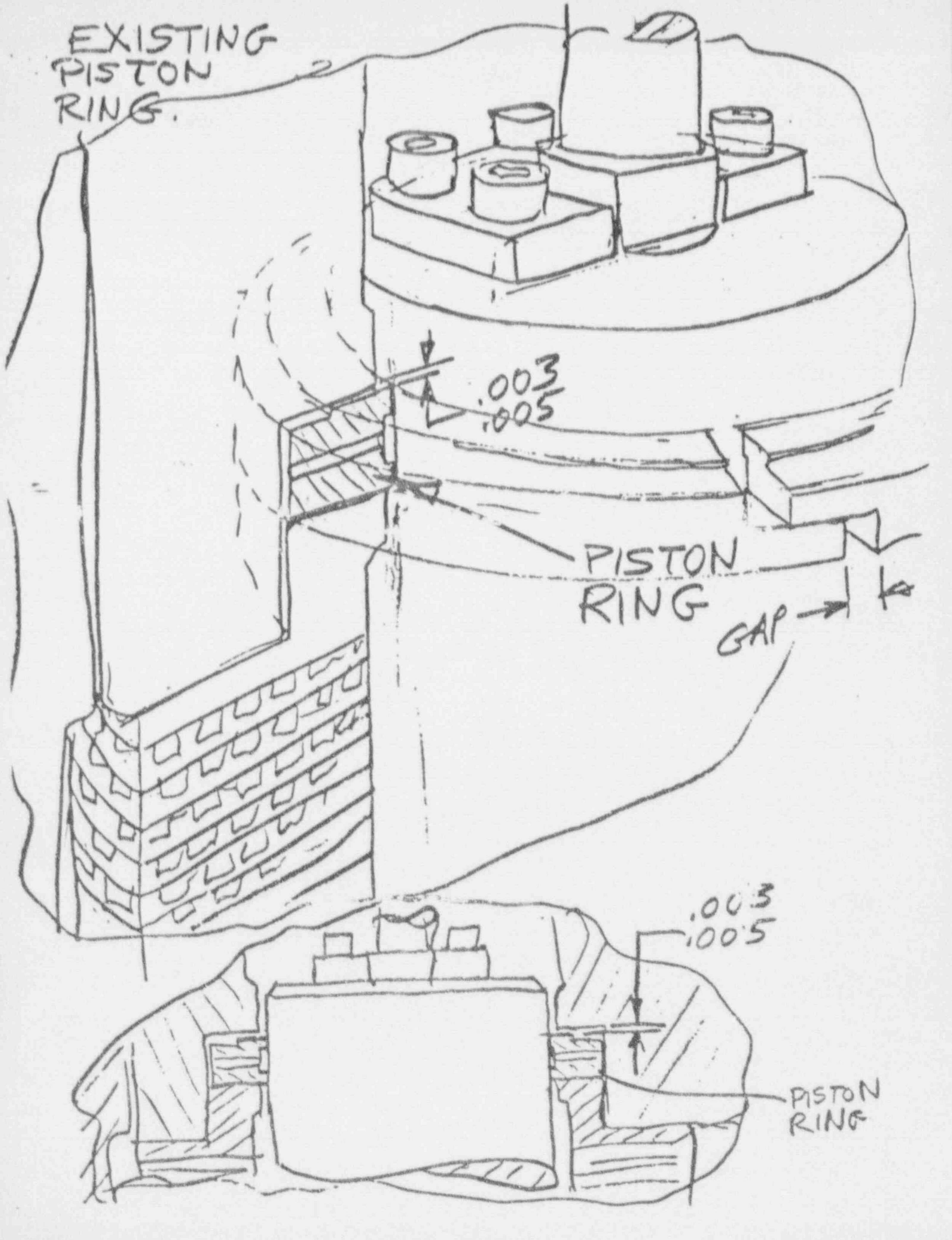
FIG. 1.2

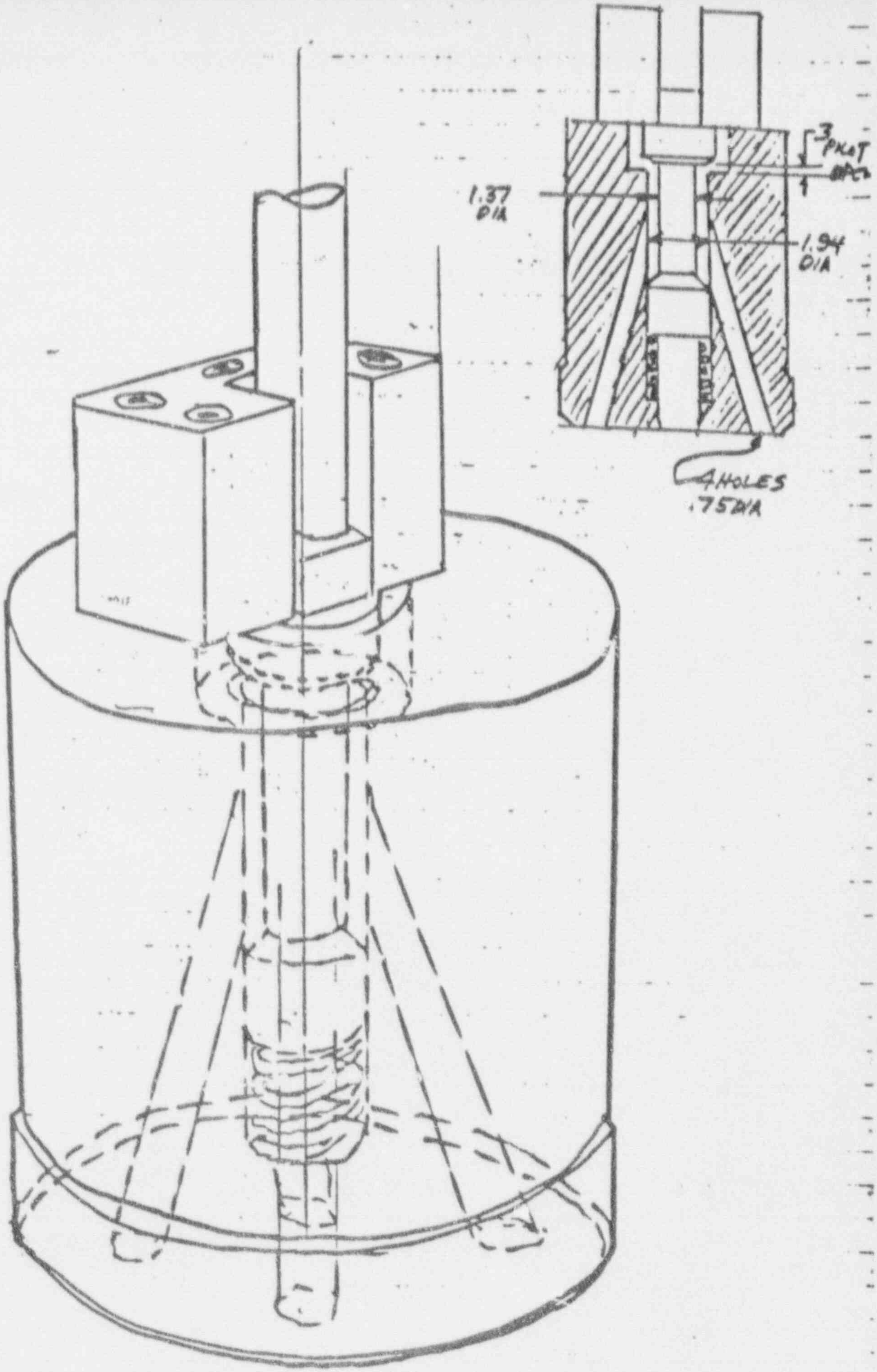


P2
P1
PISTON RING
P BONNET
DRAIN



P1, W1
Cv
PISTON
RING
SAN ONOFRE
Cv
DISK STACK
P3
Cv
DRAIN
CATAWBA
Cv
PLUG
PILOT
P2
Cv
RESISTER
14.7PSIA, W2


EXISTING PISTON RING.
.003
.005
PISTON RING
GAP
.003
.005
PISTON RING


1.37
DIA
1.94
DIA
4 HOLES
.75 DIA

APS TEST

TESTING RUN WITH 1170 PSI INLET PRESSURE

	TESTED				CALCULATED			
VALVE OPENING	4%	15%	25%	33%	4%	15%	25%	33%
P2 = OUTLET PRESS PSIA	15.3	20.3	99.5	154.4	15.	26	96.5	140.7
P3 = BONNET PRESS PSIA	23.0	55.9	151.1	239.8	19	29	117.9	238
LOAD ON ACTUATOR LBS	6565	5729	3881	3718	7132	6942	5056	4791
ACTUATOR ΔP PSI	59	51.5	35	33.4	63.5	62.5	45.5	43.2

genuine steady state
picked off typical set of data
w/o time averaging

WORST CASE MODEL ASSUMPTIONS

1. Piston Ring Capacity	Over 2 times highest capacity measured at APS.
2. Pilot Valve Capacity	Based on lab test using ISA test procedure
3. Packing Friction	2250 PSI stress on packing, over two times working pressure.
4. Piston Ring Friction	0.4 friction factor versus two times sliding friction, 0.3, expected.

SUMMARY OF RESULTS
PWR ATMOSPHERIC DUMP VALVES DESIGN INFORMATION
WORST CASE ANALYSIS (4/1[illegible]/89)

CUSTOMER SITE	VALVE STYLE	PLUG SIZE	VALVE STROKE	ACTUATOR TYPE (1)	MAX ACT. PWR.(LBS)	MAX DESIGN FLOW LBM SAT. TEMP.	MAX VALVE CV	RESISTOR CV	P IN @ REACTOR TRIP PSIA
A.P.S.-Palo Verde Unit 1,2&3 (12) Valves (WO#21408-1,4&7)	Offset Globe	10" 10.13	12"	111 in^2 * PN Spring To Close	10577 @ 95 PSI	1470000 @ 1000 PSI	830	1696	1150
L.P.& L.-Waterford Unit 3 (2) Valves (WO#17285-11)	Angle	10" 10.13	10"	111 in^2 * PN Spring To Close	1[illegible]577 @ 95 PSI	800000 @ 885 PSI	508	1202	885
S.C.E.-San Onofre Unit 2&3 (4) Valves (WO#18447-3)	Angle (upside down)	8" 7.935	10"	111 in^2** PN Spring To Close	10577 @ 95 PSI	795000 @ 795 PSI	539	1450	960
Duke Power-Catawba(2) Unit 1&2 (8) Valves (WO#18789-3)	Angle upside down	8" 7.935	8"	111 in^2* PN Spring To Close	10577 @ 95 PSI	500000 @ 1200 PSI	195	1347	1200
C.P.& L.-Shearon Harris Unit 1 (3) Valves (WO#21739-1,2,3&4)	Offset Globe	8" 7.875	8"	Electric Hydraulic	[illegible]	427000 @ 1106 PSI	350	1505	1200
G.P.-Alvin Vogtle Unit 1&2 (8) Valves (WO#23468-1 Unit 1) (WO#23469-1 Unit 2)	Offset Globe	8" 7.875	8"	Electric Hydraulic	20000	596000 @ 1200 PSI	350	1505	1200
F.P.& L.-St. Lucie Unit 2 (4) Valves (WO#25589-1)	Angle	8" 7.937	10"	Electric	15000	275000 @ 985 PSI	486	1347	985
H.L.& P-S.T.P. Unit 1&2 (8) Valves (WO#35199-1)	Offset Globe	8" 7.875	8"	Electric Hydraulic	20000	1050000 @ 1300 PSI	420	[illegible]696	1300

Notes: (1) All Pneumatic Actuators have springs for fail close.
The spring seated load is 1519 lbs. The spring rate is 167 lbs/in.
(2) Duke calls these steam generated power operated relief valves.
* Actuator manual override 80 ft-lbs maximum required to open.
** CCI manual override 90 ft-lbs maximum required to open, spring seated load is 2420 and spring rate is 191 lbs/in.

SUMMARY OF RESULTS
PWR ATMOSPHERIC DUMP VALVES CURRENT DESIGN RESULTS
WORST CASE ANALYSIS (~~4/17/89~~) 4/13/89

CUSTOMER SITE	PILOT SEAT CV	BONNET PRESS BAD* PISTON RING PSIA	BONNET PRESS GOOD PISTON RING PSIA	ACTUATOR LOAD BAD* PISTON RING LBF	ACTUATOR LOAD GOOD PISTON RING LBF	ACTUATOR DP BAD* PISTON RING PSI	ACTUATOR DP GOOD PISTON RING PSI
A.P.S.-Palo Verde Unit 1,2&3 (12) Valves (WO#21408-1,4&7)	27	210	30	21187	7136	191	64
L.P.& L.-Waterford Unit 3 (2) Valves (WO#17285-11)	26.7	149	17.5	16573	6124	149	55
S.C.E.-San Onofre Unit 2&3 (4) Valves	17.9	198.6	18.3	14039	5554	126	50
(WO#18447-3) **	18.43	193.2	18.1	13422	5186	120.6	46.6
Duke Power-Catawba(2) Unit 1&2 (8) Valves	17.9	252	20.3	15539	4656	139.6	41.8
(WO#18789-3)	***	274	41.1	16570	5634	148.8	50.6
C.P.& L.-Shearon Harris Unit 1 (3) Valves (WO#21739-1,2,3&4)	21.26	214	20.5	13408	4513	-	-
G.P.-Alvin Vogtle Unit 1&2 (8) Valves (WO#23468-1 Unit 1) (WO#23469-1 Unit 2)	21.26	214	20.5	13408	4513	-	-
F.P.& L.-St. Lucie Unit 2 (4) Valves (WO#25589-1)	18.9	194	19.5	11270	3068	-	-
H.L.& P-S.T.P. Unit 1&2 (8) Valves (WO#35199-1)	21.26	232	21.5	14256	4755	-	-

* "BAD" Simply means the piston ring is not functioning properly for whatever cause.

* Drain From Bonnet to Sump.(With Block Valve)

** Drain From Bonnet To Main Steam. This Increases Piston Ring "Leak" By .368 C_V.

SUMMARY OF RESULTS

PWR ATMOSPHERIC DUMP VALVES MODIFIED DESIGN RESULTS
WORST CASE ANALYSIS (4/13/89)

CUSTOMER SITE	PILOT CV	UPGRADES PILOT & WEDGE PISTON RINGS: BONNET P-PSIA	UPGRADES PILOT & WEDGE PISTON RINGS: ACTUATOR LOAD LBF	UPGRADES PILOT & WEDGE PISTON RINGS: ACTUATOR DP-PSI	UPGRADE PILOT ONLY: BONNET P-PSIA	UPGRADE PILOT ONLY: ACTUATOR LOAD LBF	UPGRADE PILOT ONLY: ACTUATOR DP-PSI
A.P.S.-Palo Verde Unit 1,2&3 (12) Valves (WO#21408-1,4&7)	74	28	7628	68	79.2	11466	103
L.P.& L.-Waterford Unit 3 (2) Valves (WO#17285-11)	74	23	6504	58.6	60	9249	83
S.C.E.-San Onofre Unit 2&3 (4) Valves (WO#18447-3) **	30.9 31.43	37.14 36.62	6437 6412	57.8 57.6	118 116.24	10235 10144	91.9 91.1
Duke Power-Catawba(2) Unit 1&2 (8) Valves (WO#18789-3)	30.9 ***	45.7 59.3	5842 6474	52.5 58.1	149 162.9	10679 11316	95.9 101.6
C.P.& L.-Shearon Harris Unit 1 (3) Valves (WO#21739-1,2,3&4)	29.4	48.9	5817	-	157	10740	-
G.P.-Alvin Vogtle Unit 1&2 (8) Valves (WO#23468-1 Unit 1) (WO#23469-1 Unit 2)	29.4	48.9	5817	-	157	10740	-
F.P.& L.-St. Lucie Unit 2 (4) Valves (WO#25589-1)	22	51.5	4587	-	168	10041	-
H.L.& P-S.T.P. Unit 1&2 (8) Valves (WO#35199-1)	29.4	52.3	6126	-	170	11394	-

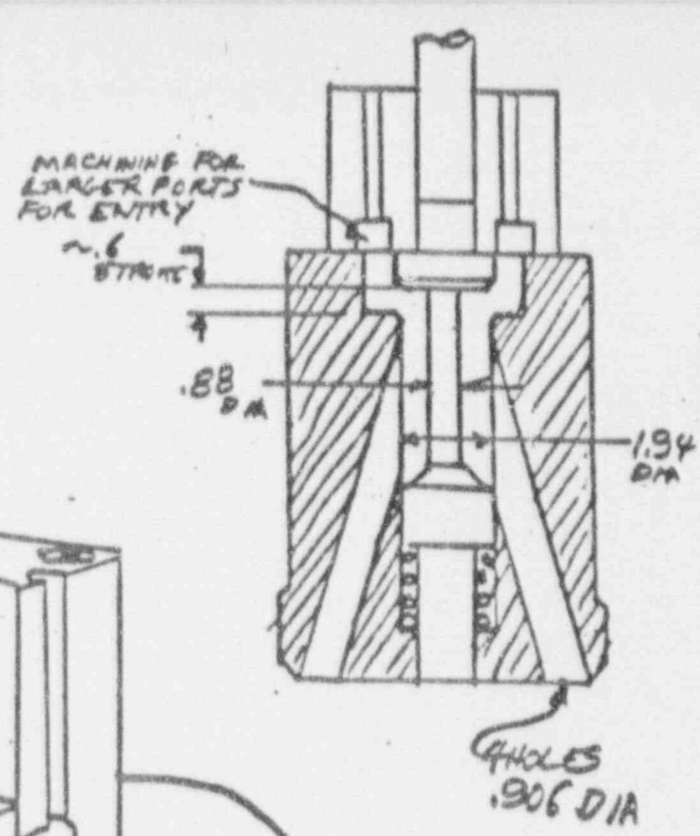
**** Drain From Bonnet To Atmos.
**** Drain From Bonnet To Main Steam. This Increases Piston Ring "Leak" by .368 C_v.

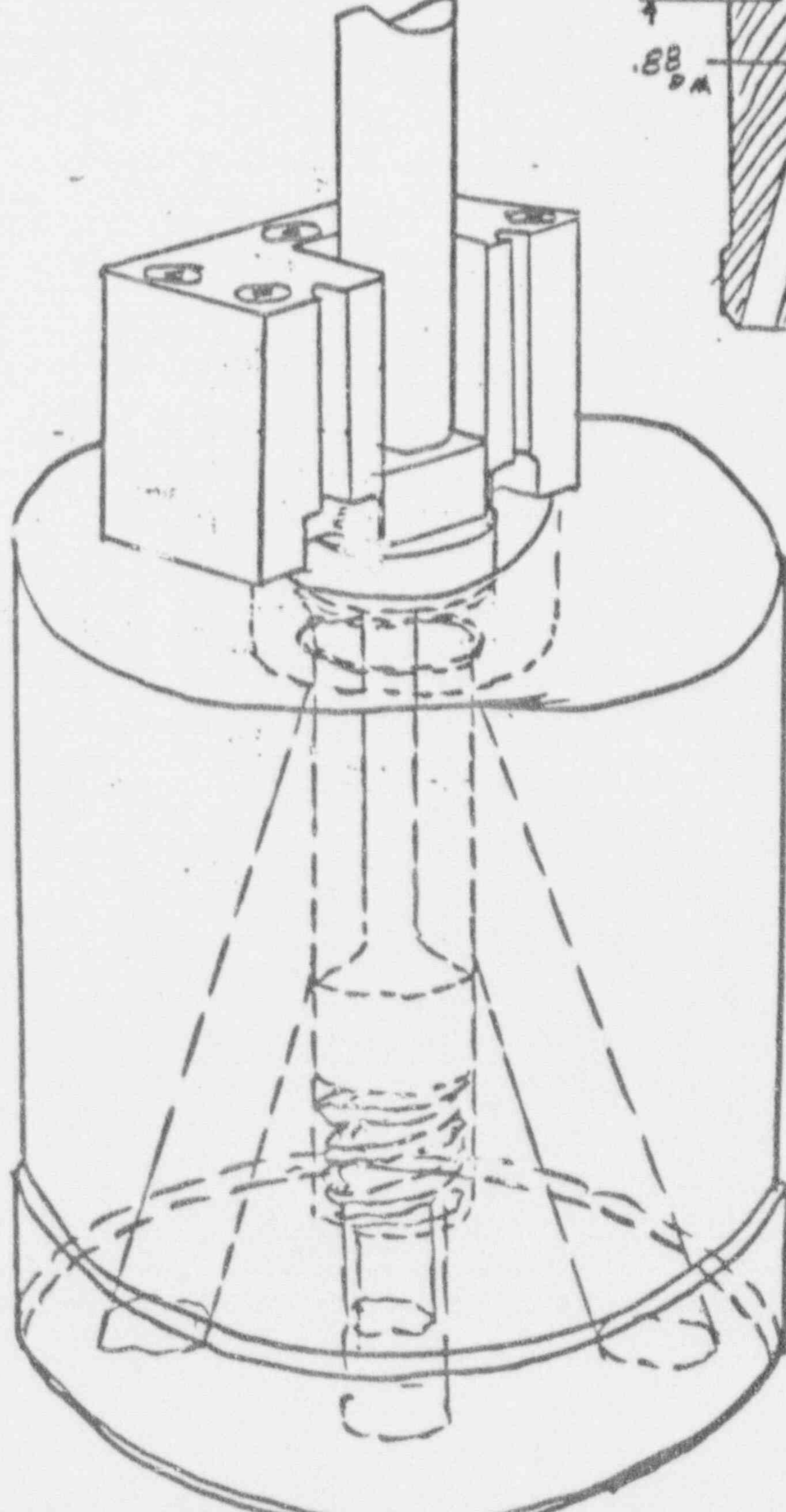
Differences Between Plants

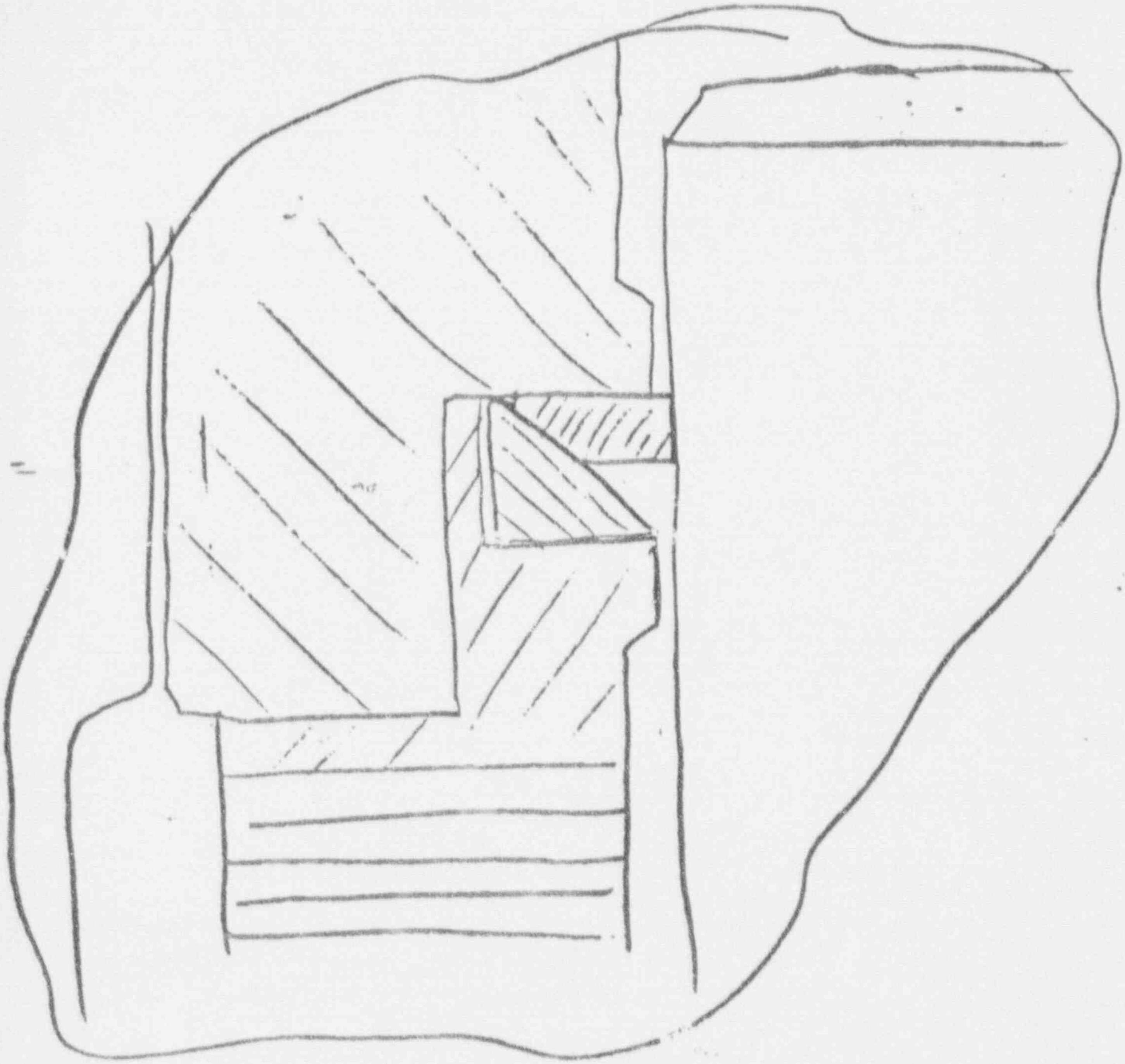
Valve Orientation-	Songs & Catawba inverted with drains.	
Qualification	Palo Verde has seismic, radiation, elevated environment and age conditioning.	
	Others have seismic	
Actwator Control Schematic	Palo Verde has two Solenoids in series.	
	Other have boosters	
Time To Open	Palo Verde	80 Sec.
	Catawba	20 Sec.
	Waterford	11 Sec.
	Songs	10 Sec.
Plant Operation	Palo Verde and Songs idle until called upon to operate.	
	Waterford used for 4 to 5 start-up cycles per year.	
	Duke operated quarterly after isolation.	

EXPERIENCE

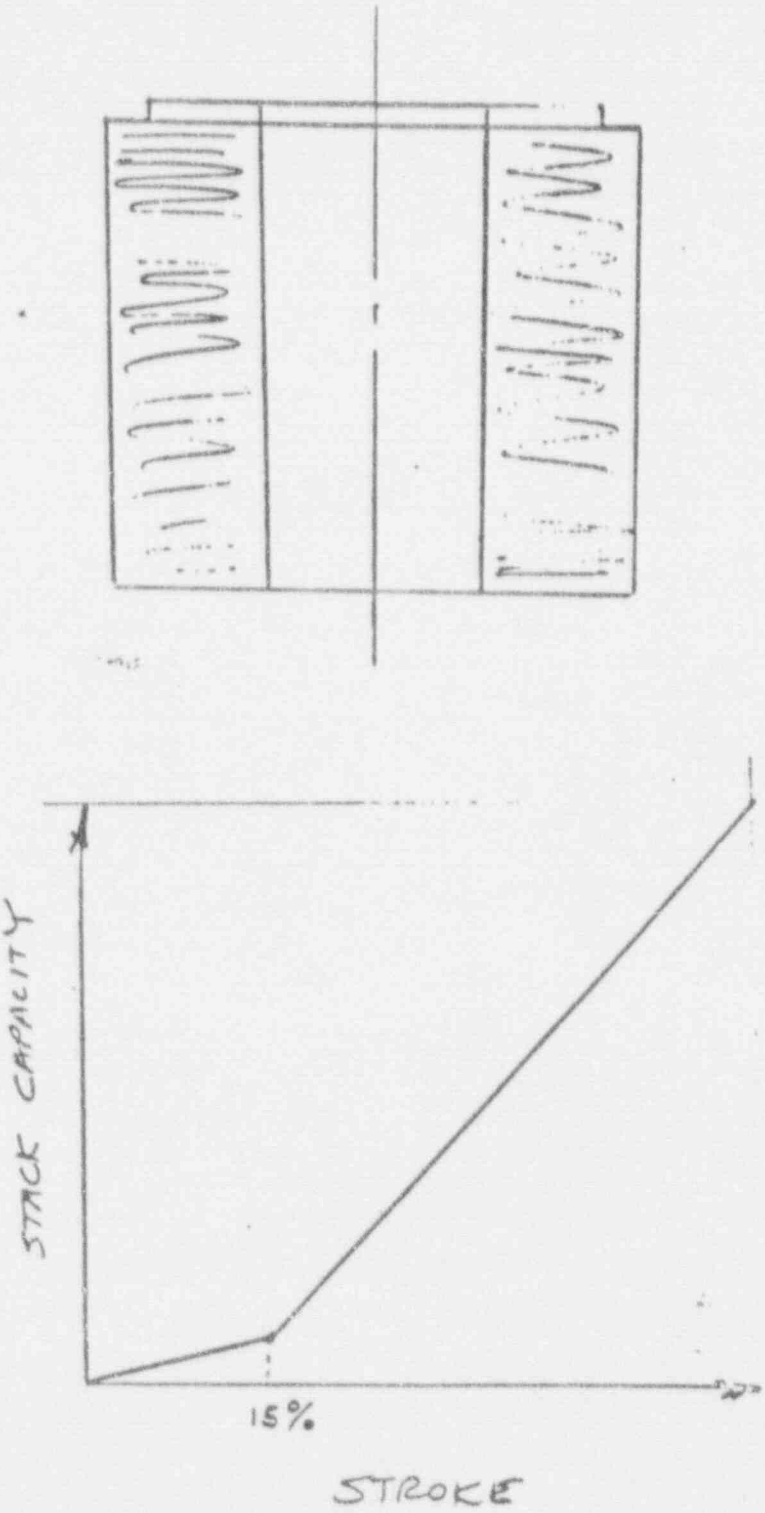
* SONGS		1 valve slow to open
	1 Anomaly	Piston ring upside down
* CATAWBA	2 Anomalies	Failed at 1130/1140 psi
		OK at 1075 psi
		Piston ring worn
* ST. LUCIE	1 Anomaly	Open torque switch tripping, mid stroke when torque bypass switch dropped out
* PALO VERDE	Unit One	Only one confirmed failure to open
	Unit Three	Three valves were questioned


MACHINING FOR LARGER PORTS FOR ENTRY
~.6 STROKE
.88 DIA
1.94 DIA
4 HOLES .906 DIA

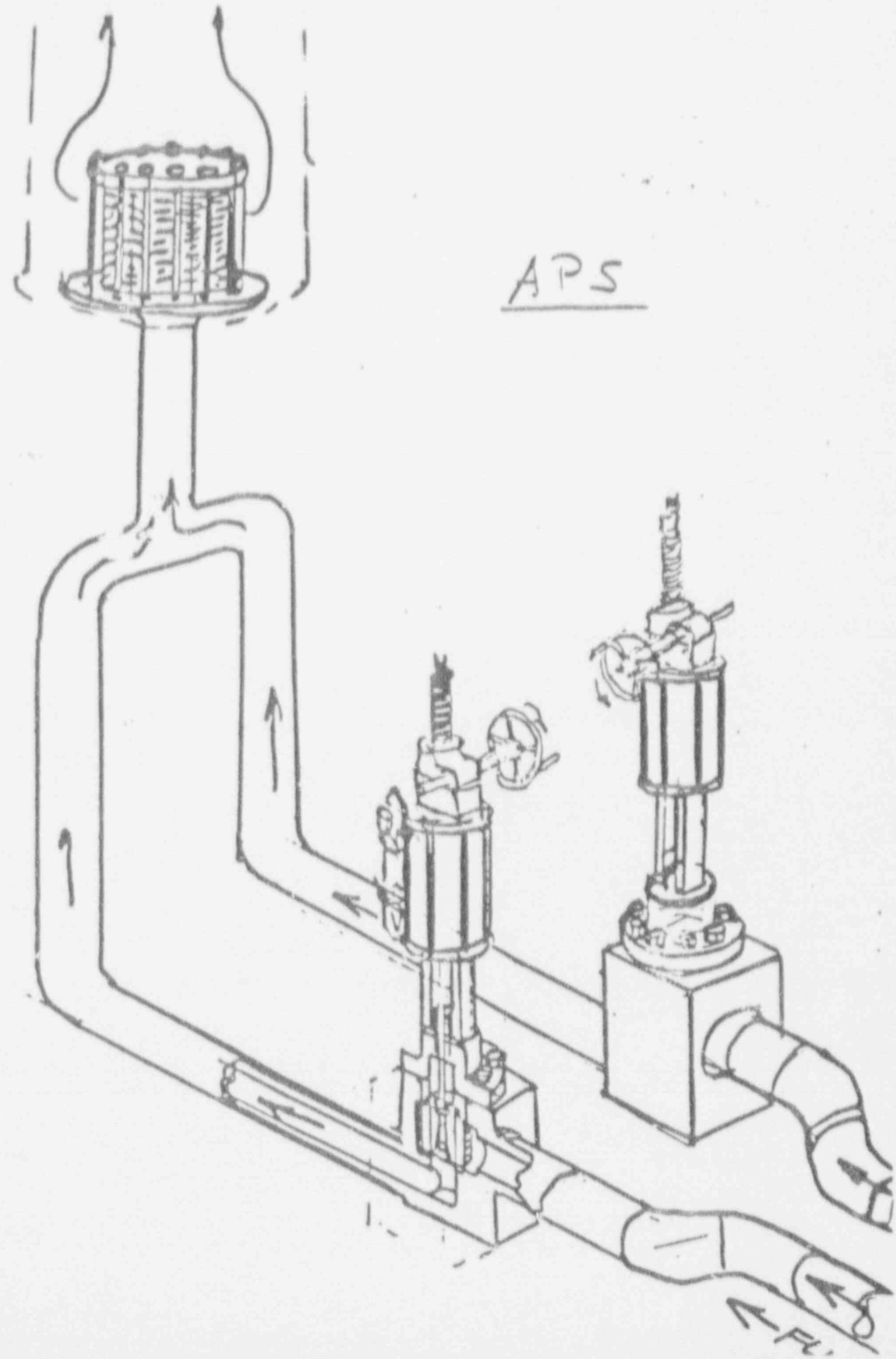




NEW DESIGN
PISTON RING



APS - DISK STACK CHARACTERIZATION


APS

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

192-00467-JGH/TDS/DAJ
April 17, 1989

U. S. Nuclear Regulatory Commission
NRC Document Control Desk
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 1
Docket No. STN 50-528 (License No. NPF-41)
Licensee Event Report 89-005-00
File: 89-020-404

Attached please find Licensee Event Report (LER) No. 89-005-00 prepared and submitted pursuant to 10CFR50.73. In accordance with 10CFR50.73(d), we are herewith forwarding a copy of the LER to the Regional Administrator of the Region V office.

This report is also being submitted to include the information requested by 10CFR21. In accordance with 10CFR21.21(b)(2), three copies three copies of this report are being provided to the Director, Office of Nuclear Reactor Regulation.

If you have any questions, please contact T. D. Shriver, Compliance Manager at (602) 393-2521.

Very truly yours,

J G Haynes

J. G. Haynes
Vice President
Nuclear Production

JGH/TDS/DAJ/kj

Attachment

cc: D. B. Karner (all w/a)
E. E. Van Brunt, Jr.
T. E. Murley (3 copies)
J. B. Martin
T. J. Polich
M. J. Davis
A. C. Gehr
INPO Records Center
H. L. Miller

IE28
1/1

NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Palo Verde Unit 1	0 5 0 0 0 5 2 8	1 OF 1 5

TITLE (4): Atmospheric Dump Valve Deficiencies

EVENT DATE (5) Month	Day	Year	LER NUMBER (6) Year	Sequential Number	Revision Number	REPORT DATE (7) Month	Day	Year	OTHER FACILITIES INVOLVED (8) Facility Names	Docket Number(s)
0 4	1 2	8 9	8 9	— 0 0 5 —	0 0	0 4	1 7	8 9	Palo Verde Unit 2	0 5 0 0 0 5 2 9
									Palo Verde Unit 3	0 5 0 0 0 5 3 0

OPERATING MODE (9): 4

POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

X 50.73(a)(2)(v)
X OTHER (Specify in Abstract below and in Text, NRC Form 366A) 10CFR21

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER Area Code	
Timothy D. Shriver, Compliance Manager	6 0 2	3 9 3 - 2 5 2 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

X YES (If yes, complete EXPECTED SUBMISSION DATE) NO

EXPECTED SUBMISSION DATE (15): Month 0 6, Day 1 5, Year 8 9

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On April 12, 1989 APS completed an evaluation of a deficiency identified by the manufacturer of the PVNGS Units 1, 2, and 3 Atmospheric Dump Valves (ADV's). The ADV's are manufactured by Control Components Incorporated (CCI). Based upon APS' evaluation, it was determined that the deficiencies reported by CCI constituted a reportable condition pursuant to 10CFR21 and consequently 10CFR50.72 and 73.

On April 4, 1989, CCI notified APS that an evaluation had been performed and that excessive internal valve leakage could result in the inability to remotely or manually operate the PVNGS ADV's. The cause of the excessive leakage is the result of an internal piston ring which fails to seat. Excessive leakage by the piston ring results in high internal pressures which would preclude opening of the valve.

A supplement to this report will be submitted to detail the final corrective actions developed as a result of APS's ongoing investigation.

No previous similar events have been reported pursuant to 10CFR50.73.

IE28 1/1

This report is also being provided pursuant to the provisions of 10CFR21. The narrative below includes information requested by 10CFR21(b)(3); however, it is formatted to report this event in accordance with the requirements of 10CFR50.73.

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

The following plant conditions existed when the event described in this LER was determined to be reportable at approximately 1254 MST on April 12, 1989.

Palo Verde Unit 1 was in Mode 4 (HOT SHUTDOWN) at approximately 2000 pounds per square inch (psi) and 325 degrees Fahrenheit (F).

Palo Verde Unit 2 was in Mode 3 (HOT STANDBY) at normal operating temperature and pressure.

Palo Verde Unit 3 was in Mode 6 (REFUELING) at approximately 82 degrees F.

B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classification: Condition which could have prevented the fulfillment of a safety function.

Note: This section includes information requested by 10CFR21 concerning the nature of the defect and dates for which information was obtained/developed.

On April 12, 1989 at approximately 1254 MST Arizona Public Service (APS) determined that deficiencies identified by the manufacturer of the PVNGS Unit 1, 2, and 3 Atmospheric Dump Valves (ADV)(SB)(V) constituted a reportable condition pursuant to 10CFR21 and 10CFR50.73.

On March 3, 1989, a Palo Verde Unit 3 reactor trip occurred from approximately 98 percent power (Reference Unit 3 LER 530/89-001-00). Following the reactor trip, Control Room personnel (utility, licensed and non-licensed) attempted to remove decay heat and control steam generator (AB)(SG) pressure utilizing the Atmospheric Dump Valves (ADV's)(SB)(V). Control Room personnel could not remotely operate the ADV's from the Control Room or Remote Shutdown Panel. Heat removal was subsequently established by manually opening the ADV's.

NRC Form 366A

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/88

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Palo Verde Unit 1	0 5 0 0 0 5 2 8	8 9	— 0 0 5 —	0 0	0 3 OF 1 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Because of the ADV problems encountered during the Unit 3 reactor trip event, APS engineering personnel have been conducting an extensive evaluation of the ADV design and operation. The original equipment manufacturer, Control Components Incorporated (CCI), has been assisting during the APS evaluation. On April 4, 1989 CCI sent a letter to APS providing notification that a "potential significant deficiency" existed with the ADV design. Following receipt of this information, APS conducted an evaluation pursuant to 10CFR21 to determine the reportability of the information contained in the CCI notification. Further information was received from CCI on April 10, 1989 informing APS that local manual operation of the ADV's would not be possible if the deficient condition were to occur.

On April 12, 198[illegible], PVNGS Engineering completed the evaluation and determined that the deficiency identified by CCI [illegible]stituted a reportable condition.

The following discussion is intended to assist the reader in understanding the ADV's principle of operation. The disk stack (Figure 1) permits changes in flow rate while limiting flow velocity through the control element. The disk stack consists of a number of disks into which labyrinth flow passages have been etched to allow a fixed impedence. Impedence in the passages is developed by a series of right-angle turns, with a specific number of turns in each passage to limit the velocity to an acceptable level. Since each disk has a known flow capacity, flow through the control element can be accurately measured and controlled. The position of the plug within the disk stack bore determines flow by exposing more or fewer disk passages.

With the valve in the closed position, upstream pressure fills the chamber above the plug by way of a controlled leak across the piston ring. This provides a seating load equal to the inlet pressure times the full area of the plug.

When a signal to open the valve is received, the actuator lifts the stem, opening the pilot seat which results in the chamber pressure above the plug equalizing with the downstream pressure. Upstream pressure acts upon the differential plug area and provides an axial biasing force which causes the plug to remain on the main seat.

As the valve stem continues to move in the opening direction, the pilot valve shoulder engages the plug to lift it off the main seat. The axial biasing force causes these opposing faces to remain in contact under all operating conditions.

When the plug is in the modulated mode, biasing force provided by pressure acting on the differential area overcomes fluctuating pressures from the fluid jets exiting the disk stack.

When a signal to close the valve is received, the actuator moves the stem in the closing direction. The biasing force on the plug causes it to follow the stem until the main seat is contacted. The actuator then seats the pilot section. Controlled leakage by the piston ring then fills the chamber above the plug providing additional seating force.

C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

Other than the ADV problems discussed in this LER, there were no structures, systems, or components inoperable at the start of the event which contributed to the event.

D. Cause of each component or system failure, if known:

Note: This section includes information requested by 10CFR21 concerning the nature of the defect and dates for which information was developed.

As a result of the ADV malfunctions experienced at Unit 3, APS engineering contracted with CCI to assist in the root cause investigation. The Unit 1, 2, and 3 ADV's were tested in accordance with approved test instructions. The purpose of the testing was to determine the force involved in the operation of the ADV's and to characterize the positioner operation at normal operating temperature and pressure. The results of the testing are summarized below:

1. Test Results

Unit 1

ADV 184 was the first valve to be tested on March 14, 1989 using nitrogen gas supply at 95 psig. The valve did not stroke when given up to a 50 percent open demand signal. A bonnet pressure tap was not installed at this time which made the valve malfunction difficult to analyze.

Following the malfunction of ADV 184, one operable ADV was required to allow Unit 1 to remain in Mode 3 for completion of additional testing. ADV 179 was tested on March 16, 1989 and given 10 percent incremental open demand signals up to 50 percent. Nitrogen was used to stroke the valve with an initial pressure of 93 psig. It stroked very smoothly and followed within 6 percent of the demand signal. As a result of this test, ADV 179 was confirmed to be operable.

On March 18, 1989, ADV 178 was given both incremental and step demand signals initially using nitrogen at 95 psig. As the valve opened through the disk stack transition region (approximately 15 to 20 percent open) it oscillated between 20 and 60 percent for several seconds. During this test, a close signal was given to the valve and the valve closed. After repeated testing, it was observed that the ADV did not oscillate, but would stroke relatively smoothly. The testing of ADV 178 was repeated using instrument air at normal supply pressure; all strokes were smooth, and no oscillations were observed.

ADV 185 experienced substantial oscillations when originally tested using nitrogen supply. During the first testing on March 18, 1989, a 20 percent open demand signal was given and the valve oscillated and closed. During additional testing the valve exhibited damped oscillation. It was observed that the more the valve was exercised, the more smoothly it would stoke. The valve was manually stroked and then observed to operate smoothly. ADV 185 testing was repeated using instrument air; all cycles were smooth, the valve closely followed the input demand signal.

A second attempt to test ADV 184 was made on March 21, 1989 using instrument air. This time ADV 184 began to open when given a 30 percent demand signal, but quickly shut on its own. A 40 percent demand signal was then applied. The valve oscillated slightly, then opened 40 percent. The test was repeated several more times to a maximum open signal of 50 percent. Each time the valve stroked smoothly.

Unit 2

All Unit 2 ADV's were stroked utilizing nitrogen at normal pressure (95 psig) and most utilizing instrument air at approximately 110 psig. A total of 22 tests were performed stroking the ADV's to 20 percent or more. No oscillations were observed and no instances occurred wherein the valves did not open.

Unit 3

Unit 3 ADV's with the exception of 179 were stroked utilizing nitrogen after the plant had been cooled down in Mode 5. (ADV 179 could not be tested since the actuator was damaged following the March 3, 1989 Unit 3 trip.) When ADV 178 was given a 10 percent open demand signal, the valve moved to 6 percent smoothly and the actuator force required to move the valve more than twice the expected force. Additional stroking consistently required excessive force to move the valve. In order to identify the source of the excessive resistance, the packing gland follower was loosened and approximately 50 percent of the packing was removed from the valve. Retesting the valve showed a significant reduction in the actuator force required to open the valve; however, it was still much higher than originally predicted. The actuator was decoupled from the valve. Stroking the actuator alone required approximately twice the predicted force. When the actuator was disassembled, an extra spring was found (two springs are specified by CCI). This explained the excessive force required to stroke the actuator.

ADV 18 and 185 were both stroked and actuator forces were observed to be on the high end of the predicted range. Both ADV's 184 and 185 experienced a reduction in the opening force when the packing gland follower was loosened. During disassembly of both ADV actuators, a third spring was discovered to be improperly installed in both valves.

Summary

During the testing described above, APS determined that the Unit 1 ADV 184 malfunction caused excessive bonnet pressure and, therefore, the force necessary to open the valve to exceed the capability of the actuator when the valve was being operated on the nitrogen gas supply. This discovery led to the development of revised test instructions to be performed on the ADV's in Units 1 and 2. The purpose of the procedure was to verify all the ADV's would operate on both the non-Class 1E Instrument Air supply and the Class 1E nitrogen gas supply. The valves were stroked using the safety-grade nitrogen system and then repeating the test using the Instrument Air (IA) system. The IA system provides additional force for opening the valve since it is maintained at 110 psig while the nitrogen system pressure regulator maintains pressure at 95 psig. An abnormally high bonnet pressure was suspected of causing the excessive force holding valve ADV 184 closed. As a result, a bonnet pressure tap was added and appropriate pressure measurements were taken.

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Since ADV 184 had already been tested using the nitrogen accumulator, that portion of the test was deleted and the valve was stroked using the normal IA supply. The valve was tested in the following sequence and with the following results:

1) A 10 percent demand open signal was given. The valve did not move in response to the demand signal as expected.

2) A 20 percent demand was then given and the pilot valve opened. This allowed the bonnet pressure to decrease and the condition of the seal ring to be determined. Bonnet pressure decreased to 60 psig and then slowly increased to 110 psig (this is approximately 6 to 10 times higher than design).

3) Next, a 30 percent demand signal was given. The pilot valve opened and the bonnet pressure decreased to approximately 42 psig. The valve rapidly opened to 20 percent, the bonnet pressure rapidly increased from 42 psig to 110 psig, and the valve shut.

4) A 40 percent demand signal was given. The bonnet depressurized to between 44 and 34 psig and the valve rapidly opened to 38 percent, closed to 6 percent, and then opened smoothly to 40 percent.

5) The valve was then given another 40 percent open demand signal. The bonnet depressurized to between 2 and 8 psig, and the valve opened smoothly to 45 percent.

6) A 30 percent demand was then repeated. The bonnet depressurized to approximately 2 to 7 psig and the valve stroked smoothly to 32 percent. The valve was then given an incremental signal from 10 percent to 50 percent pausing at each 10 percent increment to allow the valve to stabilize prior to increasing demand.

The bonnet pressure measured on ADV 184 initially was 110 psig. This would require approximately 14,000 pounds-force (lbf) to open the valve. Based upon the available Instrument Air (IA) or nitrogen supply pressures, the IA system will not provide enough force to open the valve unless the bonnet pressure is less than approximately 80 psig . Also, the nitrogen gas supply will not provide adequate force to open the valve unless the bonnet pressure is approximately 60 psig.

CCI believes that the cause of the valve being able to stroke only to the pilot open position is excessive bonnet pressure due to excessive piston ring leakage. To investigate this hypothesis, CCI fabricated a fixture in order to flow test the 12 inch piston ring. The flow test was conducted utilizing air at 1200 psi. CCI tested the design currently installed at PVNGS for 100 open-shut cycles. During one of the tests, excessive leakage resulting in high bonnet pressure was observed. These tests were performed in late 1986 as a result of erratic performance observed on the non-safety related valves at another nuclear facility. The excessively leaking piston ring condition is random and cannot be predicted.

During further testing, CCI intentionally placed a 0.010 inch high spot on the piston ring to simulate dirt. CCI then measured the leakage flow coefficient (Cv). The measured Cv corresponds to a leak which would be expected to result in excessive bonnet pressure.

A second series of tests were performed by CCI to investigate potential problems in the pilot plug area. CCI constructed full size models of the existing pilot plug and also designed a new pilot area. Both models were flow tested on a low pressure air flow system to determine their Cv and develop improvements to the design.

Prior to the malfunctions which occurred at PVNGS, CCI installed pressure taps on numerous valves which had failed to open at other facilities. The valves were always operable after instrumentation was installed. Consequently, CCI did not have any evidence that excessive bonnet pressure was the cause of the failure. The test at PVNGS on SG-HV-184 is the first valve failure during which representative pressure measurements could be taken.

Mechanical binding due to thermal expansion mismatch, hoop deflection due to pressure, and flow and galling due to high piston ring hub forces have also been postulated to be the cause. However, many valves have been disassembled and examined by CCI. No inordinate rubbing has been found and no visible reason for binding has been observed. CCI has performed thermal and stress calculations and did not find any mismatch or fit problems.

2. Root Cause

CCI has over 200 similarly constructed valves in other nuclear facilities which have been in service for the last several years. The "stuck at pilot open" problem has occurred least often with 8 inch plug valves, and most often with 12 inch plug valves. The sticking seems to be most likely when the valve is not stroked over a period of time. Based upon previous CCI experience, when a valve exhibits the problem observed at PVNGS, it has been discovered that stroking the valve for 3 to 4 cycles "re-seats" the piston ring and the valve operates properly.

The following root causes have been provided by CCI based on their investigation of the ADV problems experienced at PVNGS.

a) Dirt or foreign material such as corrosion products (magnetite) is building up on sealing surfaces of the piston ring when the valve is clos[illegible]. The piston ring would not be energized due to equ[illegible] pressures on both sides of the piston ring. When th[illegible] pilot plug is opened during attempted operations, there is excessive piston ring leakage since the contamination holds the piston ring off the sealing surfaces. Cycling of the ADV's three (3) or four (4) times allows the contamination to "wash" away and the piston ring seal operates properly.

b) There is a vertical clearance of approximately 0.005 inch between the piston ring and the upper sealing surface. CCI believes that, when the pilot valve is opened, the fluid rushing past this 0.005 inch upper clearance results in a dynamic pressure holding the piston ring down, away from its sealing surface. To address this scenario, CCI proposed "wave springs" which hold the piston ring in contact with its upper sealing surface at all times. There has been at least one instance of a valve not opening as required with a wave spring installed to energize the piston ring.

E. Failure mode, mechanism, and effect of each failed component, if known:

The failure mode, mechanism, and effect of potential ADV failures are discussed in Sections I.D and II.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - the ADV's do not have multiple functions.

G. For failures that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

The information requested by the above is not considered appropriate for the event being described in this LER. There have been no ADV failures at PVNGS wherein the capability to remotely and locally operate the ADV's was lost as a result of the causes described in Section I.D.

H. Method of discovery of each component or system failure or procedural error:

The inability to remotely operate the ADV's was originally discovered during the reactor trip event discussed in Section I.B. Subsequent malfunctions were discovered during testing conducted after the Unit 1 trip. The cause of the ADV malfunctions was identified by CCI and provided to APS on April 4, 1989 as discussed in Section I.B. There have been no procedural errors discovered.

I. Cause of Event:

The cause of the event being reported in this LER has been determined to be an inadequate design by the original equipment manufacturer. Further investigation of the ADV problems is continuing and will be discussed in a supplement to this report expected to be submitted by June 15, 1989.

J. Safety System Response:

Not applicable - there were no safety system responses and none were necessary.

K. Component Information:

Note: This section includes information requested by 10CFR21 concerning the identification of the firm supplying the basic component and the number and location of the relays at Palo Verde.

The PVNGS design incorporates the use of four (4) ADV's per unit (twelve total) as a means of providing decay heat removal in the event of a loss of offsite power. These valves are located between the steam generator and Main Steam Isolation Valves (SB)(V). The ADV's are manufactured by Control Components, Inc. (CCI) in accordance with Specification 13-JM-601A. They are model number B3G9-10-12P8-31NAS1. The valves are pilot operated, pneumatically actuated drag valves. The valves are powered by a double acting, spring to close, pneumatic piston actuator. The actuator area is approximately 111 square inches developing over 10,000 lbf of thrust when one side is fully pressurized and the other side is vented to atmosphere. The design relieving capability is 1.47 x 10E06 pounds-mass (lbm) per hour.

II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS EVENT:

The ADV's are used to remove decay heat from the steam generator in the event that the main condenser (SG) is unavailable for service for any reason including a loss of ac power. The decay heat is dissipated by venting steam to the atmosphere. In this way, the reactor coolant system (RCS)(AB) can either be maintained at hot standby conditions or cooled down. The system instrumentation and controls for the atmospheric dump valves are described below.

- Initiating Circuits and Logic

  There are no automatic initiating circuits for operation of the atmospheric dump valves.

  The atmospheric dump valves are positioned manually by a controller (manual loading station) from either the main control room or the remote shutdown panel as part of the capability for emergency shutdown from outside the control room. Each valve has two separate permissive control circuits. Valve position indication is provided at each remote control station. A handwheel is also provided with the atmospheric dump valve for local manual operation.

- Bypasses, Interlocks, and Sequencing

  No bypasses, interlocks, or sequencing are provided for the atmospheric dump valves.

- Redundancy

  Two (2) redundant, atmospheric dump valves are provided for each steam generator.

The major accident scenarios which credit the use of the ADV's are:

- 6.3.3.4 - Post Loss of Coolant Accident (LOCA) Long Term Cooling
- 15.1.4 - Inadvertent Opening of a Steam Generator Relief or Safety Valve (MSSV)
- 15.3.1 - Total Loss of Reactor Coolant Flow
- 15.4.1 - Uncontrolled Control Element Assembly (AA)

Withdrawal from a Subcritical or Low Power Condition

* 15.6.3 - Steam Generator Tube Rupture

In the event that all four (4) ADV's could not be opened upon demand (due to a failure of the pneumatic actuators to provide sufficient opening force by themselves as a result of the reported deficiency), reactor decay heat will be removed through the Main Steam Safety Valves (MSSV's). The MSSV's will open when pressure in the steam generator reaches the pressure relief setpoints. Steam release will continue until the pressure is reduced to the safety valve reset pressure. The safety valves will continue to cycle in this manner as steam generator pressure increases and decreases. The RCS will remain at hot standby conditions during this pressure relief cycling. Hence, the RCS pressure boundary integrity will be maintained and the safety analysis will bound the consequences of the reported deficiency.

APS has reviewed Chapters 6 and 15 of the Combustion Engineering Standard Safety Analysis Report (CESSAR) and the PVNGS Updated Final Safety Analysis Report (UFSAR) and determined that the earliest the ADV's are required for any of the accident scenarios is 30 minutes from the onset of the particular accident. In these scenarios, the ADV's are used to cooldown the plant in the event of a loss of offsite power coincident with the particular accident. APS has reviewed the Chapter 15 CESSAR events and has found several instances wherein manual operation of the ADV's is credited. However, it should be noted that the safety analyses do not make a distinction between "remote manual" or "local manual" operation of the ADV's. APS considers that remote or local manual operation of the ADV's are equally valid methods of performing the manual operation discussed in the safety analyses.

APS was informed by the valve manufacturer on April 10, 1989 that neither the pneumatic actuator nor handwheel alone can produce sufficient force to open the valve for valve inlet pressures of 1150 psia and the worst case piston ring seal leakage is assumed. However, CCI has indicated that if the pneumatic actuator is given a signal to open (remote manual operation) and the handwheel (local manual operation) is used to open the valve in conjunction with the pneumatic actuator, the combination will provide sufficient opening force to open the valve even with the valve inlet pressure equal to the lowest set MSSV plus accumulation (approximately 1302 psia) and worst case piston ring seal leakage assumed. Although the procedures are in place for remote or local operation of the ADV's, no procedures were in place for the combined remote/local operation of the valve at the time the ADV failed to open remotely at PVNGS. Hence, credit is not taken for the combined remote/local manual operation from a 10CFR21 reportability standpoint.

The loss of the remote and local manual operation (no credit taken for the combined remote/local operation) of the ADV's will not allow the successful completion of recovery operations from postulated accidents for entry to shutdown cooling conditions (350 degrees F).

Based on the above, the failure of all 4 ADV's to open due to a failure of their pneumatic actuators and handwheel assemblies has been determined to be safety significant. Loss of the remote and local operation of the ADV's adversely affects the ability of the plant to achieve or maintain safe shutdown conditions.

The consequences of the reported deficiency (loss of both remote and local valve operation) will result in the loss of the safety function (i.e., decay heat removal) of the ADV's to the extent credited in the safety analyses presented in Chapter 6 and 15 of the UFSAR/CESSAR.

III. CORRECTIVE ACTIONS:

This section contains the information requested by 10CFR21 concerning the corrective action which has been, is being, and will be taken; the organizations responsible for the corrective action; and the length of time for accomplishing the corrective action.

A. Immediate:

PVNGS initiated an extensive investigation of the ADV malfunctions. As a result of APS concerns regarding the operability of the ADV's, Palo Verde Unit 1 remained shutdown following a reactor trip on March 5, 1989. Palo Verde Unit 2 was shutdown on March 15, 1989. Palo Verde Unit 3 remained shutdown and began a refueling outage on March 8, 1989.

In order to ensure the continued operability of the Unit 2 ADV's, APS has installed the capability to determine bonnet pressure. This will enable the detection of excessive piston ring leakage. APS is developing administrative controls for periodically monitoring for excessive piston ring leakage in the Unit 2 ADV's. If excessive piston ring leakage is determined to exist during the periodic monitoring, the ADV(s) will be declared inoperable. These administrative controls will be in place and implemented prior to restarting Unit 2.

B. Action to Prevent Recurrence:

CCI has provided the following recommendations to eliminate the valve deficiency.

- Increase the pilot valve capacity. This requires rework of the plug to enlarge the pilot flow area and a new stem to seal the pilot valve when closed.
- Use two piece wedge style piston ring to ensure a good

seal. CCI tested a two piece piston ring manufactured by Dover Corporation. This piston ring provided the lowest and most consistent Cv of the alternative piston ring designs.

APS is preparing site modifications to incorporate these CCI recommendations and expects to install these modifications prior to the completion of the next refueling outages for each Unit. APS is also trending ADV performance by instituting a periodic stroking program for the ADV's. CCI believes there is evidence that cycling of the valve reduces the probability of the excessive piston ring leakage that causes the valves' failure to open (i.e., excessive valve bonnet pressure). Previous experience with CCI valves supports energizing the piston ring regularly to improve its effectiveness. APS is continuing to evaluate potential corrective actions for the ADV problems. Based upon the evaluation, APS will develop final corrective actions. A supplement to this report will be submitted to describe the final corrective actions. The development of final corrective actions is expected to be completed by May 15, 1989 and the supplement submitted by June 15, 1989.

IV. PREVIOUS SIMILAR EVENTS:

There have been no previous similar events reported pursuant to 10CFR50.73.

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LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Palo Verde Unit 1	0 5 0 0 0 5 2 8	8 9	— 0 0 5	— 0 0	1 5 OF 1 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

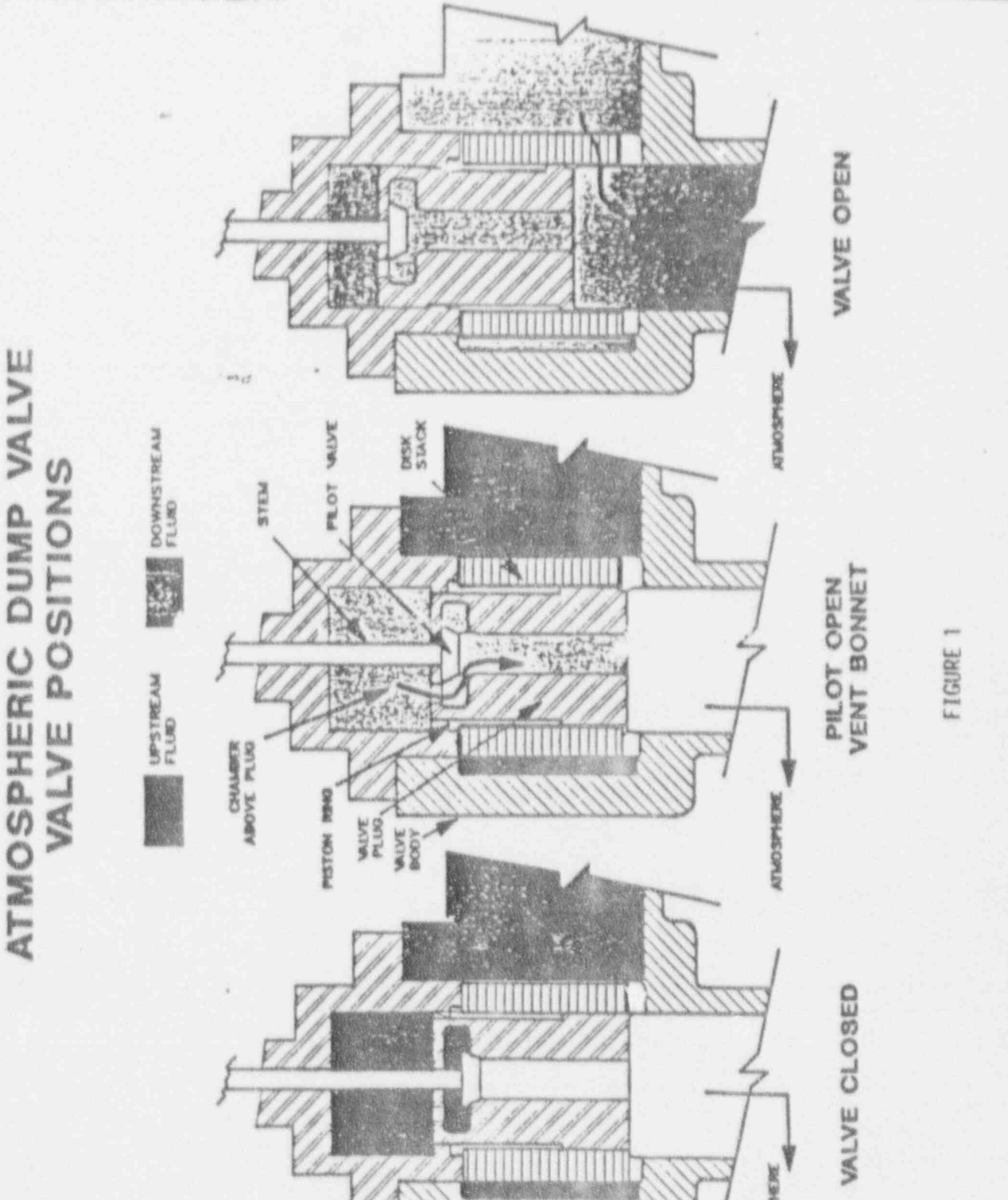

FIGURE 1

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