Docket File

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

February 23, 1993

Docket No. 52-003

APPLICANT: Westinghouse Electric Corporation

PROJECT: Westinghouse AP600 Design

SUBJECT: SUMMARY OF MEETING TO DISCUSS DESIGN OF VALVES USED IN THE AP600 DESIGN

On February 5, 1993, representatives of the U.S. Nuclear Regulatory Commission (NRC) and Westinghouse met in Monroeville, Pennsylvania, to discuss the design characteristics of valves used in the AP600 design. Enclosure 1 is a list of attendees. Enclosure 2 is a copy of the non-proprietary slides presented at the meeting. A copy of the proprietary slides was submitted by letter dated February 5, 1993. The following is a summary of the discussions during the meeting with additional elaboration of concerns identified during the meeting.

The NRC opened the meeting stating that the purpose of the meeting is to obtain information necessary to assess the reliability of "critical" valves used in the AP600 plant design (see Q210.27 and Q210.28 in the staff's letters to Westinghouse dated January 26, 1993 and February 9, 1993).

Westinghouse began their presentation with a brief overview of the passive safety systems used in the AP600. Then they discussed the following types of valves:

- Motor Operated Valves - including: ADS Stage 1; ADS Stage 2/3
- Air Operated Valves - including: ADS Stage 4; Core Makeup Tank Isolation; PRHR HX Control
- Check Valves - including: IRWST Injection; Containment Sump Recirculation; Core Makeup Tank Discharge; Core Makeup Tank Pressurization
- Squib Valves - including: pH Tank Outlet Isolation

For each valve type, Westinghouse described the functional requirements of the valve, provided valve and valve actuator characteristics (as applicable and as is currently available), and described valve testing that is planned. Most of the information provided was preliminary ("draft") and proprietary. For each

050065

DF03
1/1

valve type (except the squib valve), Westinghouse provided a draft valve specification, i.e., a "Control Valve Data Sheet." These Control Valve Data Sheets typically had general information about the valve, specification of the hydraulic conditions under which the valve would be required to operate, opening/closing conditions and characteristics, leak tightness requirements, and a list of notes related to the valve's design.

While the Control Valve Data Sheets demonstrate that Westinghouse has made a good start at defining the information that will be needed for a complete valve specification, the staff determined that the Control Valve Data Sheets should also contain:

- Specification of the environmental conditions under which the valve, actuator, and/or motor would be required to operate (as appropriate). For example, the Westinghouse design for the ADS valves, the ADS test solenoid valves, and the check valves in various systems will incorporate provisions for non-intrusive position indication. Westinghouse should address the qualification requirements for these position indicators.

- Additional specification of the valve design. For example, Westinghouse stated that they were not sure yet that certain check valve seats would be stellite. Other materials, such as nickel, may be much more susceptible to galling. The valve seat types need to be determined and identified.

- Specification of the "anticipated duty cycle" for the valve, actuator, and/or motor (as appropriate).

- Specification of how the Code test requirements will be met. (Specific examples are provided below.)

- Definition of pre-service test plans.

- A description of how each valve's design differs from conventional valve designs.

Westinghouse indicated that they also plan to include test conditions and electrical information on revised Control Valve Data Sheets.

Most of the Control Valve Data Sheets contained a note similar to the following:

> The reliability of this valve is important with respect to public safety. A probability of failing to close[1], when required, of 1 in 2000[1] demands has been used in AP600 reliability calculations.

---

[1]The valve position and number of failures per demand varies from valve to valve.

This note was not listed as a valve design requirement. Rather, it was listed to give the valve manufacturer some indication of the valve reliability expectations under the specified valve operating conditions. Westinghouse indicated that they did not believe that it is feasible to have a valve vendor design to a reliability target. Nevertheless, the staff indicated that, in some cases, the Westinghouse estimates were substantially lower than current experience would indicate and that Westinghouse should develop a basis to support their estimates.

Westinghouse stated that the ADS Valves for Stages 1, 2, and 3 will only be tested under reduced DP/flow conditions on some periodic basis. The testing proposed is essentially a pressurized valve body test where the conditions principally will only simulate actual stem rejection loads. This type of testing is not responsive to the staff's position in SECY-90-016 that states: "(d)esigns should incorporate provisions to test motor-operated valves under design basis differential pressure." Westinghouse should reconsider the proposed testing and make modifications as appropriate. Westinghouse indicated that while the 4th stage ADS valves are not part of their ADS test program in Cassacia, Italy, they will try to get data on these valves, even though they are not yet certain of the specific valve type or vendor. Westinghouse said that they planned to work with ITT/MOVATS to determine how to monitor the ADS Stage 1, 2, and 3 valves during the ADS valve test program. Westinghouse indicated that they were not planning on doing any ADS valve testing under adverse environmental conditions. Also, they are not testing the valve's dc operator. The dc motor on these operators have a torque output that varies with motor temperature. Motor temperature is a function of both duty cycle and ambient temperature. Supplying an oversized motor for this application may create a problem of excessive torque input because the high ratio gear train planned for these actuators are susceptible to damage from excessive torque.

The Stage 4 ADS valves are required to open at a certain pressure (e.g., 1100 psig) and are required to be designed to be incapable of opening above a certain higher pressure (e.g., 1500 psig). The staff questioned whether the window between these two pressures is too narrow to achieve their design objectives, given the type of valve to be used (i.e., air-operated gate valve) and current technology. There was also a question whether lubricants used in this air-operated valve could contaminate the solenoid-operated valves used in its air supply and return lines. This concern is discussed in EPRI NP-7414, "EPRI NMAC Solenoid Valve Maintenance and Application Guide," April, 1992, on pages 6-18, where it is stated that "petroleum lubricants used in actuators will find their way back to the air pilot SOVs ... the use of petroleum-tolerant elastomers may be necessary." Unfortunately, the petroleum-tolerant elastomers do not withstand radiation as well as other elastomers. One option discussed during the meeting was to locate the pilot valves remotely. Another option may be to use a direct lift, "through the wall" magnetic principle type of solenoid valve so that packing and diaphragms are eliminated. These valves are also available with stellite seats if slight leakage can be tolerated. Westinghouse should provide a response regarding how they intend to address these concerns.

The NRC expressed concern that the designs of the AP600 valves may not adequately address valve functional and Code test requirements. For example:

* Westinghouse had not identified that the ADS valves for Stages 1, 2, and 3 have a function to open against full RCS pressure. Westinghouse needs to revise the functional requirements to address opening against full RCS pressure.

* In the discussions of the in-series Core Makeup Tank (CMT) discharge check valves, Westinghouse identified that these valves are biased-open check valves and that they are both required to close under reverse flow conditions. Westinghouse should develop a method to test both of these valves for reverse flow closure. There was discussion regarding the fact that these are tilting disc check valves. When tilting disc check valves are designed for low leakage, i.e., when they have low angle of taper, they are susceptible to jamming shut. Westinghouse stated that low leakage was not a requirement, but the maximum allowable leakage was not yet determined. Westinghouse should address the maximum allowable leakage and the angle of taper; testing for reverse flow closure followed by reopening on forward differential pressure should be provided.

* In the discussions of the Containment Recirculation check valves, the staff pointed out that the Code would require that this pair of valves be forward flow tested and that at least one or both of the pair of valves be reverse flow closure tested. Westinghouse should address this testing requirement.

* In the discussions of the IRWST Injection check valves, Westinghouse indicated that these valves could be full flow tested at low differential pressure during refueling. The test differential pressure quoted was substantially higher than the minimum differential pressure opening requirements for the valve and the proposed test may not verify the differential pressure assumptions. Westinghouse should address this concern.

The NRC indicated to Westinghouse that it would like to get more detailed Control Valve Data Sheets for each of the "critical" valves specified in the staff's revised RAI (see letter dated February 9, 1993). In addition, the staff indicated that it would like Westinghouse to provide the basis for the anticipated valve reliability stated on each Control Valve Data Sheet and a commitment that the valves will be included in the Inservice Testing and Reliability Assessment Programs to ensure that the anticipated valve reliabilities are achieved and maintained.

Finally, there was a discussion about the passive core cooling system accumulator outlet check valves (PXS V028 A/B and PXS V029 A/B). While these valves were not considered "critical" valves because they are conventional valves, similar to those used in the current design Westinghouse plants, they were of concern to the NRC because there has been a history of problems with the testability of these valves. There was some question as to how these valves would be tested in accordance with the Code to their full open position.

According to Westinghouse, these valves will have position indicators and will be able to be leak tested individually. The staff noted that the use of a non-intrusive diagnostic system for position indication may present unique challenges due to the potential interference of acoustic signals between the valve pair. This is generic to paired valves located in close proximity to each other. An overall system flow test does not provide adequate information on specific valve degradation. Westinghouse will need to develop a qualified system that addresses this concern.

In general, the Westinghouse design as it is currently developed has incorporated provisions for some degree of valve testing. However, as identified in some of the specific comments above, there are a number of staff concerns in this regard. Operating experience indicates that provisions for valve testability in current designs is less than optimal. Westinghouse should reconsider this aspect of their design to ensure that all Code testing requirements will be able to be met. Westinghouse should also ensure that the system designs will enable the operators to periodically verify the capability of all valve types under conditions as close as possible to the design basis.

At the end of the meeting, the NRC indicated that the information presented during the meeting resolved a number of the staff's concerns. However, the staff raised a number of concerns during the meeting (as identified in this meeting summary) and expected to see documented evidence that these concerns were considered and factored into the design. The staff indicated that it would be developing more detailed questions in the area of reliability and failure rates of these valves. The staff further indicated that the information requested in Q210.28 would need to be placed on the docket.

The staff agreed to send Westinghouse the following:

- A revision to Q210.28 (see February 9, 1993 letter), and

- Selected NRC generic communication(s) related to the use of stainless steel, including NRC Information Notice No. 88-85, "Broken Retaining Block Studs on Anchor Darling Check Valves"; NRC Bulletin 89-02, "Stress Corrosion Cracking of High-Hardness Type 410 Stainless Steel Internal Preloaded

Bolting in Anchor Darling Model S350W Swing Check Valves or Valves of Similar Design;" and the AEOD Special Study on "Pressure Locking and Thermal Binding of Gate Valves" (AEOD/S92-07).

Original Signed By:

Thomas J. Kenyon, Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/enclosures:
See next page

DISTRIBUTION w/enclosures:

Docket File	PDST R/F	TKenyon	PShea
PDR	BPerch, 8H7	DTerao, 7H15	

DISTRIBUTION w/o enclosures:

TMurley/FMiraglia	DCrutchfield	WTravers	RBorchardt
EJordan, MNBB3701	JNWilson	ACRS (11)	TSullivan, 7E23
DFischer, 7E23	JMoore, 15B18	GGrant, 17G21	

OFC:	LA:PDST:ADAR	PM:PDST:ADAR	SC:PDST:ADAR
NAME:	PShea	TKenyon:sg	RBorchardt
DATE:	02/22/93	02/ /93	02/22/93

OFFICIAL RECORD COPY:
DOCUMENT NAME: VALVE.SUM

cc: Mr. Nicholas J. Liparulo
Nuclear Safety and Regulatory Analysis
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, Pennsylvania 15230

Mr. B. A. McIntyre
Advanced Plant Safety & Licensing
Westinghouse Electric Corporation
Energy Systems Business Unit
Box 355
Pittsburgh, Pennsylvania 15230

Mr. John C. Butler
Advanced Plant Safety & Licensing
Westinghouse Electric Corporation
Energy Systems Business Unit
Box 355
Pittsburgh, Pennsylvania 15230

Mr. M. D. Beaumont
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
One Montrose Metro
11921 Rockville Pike
Suite 350
Rockville, Maryland 20852

Mr. Sterling Franks
U. S. Department of Energy
NE-42
Washington, D.C. 20585

Mr. S. M. Modro
EG&G Idaho Inc.
Post Office Box 1625
Idaho Falls, Idaho 83415

Mr. Steve Goldberg
Budget Examiner
725 17th Street, N.W.
Room 8002
Washington, D.C. 20503

VALVE MEETING ATTENDEES

FEBRUARY 5, 1993

NAME	AFFILIATION
John C. Butler	Westinghouse
Preston A. Vock	Westinghouse
Mark J. Loeffler	Westinghouse
Terry Schulz	Westinghouse
Sue Fanto	Westinghouse
Don Casada	ORNL
John Kueck	ORNL
Karen McElhaney	ORNL
Robert Staunton	ORNL
Ted Sullivan	NRC
Dave Fischer	NRC
Tom Kenyon	NRC

Enclosure 1

Westinghouse/NRC Meeting on AP600 Valves

Presentation Material

February 5, 1993

Westinghouse Energy Center
Monroeville, PA

NRC/WESTINGHOUSE VALVE MEETING
FEBRUARY 5, 1993
AGENDA

1. INTRODUCTION	Butler Hasselberg (NRC)
2. PASSIVE SYSTEMS OVERVIEW	Schulz
3. MOTOR-OPERATED VALVES	(**)
4. AIR-OPERATED VALVES	(**)
5. CHECK VALVES	(**)
6. SQUIB VALVES	(**)
7. CONCLUSION / DISCUSSION	all

(**) PRESENTATION MATERIAL FOR EACH VALVE TYPE

- System Applications	Schulz
- Valve Functional Requirements	Schulz
- Valve Design Information	Vock
- Valve Testing Information	Fanto
- Miscellaneous Questions	As required

AP600 SYSTEMS DESIGN

- **Greatly Simplify Systems to Improve Safety, Cost, Construction, Maintenance, & Operation**

- **Provide Simple Passive Safety Systems**
  - Use "natural" driving forces only
  - One-time alignment of active valves
  - No support systems after actuation
  - Reduced operator dependency

- **Provide Non-Safety Systems**
  - Reliable active equipment for normal operation
  - "First line of defense"; redundant active equipment powered by on-site non-safety diesels
  - Reduced use of passive safety systems
  - Reduced risk to utility & public

- **Iterative Design Development**
  - Safety analysis studies
  - Risk and severe accident analysis studies
  - Plant arrangement and modularization studies

TLS - 2/2/93

AP600 SAFETY SYSTEMS

- **Provide Passive Safety Systems**
  - Greatly simplified considering construction, maintenance, operation, ISI / IST
  - Mitigate design basis accidents without use of NNS systems
  - Meet NRC safety goals without NNS sys (EPRI)
  - Meet EPRI safety goals with NNS systems

- **Safety Systems Design Features**
  - Only passive processes; no "active" equipment
  - Significant design margins
  - Redundancy to meet single failure criteria
  - PRA based redundancy / diversity
  - Greatly reduced need for operator actions

- **Safety Equipment Design Features**
  - Reliable / experience based equipment
  - Improved inservice testing / inspection
  - Reg Guide 1.26 Quality Group A, B, or C
  - Seismic I design
  - Qualified Equipment
  - Availability controlled by Technical Specifications with shutdown requirements
  - Reliability Assurance Program
  - Tier I description and ITAAC

TLC - 2/2/93

AP600 PASSIVE SAFETY FEATURES

- **Passive Decay Heat Removal**
  - Natural circulation HX connected to RCS

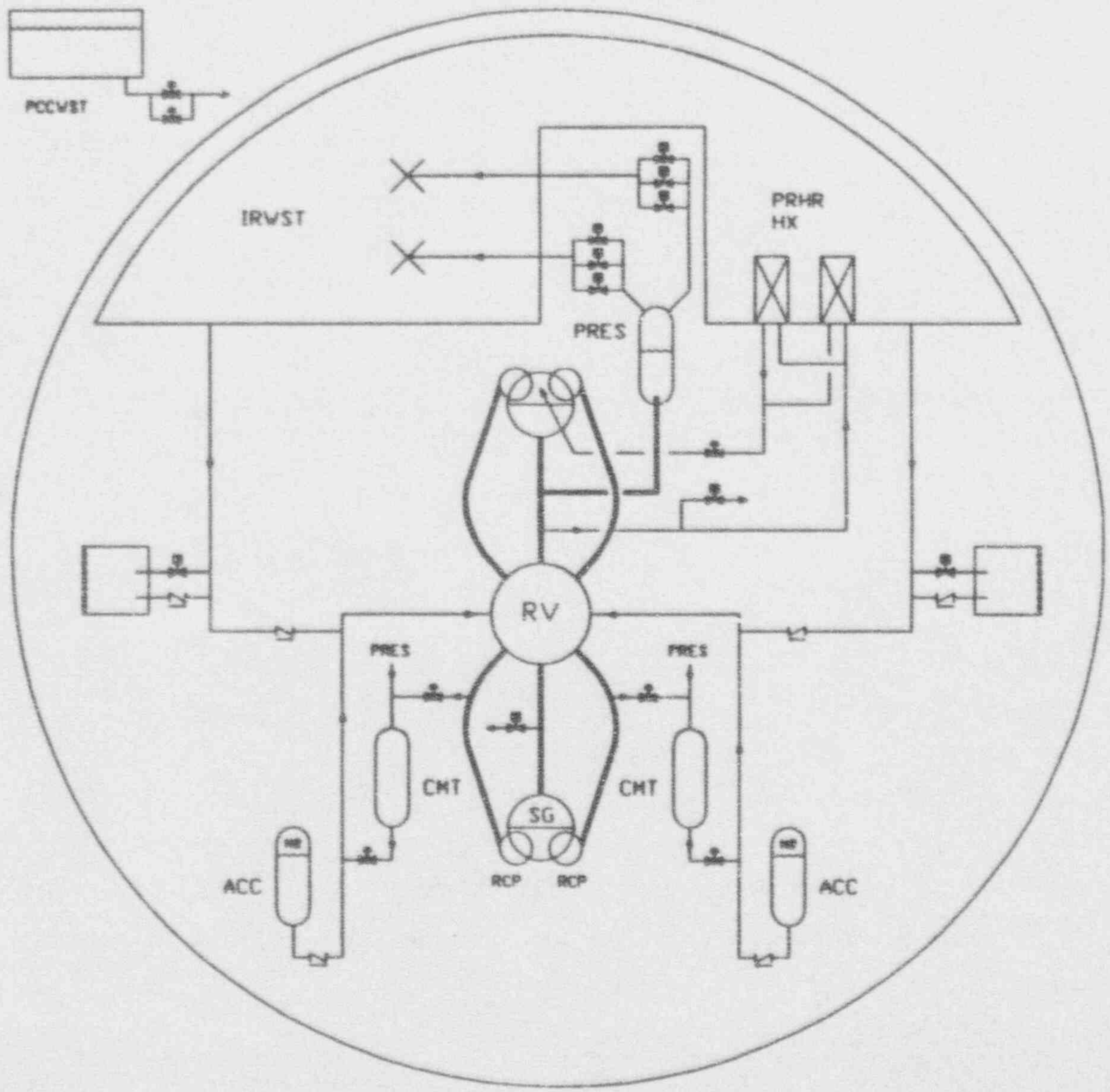
- **Passive Safety Injection**
  - N2 pressurized accumulators
  - Gravity drain core makeup tanks (RCS pressure)
  - Gravity drain in-containment refueling water storage tank (containment pressure)
  - Automatic RCS depressurization

- **Passive Containment Cooling**
  - Steel containment shell transfers heat to natural circulation of air and evaporation of water drained by gravity

- **Passive HVAC**
  - Compressed air for habitability of main control room
  - Concrete walls for heat sink (MCR and I&C rooms)

TLS - 2/2/93

AP600 - PASSIVE SAFETY SYSTEMS



WESTINGHOUSE - 1/92

MOTOR OPERATED VALVES

- **Special Applications**
  - ADS Stage 1
  - ADS Stage 2 / 3

ADS VALVES - STAGE 1

- **Functional Requirements**
  - Normally Isolate Pressurizer from IRWST
  - Limited Manual RCS Depressurization
  - Automatic RCS Depressurization

- **Valve Characteristics**

[ ] a,c

- **Valve Actuator**
  - Motor-Operator, dc Powered
  - Normally Closed, Fail-As-Is
  - Slow Opening, [ ] a,c sec
  - Open Against Full RCS Pressure

- **Valve Actuation**
  - Low-1 CMT Level Setpoint

- **Valve Testing**

[ ] a,c

TLS - 2/3/93

ADS VALVES - STAGES 2 AND 3

- **Functional Requirements**
  - Normally Isolate Pressurizer from IRWST
  - Automatic RCS Depressurization

- **Valve Characteristics**
  - [ ]a,c

- **Valve Actuator**
  - Motor-Operator, dc Powered
  - Normally Closed, Fail-As-Is
  - Slow Opening, [ ]a,c sec
  - Open Against Full RCS Pressure

- **Valve Actuation**
  - Low-2 & -3 CMT Level Setpoints

- **Valve Testing**

[ ]a,c

AP600 ADS TEST FEATURES, STAGES 1 - 3

(AT POWER TEST)

a,c

AP600 ADS TEST FEATURES, STAGES 1 – 3

(SHUTDOWN TEST)

a,c

CONTROL VALVE DATA SHEET NO: CT-001

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 1	V001A,B,C,D

DRAFT

a,c

Rev: 5 Date: 01/31/93

Printed: 02/04/93 08:35:04

File:C:\ALPHA4\VALVES\...

11

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 1	V001A,B,C,D

DRAFT

a,c

CONTROL VALVE DATA SHEET NO: CT-001

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 1	V001A,B,C,D

DRAFT

a,c

[ ]

CONTROL VALVE DATA SHEET NO: CT-002

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 2 and 3	V002A,B,C,D, V003A,B,C,D

a,c

CONTROL VALVE DATA SHEET NO: CT-002

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 2 and 3	V002A,B,C,D, V003A,B,C,D

a,c

CONTROL VALVE DATA SHEET NO: CT-002

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 2 and 3	V002A,B,C,D, V003A,B,C,D

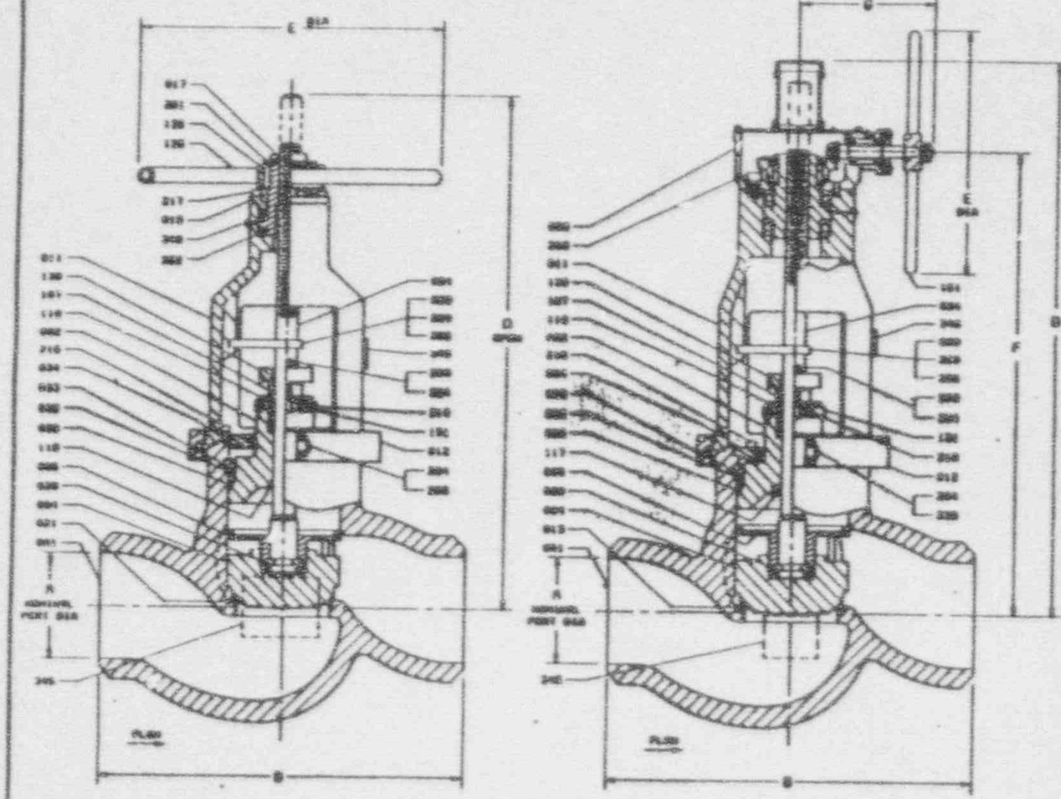
a,c

[ ]

AP600
AUTOMATIC DEPRESSURIZATION SYSTEM (ADS)
TEST VALVES

a,c

	TAG NO. ADS-01	TAG NO. ADS-02	TAG NO. ADS-02
DESCRIPTION			
MOTOR OPERATOR			
STROKE TIME			
VENDOR	ANCHOR DARLING	ANCHOR DARLING	WESTINGHOUSE



2½" AND 3"

4" THRU 24"

ITEM NO.	DESCRIPTION	TYPICAL CARBON STEEL MATERIAL	TYPICAL CARBON STEEL MATERIAL SPEC. ASME-SA ASTM-A	TYPICAL STAINLESS STEEL MATERIAL	TYPICAL STAINLESS STEEL MATERIAL SPEC. ASME-SA ASTM-A
[illegible]	BODY	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	BONNET	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	DISC	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	DISC INSERT	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	YOKE	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	YOKE CLAMP	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	SEAT RING	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	YOKE SLEEVE	[illegible] BRONZE	[illegible]	[illegible] BRONZE	[illegible]
[illegible]	YOKE CAP	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	SEAT RING-INTEGRAL	COCR-A		COCR-A	
[illegible]	STEM	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	STEM RETAINER	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	STEM CLAMP	STRUCTURAL STEEL	[illegible]	STRUCTURAL STEEL	[illegible]
[illegible]	PRESSURE SEAL GASKET	SOFT STEEL		STAINLESS STEEL	[illegible]
[illegible]	SPACER RING	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	GASKET RETAINER	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	BONNET RETAINER	STRUCTURAL STEEL	[illegible]	STAINLESS STEEL	
[illegible]	GLAND	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
110	PACKING	JOHN CRANE [illegible]		JOHN CRANE [illegible]	
117	BACKSEAT	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	BACKSEAT-INTEGRAL	COCR-A		COCR-A	
[illegible]	GLAND FLANGE	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	GLAND RETAINER	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	HANDWHEEL KEY	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	HANDWHEEL	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	IMPACTOR HANDWHEEL (OPT)	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	YOKE CLAMP STUDS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	GLAND EYEBOLTS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	BONNET CAPSCREWS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	YOKE CAPSCREWS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	ACTUATOR CAPSCREWS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	GLAND RET. CAPSCREWS	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	SETSCREW	ALLOY STEEL	[illegible]	ALLOY STEEL	[illegible]
[illegible]	YOKE CLAMP NUTS	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	GLAND STUD NUTS	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	STEM CLAMP KEY	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	RETAINING RING	CARBON STEEL		CARBON STEEL	
[illegible]	GREASE FITTING	ALLOY STEEL		ALLOY STEEL	
[illegible]	NAMEPLATE	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	I.D. PLATE	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	THRUST BEARING	ALLOY STEEL		ALLOY STEEL	
[illegible]	BEVEL GEAR ACTUATOR	ANCHOR/DARLING VALVE CO	SEE DWG. PD-[illegible]	ANCHOR/DARLING VALVE CO	SEE DWG. PD-[illegible]

NOTES:

1 - DRAWING HAS TYPICAL INFORMATION ONLY, FOR INSTALLATION PURPOSES USE CERTIFIED DRAWING.

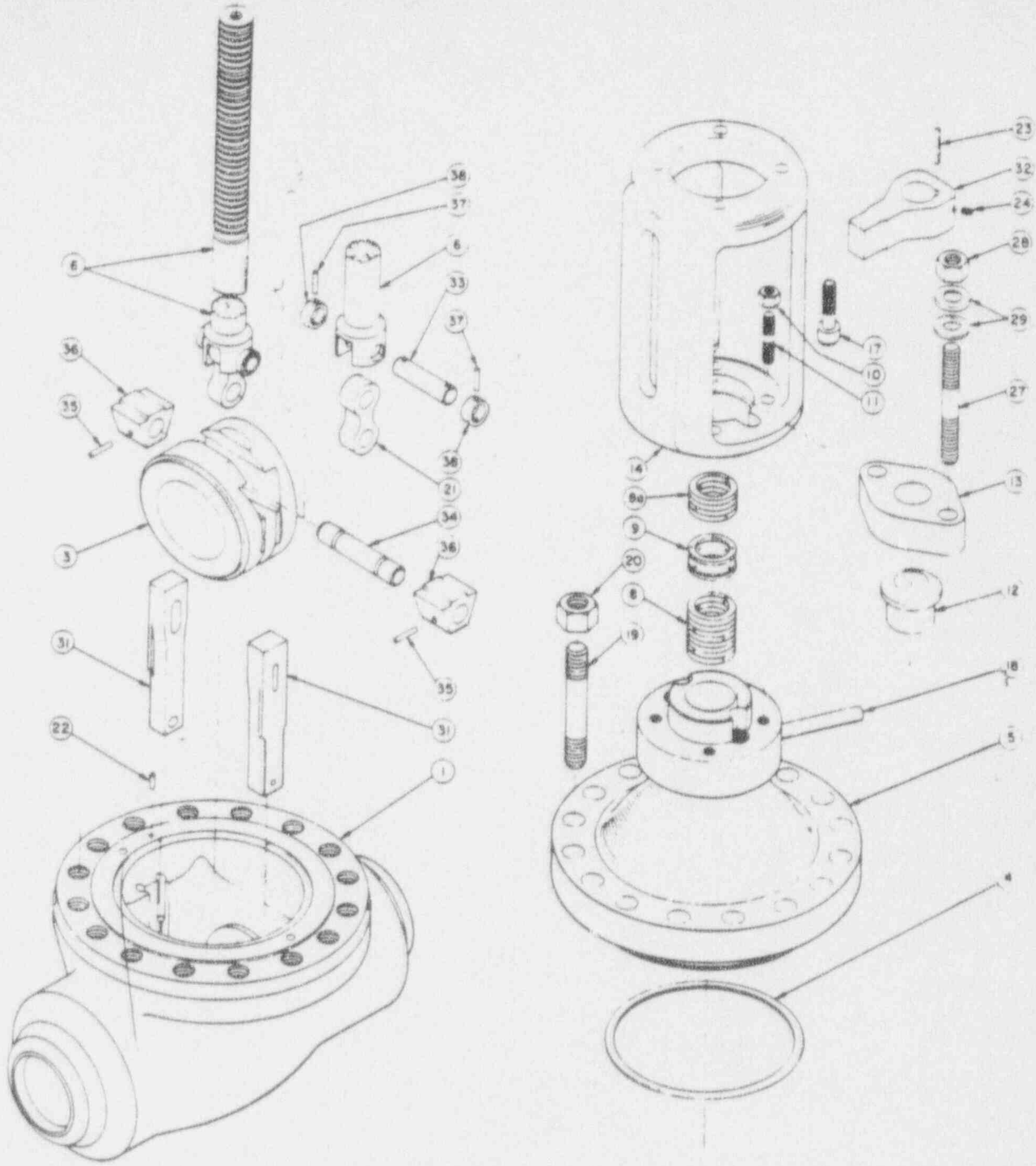
2 - DIMENSION "B", END TO END, ARE TO MANUFACTURERS STANDARD.

VALVE SIZE	A	B		D	E	F	G	WT. APPROX.	[illegible]
2½"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]
3"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]
4"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]
6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRAWING CONTAINS TYPICAL INFORMATION ONLY - PLEASE DO NOT REFERENCE ON P.O.

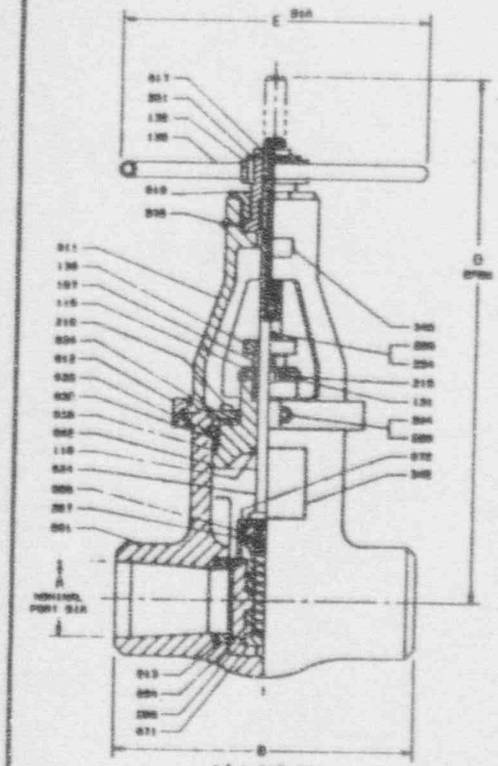
ANCHOR/DARLING VALVE COMPANY

2½" THRU 24" - 1500 lb.
GLOBE VALVE
PRESSURE SEAL BONNET
BUTT WELD ENDS

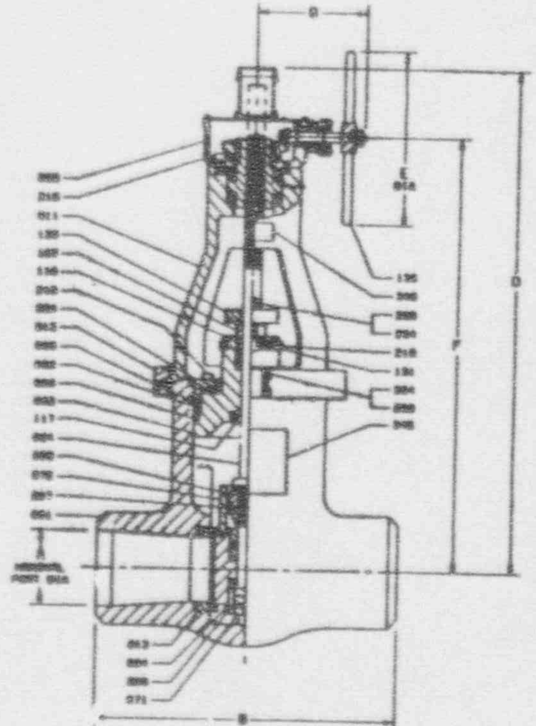


1. Body
3. Disc
4. Main Flange Gasket
5. Bonnet
6. Stem
8. Primary Packing
8a. Secondary Packing
9. Lantern Ring
10. Yoke-Bonnet Nut
11. Yoke-Bonnet Stud
12. Gland
13. Gland Follower
14. Yoke
17. Operator Cap Screw
18. Leak-Off Pipe
19. Main Flange Stud
20. Main Flange Nut
21. Link
22. Pin
23. Torque Key
24. Torque Arm Set Screw
27. Packing Gland Stud
28. Packing Gland Nut
29. Spherical Washer
31. Guide
32. Torque Arm
33. Stem Pin
34. Disc Pin
35. Lock Pin
36. Bearing Block
37. Lock Pin
38. Lock Ring

Gate Valve (Exploded View)
Figure 1.2



2½" AND 3"



4" THRU 24"

ITEM NO.	DESCRIPTION	TYPICAL CARBON STEEL MATERIAL	TYPICAL CARBON STEEL MATERIAL SPEC ASME-SA ASTM-A	TYPICAL STAINLESS STEEL MATERIAL	TYPICAL STAINLESS STEEL MATERIAL SPEC ASME-SA ASTM-A
[illegible]	BODY	CARBON STEEL	SA216-WCB	STAINLESS STEEL	[illegible]
[illegible]	BONNET	CARBON STEEL	SA105	STAINLESS STEEL	[illegible]
[illegible]	DISC	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	YOKE	CARBON STEEL	A216-WCB	STAINLESS STEEL	[illegible]
[illegible]	YOKE CLAMP	CARBON STEEL	A515-70	CARBON STEEL	A216-WCB
[illegible]	SEAT RING	CARBON STEEL	[illegible]	CARBON STEEL	A515-70
[illegible]	YOKE SLEEVE	NAVAL BRONZE	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	YOKE CAP	STRUCTURAL STEEL	[illegible]	NAVAL BRONZE	[illegible]
[illegible]	STEM	STAINLESS STEEL	[illegible]	STRUCTURAL STEEL	A36
[illegible]	PRESSURE SEAL GASKET	SOFT STEEL		STAINLESS STEEL	[illegible]
[illegible]	SPACER RING			STAINLESS STEEL	[illegible]
[illegible]	GASKET RETAINER	CARBON STEEL	A515-70	STAINLESS STEEL	[illegible]
[illegible]	BONNET RETAINER	CARBON STEEL	SA515-70	STAINLESS STEEL	[illegible]
[illegible]	UPPER WEDGE	STRUCTURAL STEEL	A36	STAINLESS STEEL	[illegible]
[illegible]	LOWER WEDGE	CARBON STEEL	A216-WCB [illegible]	STAINLESS STEEL	[illegible]
[illegible]	DISC RETAINER	CARBON STEEL	A216-WCB [illegible]	STAINLESS STEEL	[illegible]
[illegible]	GLAND	CARBON STEEL	A515-70	STAINLESS STEEL	[illegible]
[illegible]	PACKING	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	BACKSEAT	JOHN CRANE [illegible]		JOHN CRANE [illegible]	
[illegible]	BACKSEAT INTEGRAL	CARBON STEEL	A515-70 [illegible]	STAINLESS STEEL	[illegible]
[illegible]	GLAND FLANGE	STELLITE	COCR-A	STELLITE	COCR-A
[illegible]	GLAND RETAINER	CARBON STEEL	A515-70	STAINLESS STEEL	[illegible]
[illegible]	HANDWHEEL KEYS	CARBON STEEL	A515-70	STAINLESS STEEL	[illegible]
[illegible]	HANDWHEEL	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	YOKE CLAMP STUDS	CARBON STEEL	[illegible]	CARBON STEEL	[illegible]
[illegible]	EYEBOLTS	ALLOY STEEL	A193-B7	ALLOY STEEL	A193-B7
[illegible]	BONNET CAPSCREWS	ALLOY STEEL	A193-B7	ALLOY STEEL	A193-B7
[illegible]	ACTUATOR CAPSCREWS	ALLOY STEEL	A574	ALLOY STEEL	A574
[illegible]	GLAND RET. CAPSCREWS	ALLOY STEEL	A574	ALLOY STEEL	A574
[illegible]	YOKE CLAMP NUTS	ALLOY STEEL	A574	ALLOY STEEL	A574
[illegible]	GLAND STUD NUTS	CARBON STEEL	A194-2H	CARBON STEEL	A194-2H
[illegible]	RETAINER RING	CARBON STEEL	A194-2H	CARBON STEEL	A194-2H
[illegible]	HINGE PIN	CARBON STEEL	A515-70	CARBON STEEL	[illegible]
[illegible]	WEDGE SPRING	CARBON STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	GREASE FITTING	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	NAMEPLATE	ALLOY STEEL		ALLOY STEEL	
[illegible]	I.D. PLATE	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
[illegible]	BEVEL GEAR OPERATOR	STAINLESS STEEL	[illegible]	STAINLESS STEEL	[illegible]
		ANCHOR/DARLING VALVE CO	A/D DWG PB-[illegible]	ANCHOR/DARLING VALVE CO	A/D DWG PB-[illegible]

NOTES:

1 - DRAWING HAS TYPICAL INFORMATION ONLY, FOR INSTALLATION PURPOSES USE CERTIFIED DRAWINGS.
2 - DIMENSION "B" IS FOR SHORT PATTERN.
3 - WEIGHTS INCLUDE ACTUATORS

VALVE SIZE	A	B		D	E	F	G	WT. [illegible]	WT.
2½"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]
3"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]
4"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRAWING CONTAINS TYPICAL INFORMATION ONLY - PLEASE DO NOT REFERENCE ON P.O.

ANCHOR/DARLING VALVE COMPANY

2½" THRU 24" - 1500 lb.
DOUBLE DISC GATE VALVE
PRESSURE SEAL BONNET
BUTT WELD ENDS

DATE 6-1-78

PB - [illegible]

21

AP600
BONNET OVERPRESSURIZATION

Potential Causes:

- Pressure in the valve bonnet is trapped when the valve is closed under pressure and pressure in both upstream and downstream piping is relieved or reduced.

- Higher then normal pressure can be trapped in the bonnet when the system experiences pressure spikes or surges.

- Pressure in the bonnet can be increased when the valve is closed full of fluid and then subjected to a thermal transient.

Methods to Reduce Overpressurization:

- Drill weep hole in the upstream disc

- Install external bypass with a check valve to connect the bonnet cavity to the upstream pipe

- Install relief valve in bypass to vent excessive pressure in the bonnet

- Implement administrative controls to relieve pressure by periodically cycling the valve

References:

NRC Information Notice No.: 92-26 "Pressure Locking of Motor Operated Flexible Wedge Gate Valves"

AIR OPERATED VALVES

- **Special Applications**
  - ADS Stage 4
  - Core Makeup Tank Isolation
  - PRHR HX Control

ADS VALVES - STAGE 4

- **Functional Requirements**
  - Normally Isolate RCS from Containment
  - Automatic RCS Depressurization

- **Valve Characteristics**

[ ] a,c

- **Valve Actuator**
  - Air Piston Operator
  - Normally Closed, Fail-As-Is

[ ] a,c

- **Valve Actuation**
  - Low-4 CMT Level Setpoint

- **Valve Testing**

[ ] a,c

TLS - 2/3/93

AP600 ADS TEST FEATURES, STAGE 4

(AT POWER TEST)

[ ] a,c

52

AP600 ADS TEST FEATURES, STAGE 4

(SHUTDOWN TEST)

a,c

CONTROL VALVE DATA SHEET NO: CT-003

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 4	[illegible] B,C,D

DRAFT

a,c

CONTROL VALVE DATA SHEET NO: CT-003

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 4	V004A,B,C,D

a,c

CONTROL VALVE DATA SHEET NO: CT-003

Plant:	System:	Description:	Tag Number(s)
AP600	RCS	ADS Stage 4	V004A,B,C,D

DRAFT

a,c

AP600 – 4TH STAGE ADS VALVES SOLENOIDS

a,c

30

AP600
AUTOMATIC DEPRESSURIZATION SYSTEM (ADS)
TEST VALVES

	TAG NO. ADS-03	TAG NO. ADS-03
DESCRIPTION		
MOTOR OPERATOR		
STROKE TIME		
VENDOR	EDWARDS	ATWOOD MORRILL

a, c

CMT ISOLATION VALVES

- **Functional Requirements**
  - Normally Isolate CMT from RCS
  - Initiate CMT Injection

- **Valve Characteristics**

[ ]a,c

- **Valve Actuator**
  - Air-Operated Diaphragm
  - Normally Closed, Fail Open
  - Sized for Limited DP

- **Valve Actuation**
  - SI, Low Pzr Level, and Low SG Level

- **Valve Testing**

[ ]a,c

CONTROL VALVE DATA SHEET NO: CT-004

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Inlet Isolation	V002A,B; V003A,B

a,c

Rev: 5 Date: 01/31/93

Printed: 02/04/93 08:35:04

File:C:\ALPHA4\VALVES\...

CONTROL VALVE DATA SHEET NO: CT-004

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Inlet Isolation	V002A,B; V003A,B

DRAFT

a,c

CONTROL VALVE DATA SHEET NO: CT-005

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Outlet Isolation	V014A,B; V015A,B

DRAFT

a,c

CONTROL VALVE DATA SHEET NO: CT-005

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Outlet Isolation	V014A,B; V015A,B

a,c

PRHR HX CONTROL VALVES

- **Functional Requirements**
  - Normally Prevent RCS Flow
  - Initiate PRHR HX Flow
  - Provide Nonsafety Throttling Capability

- **Valve Characteristics**

[ ]a,c

- **Valve Actuator**
  - Air-Operated Diaphragm with Positioner
  - Normally Closed, Fail Open
  - Operator Sized for Limited DP

- **Valve Actuation**
  - Low SG Level, ADS, and High SG Level

- **Valve Testing**

[ ]a,c

CONTROL VALVE DATA SHEET NO: CT-006

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	PRHR HX Control	V008A,B

a,c

CONTROL VALVE DATA SHEET NO: CT-006

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	PRHR HX Control	V008A,B

DRAFT

a,c

CHECK VALVES

- **Special Applications**
  - IRWST Injection CV
  - Containment Recirculation CV
  - Core Makeup Tank Discharge CV
  - Core Makeup Tank Pressurizer CV

IRWST INJECTION CV

- **Functional Requirements**
  - Normally Prevent RCS Leakage to IRWST
  - Open for IRWST Injection After ADS

- **Valve Characteristics**
  - Simple Swing Check Design
    - No Dampers / Actuators
    - No Body Penetrations

[ ]a,c

- **Valve Testing**

[ ]a,c

CHECK VALVE DATA SHEET NO: CK-001

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	IRWST Injection	V122A,B, V123A,B, V124A,B, V125A,B

a,c

Rev: 0 Date: 01/31/93

Printed: 02/04/93 08:28:10 File:C:\ALPHA4\VALVES\CKVA

42

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	IRWST Injection	V122A,B, V123A,B, V124A,B, V125A,B

a,c

CONTAINMENT RECIRC CV

- **Functional Requirements**
  - Prevent Draining of IRWST to Containment
  - Open for Recirculation from Containment

- **Valve Characteristics**
  - Simple Swing Check Design
    - No Dampers / Actuators
    - No Body Penetrations

[ ]a,c

- **Valve Testing**

[ ]a,c

CHECK VALVE DATA SHEET NO: CK-002

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	Containment Recirc	V119A,B, V120A,B

a,c

CHECK VALVE DATA SHEET NO: CK-002

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	Containment Recirc	V119A,B, \ 120A,B

DRAFT

a,c

Rev: 0 Date: 01/31/93

Printed: 02/04/93 08:45:22

File:C:\ALPHA4\VALVES\CKVA

46

CMT DISCHARGE CHECK VALVES

- **Functional Requirements**
  - Normally Stay Open
  - Close to Prevent Gross Accumulator Backflow Through CMT During Cold Leg Break or Balance Line Break

- **Valve Characteristics**

[ ]a,c

- **Valve Testing**

[ ]a,c

TLC - 2/3/93

CHECK VALVE DATA SHEET NO: CK-004

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Injection	V016A,B, V017A,B

DRAFT

a,c

CHECK VALVE DATA SHEET NO: CK-004

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Injection	V016A,B, V017A,B

DRAFT

a,c

CMT PZR LINE CV

- **Functional Requirements**
  - Normally Pass Steam Condensate to CMT Steam Trap
  - Close to Prevent Gross CMT Backflow to Pzr During Pzr Pressure Balance Line Break or ADS

- **Valve Characteristics**
  - Simple Swing Check Valves
    - No Dampers / Actuators
    - No Body Penetrations

[ ]a,c

- **Valve Testing**

[ ]a,c

CHECK VALVE DATA SHEET NO: CK-005

DRAFT

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Pressure Balance	V006A,B; V007A,B

a,c

CHECK VALVE DATA SHEET NO: CK-005

Plant:	System:	Description:	Tag Number(s)
AP600	PXS	CMT Pressure Balance	V006A,B; V007A,B

DRAFT

a,c

AP600 CHECK VALVES

- **Current PWRs Use Check Valves In Similar Service**
  - RCS chemistry
  - Stainless steel with stellite seats
  - Infrequent use, normally closed

- **Well Designed, Simple Check Valves Are Reliable In Nuclear Power Plant Service**
  - Search of NPRDS failure records (1984 to 90) indicate 4500 check valve failures
  - Of these only 87 were failures to open
  - None of the failures was for a check valve with similar conditions to the IRWST valves
  - No indication of boric acid corrosion or self welding was found

- **Check Valve Testing**
  - Performance tests show AP600 IRWST injectior and recirculation check valves perform well
  - Further testing is being discussed to determine if in plant testing could be conducted to determine if corrosion bonding or other sticking failures would occur at IRWST opening pressures

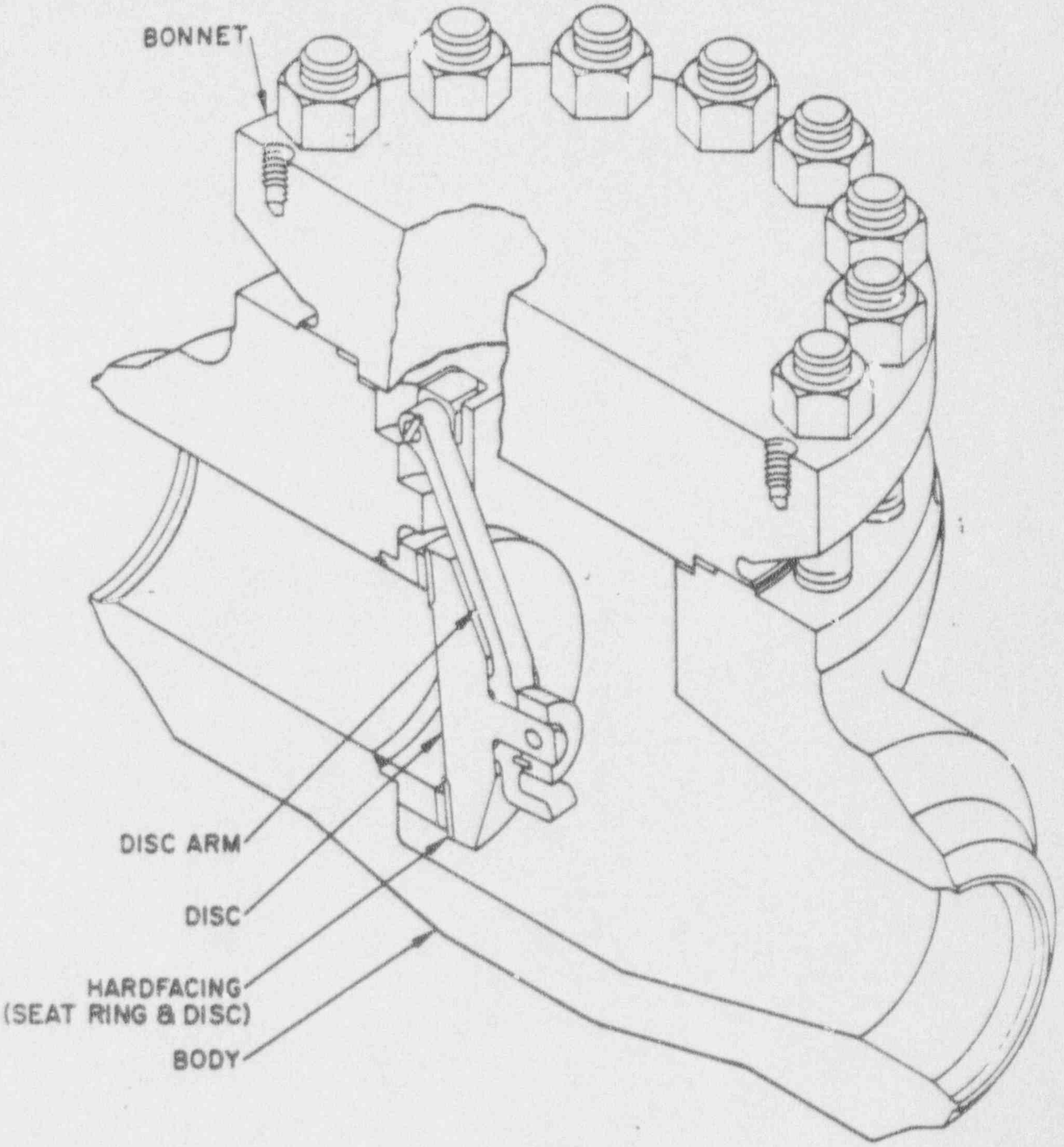
PWR CHECK VALVE FAILURE OBSERVATIONS

- o Most check valve failures occurred due to mechanical/wear damage (not applicable to AP600 valve application)
- o No failures to open due to corrosion observed for stainless steel valves
- o No failures to open due to foreign debris in water service for stainless steel valves

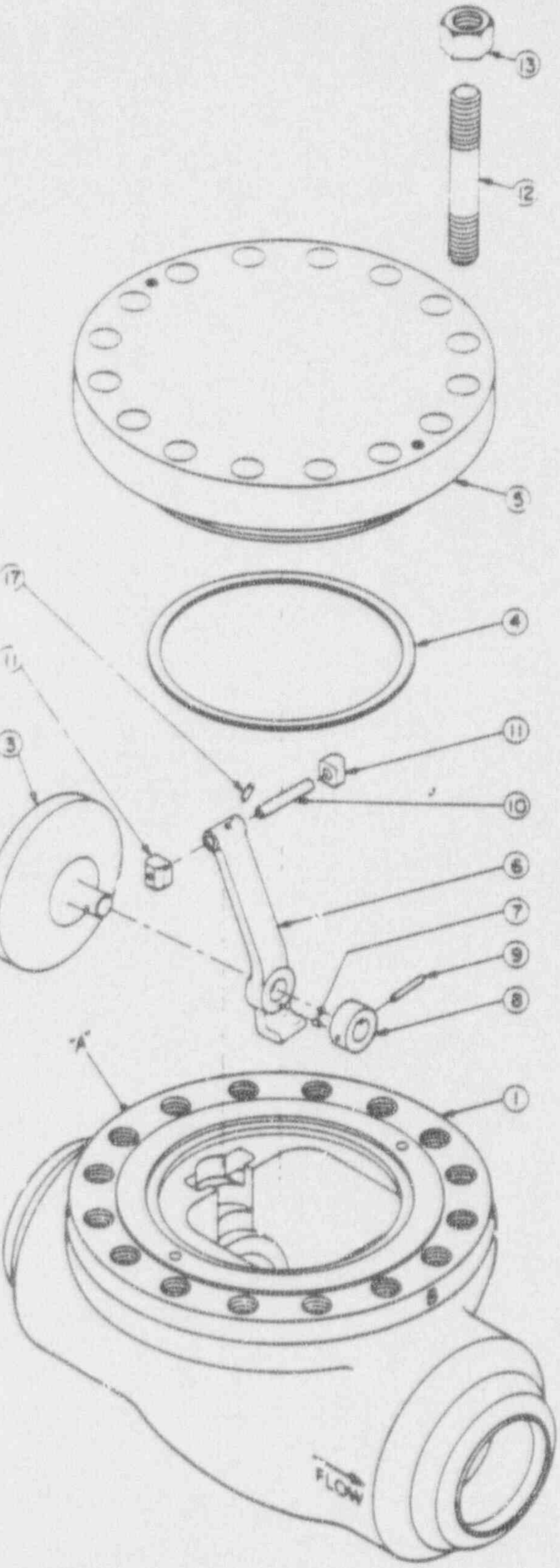
AP600 CHECK VALVE TEST

- o Verify hydraulic performance of swing check valve (provide valve design feasibility information)
  - Opening differential pressure
  - Differential pressure over the expected valve flow rate with prototypic valve arrangement
- o Develop a qualification plan
  - Contract Penn State University to review existing check valve data
- o Utility participation
  - Have contacted 5 utilities about the possibility of testing existing check valves

56



Swing Check Valve Assembly
Figure 4.1



1. Body
3. Disc
4. Main Flange Gasket
5. Bonnet
6. Disc Arm
7. Antiroation Pin
8. Collar
9. Collar Pin
10. Pivot Pin
11. Bearing Block
12. Main Flange Stud
13. Main Flange Nut
17. Lock Pin

Swing Check Valve (Exploded View)
Figure 4.2

SQUIB VALVES

- **Special Applications**
  - pH Tank Outlet Isolation

pH ADJ TANK SQUIB VALVES

- **Functional Requirements**
  - Normally Prevent Leakage of NaOH from pH Tank into Containment
  - Initiate pH Tank Discharge

- **Valve Characteristics**

[ ] a,c

- **Valve Actuator**

[ ] a,c

  - Ram Assembly Shears Inlet Fitting

- **Valve Actuation**
  - High Containment Radiation

- **Valve Testing**

[ ] a,c

AP600
PROPOSED EXPLOSIVE SQUIB VALVE

VENDOR	CONAX CORPORATION
EXAMPLE DRAWING	7048-1700 1832-021
ASME CODE CLASS	1
MATERIAL	SS 304