CROSBY

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

CROSBY REPORT NO. 3920 REVISION 1

JUSTIFICATION REPORT OF EPRI TESTING OF CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVES

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1. Scope

1.1 The purpose of this report is to provide within a single document the information listed below:

1.1.1 A summary of the Crosby models and the quantity of such models used in or intended for use in domestic PWR Nuclear Power Plants as pressurizer safety valves.

1.1.2 A concise listing of all Crosby Safety Valves used in or intended for use in PWR Plants for pressurizer safety valves. The listing includes the utility, station, valve size, model number, Crosby Order Number, quantity per plant, reactor manufacturer, drawing number, body construction, flange ratings, seat material and internal material variations within valve orifice size.

1.1.3 A brief description of valve performance including a description of the main internal parts. A drawing of the generic valve model is also included.

1.1.4 A listing of the valves selected for the EPRI tests which includes the valves origin and data sheet drawings.

1.1.5 A listing of all design variations between selected test valves and valves used in or intended for use in PWR Plants as pressurizer safety valves. An explanation of effects on performance due to each specific design variation is included.

1.1.6 An explanation of validity of selected test valves to represent all or a specific portion of all Crosby Valves used as pressurizer safety valves.

2. Introduction

2.1 Tabulated below is the quantity of each valve model provided by Crosby for use as pressurizer safety valves. The complete valve listing of Paragraph 2.2 of this report tabulates the specific design variations of each model. The Crosby Assembly Number denotes the model number. All valves listed below are the Crosby Style HB-BP-86 Safety Valve.

K Orifice		K2 Orifice		M1 Orifice		M Orifice		N Orifice	
Assem. No.	Quan. of Plants	Assem. No.	Quan. of Plants	Assem. No.	Quan. of Plants	Assem. No.	Quan. of Plants	Assem. No.	Quan. of Plants
50646-1	1	47469-1 and N51185-2	1	52137	3	51250-1	1	N60491	2
N54495	1	51249	6	N54891 and N59303	1	51688	10	N60582	2
N59336	1	51185	1	N56963-1	2	51688-1	1	N61894	2
		51689	2	N56963	1	N56964-4	3		
				N56264	2	N56964	18		
						N56964-1	1		
						N55366	1		
						N55605	1		
						N56925	2		
						N56499	2		
						N60446	5		

2.2 The following tabulation is a detailed breakout by orifice size of all models of Crosby Style HB-BP-86 Safety Valves supplied for use on or intended use on PWR Nuclear Power Plants as pressurizer safety valves.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

Assembly Identification No.	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Integ Flange Rating 1500 lbs. Size			Integ Flange Rating 2500 lbs. Size			Outlet Flange Rating 300 lbs. Size			Outlet Flange Rating 600 lbs. Size			Loop Seal		Seating Materials		Disc Holder Material and Construction *Type			Special Comments
						Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL (Note 1)	1	2	3	
[illegible]	[illegible] Pressurizer	Fort Calhoun Unit No. 1	CE	2	50646-S	M-50646-S	X				X			X							X		X	X			Note 1
[illegible]	[illegible] Pressurizer	St. Lucie 1	CE	3	M54495	M-54496	X				X			X							X		X	X			Note 1
[illegible]	[illegible] Pressurizer	St. Lucie 1	CE	1	M54495	M-54496	X				X			X							X		X	X			Note 1, 2
[illegible]	[illegible] Pressurizer	St. Lucie 2	CE	3	M59336	SS-C-59336	X				X			X							X		X			X	Note 1

*Type
1 - [illegible] With Stellite Lands and Disc Bushing
2 - [illegible] 718 Without Bushing
3 - [illegible] 718 With Stellite Bushing

Notes
1 - [illegible] Material
1.1 Specification for nozzle forging - ASTM A477 Gr. 651
1.2 Specification for bar stock used for disc insert - ASTM A638 Gr. 651
1.3 Disc inserts of 19-9DL may have proboscus (see Crosby Drawing)
2 - Spare valve.

[redacted] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE
IN [redacted] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[redacted]

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction			Special Comments
									1500 Lbs.			2500 Lbs.			300 Lbs.			600 Lbs.							*Type		
									Size			Size			Size			Size									
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[redacted]	Southern Cal. Ed. Company	San Onofre Unit No. 1	W	2	47469-1	H-47469-1	X		X										X			X		X	X			Note 1
[redacted]	Pacific Gas and Electric Company	Robert Emmett Glenn	W	2	51249	H-51249	X			X									X		X		X		X			
[redacted]	Carolina Power and Light Co.	H.B. Robinson No. 2	W	3	51249	H-51249	X			X									X		X		X		X			
[redacted]	Florida Power and Light Co.	Turkey Point No. 4	W	3	51249	H-51249	X			X									X		X		X		X			
[redacted]	Connecticut Yankee Atomic Power Co.	Connecticut Yankee	W	3	51185	H-50447-1	X		X										X			X		X	X			
[redacted]	Wisconsin Michigan Power Company	Point Beach No. 1	W	2	51249	H-51249	X			X									X		X		X		X			
[redacted]	Florida Power and Light Co.	Turkey Point No. 3	W	3	51249	H-51249	X			X									X		X		X		X			
[redacted]	Wisconsin Elec. Pwr. and Power Company	Point Beach No. 2	W	2	51249	H-51249	X			X									X		X		X		X			

*Type

1 - 347 SST With Stellite Lands and Disc Bushing
2 - Inconel 718 Without Bushing
3 - Inconel 718 With Bushing

Notes

1 - Valve seats converted to 19-9DL material in field.
2 - Spare valve.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE IN [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[illegible]

Crosby Purchase Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction Type			Special Comments
									1500 lbs. Size			2500 lbs. Size			300 lbs. Size			600 lbs. Size									
							Flanged	Studded	2"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[illegible]	[illegible] Electric and Power Company	Surry No. 1	W	3	51689	M-51689	X				X								X		X		X		X			
[illegible]	[illegible] Electric and Power Company	Maine Yankee Atomic	W	1	51249	M-51249	X			X									X		X		X		X			Note 2
[illegible]	[illegible] Electric and Power Company	Surry No. 2	W	3	51689	M-51689	X				X								X		X		X		X			
[illegible]	Southern Cal. Ed. Company	San Onofre Unit No. 1	W	2	M51183-2	DS-C-51183-2	X		X										X			X		X	X			Note 2

Types
1 - 347 SST With Stellite Lands and Disc Bushing
2 - Inconel 718 Without Bushing
3 - Inconel 718 With Bushing

Notes
1 - Valve seats converted to 19-9DL material in field.
2 - Spare valve.

[redacted] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE
[redacted] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating				Outlet Flange Rating				Loop Seal		Seating Materials		Disc Holder Material and Construction			Special Comments
									1500 Lbs. Size			2500 Lbs. Size			300 Lbs. Size			600 Lbs. Size						
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	*Type 1	2	3	
[redacted]	Wisconsin Public Service Corp.	Kewaunee Station	W	2	52137	H-52137	X				X								X		X		X			
[redacted]	Northern States Power Co.	Prairie Island No. 1	W	2	52137	H-52137	X				X								X		X		X			
[redacted]	Northern States Power Co.	Prairie Island No. 2	W	2	52137	H-52137	X				X								X		X		X			
[redacted]	Toledo Edison Co.	Davis Besse Unit No. 1	B&W	2	N54891	H-54891	X					X							X		See Special Notes			X			Note 1
[redacted]	Northern States Power Co.	Prairie Island No. 1	W	2	N57872	DS-C-57872	X				X								X		X			X		Note 3
[redacted]	Alabama Power Co.	Joseph M. Farley Nuclear Plant 1	W	3	N56963-1	DS-C-56963-1		X			X								X		X		X			
[redacted]	Alabama Power Co.	Joseph M. Farley Nuclear Plant 2	W	3	N56963-1	DS-C-56963-1		X			X								X		X		X			
[redacted]	Virginia Electric and Power Company	North Anna 3	B&W	2	N56264	DS-C-56264	X					X							X		X		X			

*Type
1 - [redacted] With Stellite Lands and Disc Bushing
2 - [redacted] Without Bushing
3 - [redacted] With Bushing

Notes
1 - Utility considering removal of valves from loop seal. Utility provided with [redacted] inserts.
2 - Valves cancelled after completion. Valves shipped for use in EPRI testing on 9/80.
3 - Spare valves.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE
[illegible] WATER REACTOR NUCLEAR POWER PLANTS

[illegible] (CONTINUED)

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction Flanged	Body Construction Studded	Inlet Flange Rating 1500 Lbs. Size 3"	1500 Lbs. 4"	1500 Lbs. 6"	2500 Lbs. Size 3"	2500 Lbs. 4"	2500 Lbs. 6"	Outlet Flange Rating 300 Lbs. Size 4"	300 Lbs. 6"	300 Lbs. 8"	600 Lbs. Size 4"	600 Lbs. 6"	600 Lbs. 8"	Loop Seal Yes	Loop Seal No	Seating Materials Stellite	Seating Materials 19-9DL	Disc Holder Material and Construction *Type 1	*Type 2	*Type 3	Special Comments
[illegible]	[illegible]	North Anna 4	B&W	2	N56264	DS-C-56264	X						X						X		X		X			X		
[illegible]	Virginia [illegible]	Surry Unit No. [illegible] (Unit Never Built)	B&W	2	N56264	DS-C-56264	X						X						X		X		X			X		Note 2
[illegible]	[illegible]	Beaver Valley Power Station	W	3	N56963	DS-C-56963		X			X								X		X		X			X		Note 4
[illegible]	[illegible]	Davis Besse Unit No. 1	B&W	2	N59303	DS-C-59303	X						X						X		X		X			X		Note 1,
[illegible]	[illegible]	Joseph M. Farley Nuclear Plant	W	1	N56963-1	DS-C-56963-1		X			X								X		X		X			X		Note 3

*Type
1 [illegible] With Stellite Lands and Disc Bushing
2 Inconel 718 Without Bushing
3 Inconel 718 With Bushing

Notes
1 [illegible] removal of valves from loop seal. Utility provided with [illegible].
2 [illegible] after completion. Valves shipped for use in EPRI testing on 9/80.
3 - Spare valves.
4 [illegible] from N56963-1.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE IN [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

Crosby Safety Valve No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction *Type			Special Comments
									1500 Lbs. Size			2500 Lbs. Size			300 Lbs. Size			600 Lbs. Size									
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[illegible]	Consolidated Edison Co. of N.Y.	Indian Point No. 2	W	3	51250-1	H-51250-1	X			X									X			X		X	X			No probes on disc insert.
[illegible]	Public Service Electric and Gas Company	Salem Station Unit No. 1	W	3	51688	H-51688-1	X				X								X		X		X		X			
9[illegible]11	Commonwealth Edison Co.	Zion No. 1	W	3	51688	H-51688-1	X				X								X		X		X		X			
9[illegible]14	Commonwealth Edison Co.	Zion No. 2	W	3	51688	H-51688-1	X				X								X		X		X		X			
9[illegible]11	Indiana and Michigan Electric Co.	Donald C. Cook No. 1	W	3	51688	H-51688	X				X								X		X		X		X			
9[illegible]12	Indiana and Michigan Electric Co.	Donald C. Cook No. 2	W	3	51688	H-51688	X				X								X		X		X		X			
8[illegible]66	Pacific Gas and Electric Company	Diablo Canyon No. 1	W	3	51688	H-51688	X				X								X		X		X		X			
9[illegible]15	Tennessee Valley Authority	Sequoyah No. 1	W	3	51688	H-51688-1	X				X								X		X		X		X			

*Type
1 - 17-4 SST With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes
1 - Plant Cancelled

CROSBY [illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE
IN [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[illegible] (CONTINUED)

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction: Flanged	Body Construction: Studded	Inlet Flange Rating 1500 lbs. Size 3"	Inlet 1500 lbs. 4"	Inlet 1500 lbs. 6"	Inlet 2500 lbs. Size 3"	Inlet 2500 lbs. 4"	Inlet 2500 lbs. 6"	Outlet Flange Rating 300 lbs. Size 4"	Outlet 300 lbs. 6"	Outlet 300 lbs. 8"	Outlet 600 lbs. Size 4"	Outlet 600 lbs. 6"	Outlet 600 lbs. 8"	Loop Seal: Yes	Loop Seal: No	Seating Materials: Stellite	Seating Materials: 19-9DL	Disc Holder Material and Construction *Type 1	*Type 2	*Type 3	Special Comment
[illegible]	Pacific Gas and Electric Company	Diablo Canyon No. 2	W	3	51680	H-51680	X				X								X		X		X		X			
[illegible]	Public Service Electric and Gas Company	Salem Station Unit No. 2	W	3	51680	H-51680	X				X								X		X		X		X			
[illegible]	Tennessee Valley Authority	Sequoyah No. 2	W	3	51680	H-51680	X				X								X		X		X		X			
[illegible]	Power Authority of N.Y.	Indian Point No. 3	W	3	51680-1	H-51680-1	X				X								X		X		X		X			
[illegible]	Northeast Utilities Service Company	Millstone Nuclear Power Unit No. 3	W	3	H56964-4	DS-C-56964-4		X			X								X		X		X			X		
[illegible]	Carolina Power and Light Co.	Shearon Harris Unit No. 1	W	3	H56964	DS-C-56964		X			X								X		X		X			X		
[illegible]	Commonwealth Edison Co.	Byron Station Unit No. 2	W	3	H56964	DS-C-56964		X			X								X		X		X			X		
[illegible]	Carolina Power and Light Co.	Shearon Harris Unit No. 2	W	3	H56964	DS-C-56964		X			X								X		X		X			X		

*Type:
1 - [illegible] SST With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes:
1 - Plant Cancelled

CROSBY STYLE HB PRESSURIZER SAFETY VALVES SUPPLIED FOR USE IN DOMESTIC PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

M ORIFICE (CONTINUED)

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction *Type			Special Comments
									1500 Lbs. Size			2500 Lbs. Size			300 Lbs. Size			600 Lbs. Size										
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
N303151	Commonwealth Edison Co.	Byron Station Unit No. 1	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
N303153	Tennessee Valley Authority	Watts Bar Unit No. 2	W	3	N56964	DS-C-A56964		X		X									X		X		X			X		
N303154	Georgia Power and Light Co.	Vogtle Unit No. 1	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
N303155	Georgia Power and Light Co.	Vogtle Unit No. 2	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
N54020	Pacific Gas and Electric Company	Diablo Canyon	W	1	N51688	H-51688	X			X									X		X		X		X			
N303169-A	Public Service of Indiana	Marble Hill Unit No. 1	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
N303102	Public Service of N.H.	Seabrook Unit No. 2	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
N303145-B	South Carolina Electric and Gas Company	Virgil C. Summer Station	W	3	N56964-1	DS-C-56964-1		X		X									X		X		X			X		

*Type
1 - 347 SST With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes
1 - Plant Cancelled

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USS [illegible] WATER REACTOR NUCLEAR POWER PLANTS

[illegible]

Crosby Assembly Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating				Outlet Flange Rating				Loop Seal		Seating Materials		Disc Holder Material and Construction *Type			Special Comments
									2500 Lbs. Size			2500 Lbs. Size			300 Lbs. Size			600 Lbs. Size						
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[illegible]	Portland General Electric Company	Trojan No. 1	W	1	N55366	M-55366	X				X							X			X			X			
[illegible]	Texas Utilities Company	Comanche Peak Unit No. 1	W	3	N56964	DS-C-56964		X			X							X			X			X			
[illegible]	Tennessee Valley Authority	Watts Bar Unit No. 1	W	3	N56964	DS-C-A56964		X			X							X			X			X			
[illegible]	Arkansas Power and Light Co.	Arkansas Nuclear Unit No. 2	CE	2	N55603	M-55603	X						X					X			X			X			
[illegible]	Duke Power Company	McGuire Nuclear Station Units 1 & 2	W	6	N56925	DS-C-56925	X				X							X			X			X			
[illegible]	Consumers Power Company	Palisades	W	3	N56499	DS-C-56499	X				X							X			X			X			Note 2
[illegible]	Indiana and Michigan Power Company	D.C. Cook Unit No. 2	W	3	N56499	DS-C-56499	X				X							X			X			X			Note 2
[illegible]	Commonwealth Edison Co.	Braidwood Station Unit No. 2	W	3	N56964	DS-C-56964		X			X							X			X			X			

*Type
1 - [illegible] with Stellite Lapped and Disc Bushing.
2 - [illegible] with Stellite Bushing.
3 - [illegible] with Bushing.

Note:
1 - Plant Cancelled
2 - Spare Valves

[illegible] STATUS OF PRESSURIZER SAFETY VALVES SUPPLIED FOR USE [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[illegible] (CONTINUED)

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction *Type			Special Comments
									1500 Lbs. Size			2500 Lbs. Size			300 Lbs. Size			600 Lbs. Size									
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[illegible]	[illegible] Power and Light Co.	Shearon Harris Unit No. 3	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
[illegible]	Texas Power and Light Co.	Comanche Peak Unit No. 2	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
[illegible]	Public Service of [illegible]	Seabrook Unit No. 1	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
[illegible]	Commonwealth Edison Co.	Braidwood Station Unit No. 1	W	3	N56964	DS-C-56964		X		X									X		X		X			X		
[illegible]	Long Island Lighting	Jamesport Unit No. 2	W	3	N56964-4	DS-C-56964-4		X		X									X		X		X			X		3
[illegible]	Long Island Lighting	Jamesport Unit No. 1	W	3	N56964-4	DS-C-56964-4		X		X									X		X		X			X		3
[illegible]	[illegible] Gas and Electric Company	Wolf Creek Unit No. 1	W	3	N60446	DS-C-60446		X		X									X		X		X				X	
[illegible]	Union Electric Company	Callaway Station No. 1	W	3	N60446	DS-C-60446		X		X									X		X		X				X	

*Type
1 - 347 S.S. With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes
1 - Plant Cancelled
2 - Spare Valves.
3 - Plant Cancelled After Shipment of Valves.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[illegible]

[illegible] Safety Valve Model No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction: Flanged	Body Construction: Studded	Inlet Flange Rating: 1500 lbs. Size: 3"	4"	6"	Inlet Flange Rating: 2500 lbs. Size: 3"	4"	6"	Outlet Flange Rating: 300 lbs. Size: 4"	6"	8"	Outlet Flange Rating: 600 lbs. Size: 4"	6"	8"	Loop Seal: Yes	Loop Seal: No	Seating Materials: Stellite	Seating Materials: 19-9DL	Disc Holder Material and Construction: *Type 1	2	3	Special Comments
[illegible]	[illegible] Electric Power Board	Sterling Station	W	3	N60446	DS-C-60446		X			X								X		X		X			X	Note 1
[illegible]	[illegible] Power Co.	Tyrone Station	W	3	N60446	DS-C-60446		X			X								X		X		X			X	Note 1
[illegible]	[illegible] Power Co.	Callaway No. 2	W	3	N60446	DS-C-60446		X			X								X		X		X			X	
[illegible]	[illegible] Power Co.	McGuire Nuclear Station Units 1 & 2	W	3	N56925	DS-C-56925	X				X								X		X		X			X	Note 2
[illegible]	[illegible] Services and Industries	Marble Hill Unit No. 2	W	3	N56964	DS-C-56964		X			X								X		X		X			X	
[illegible]	[illegible] Valley Authority	Watts Bar	W	1	N56964	DS-C-A56964		X			X								X		X		X			X	Note 2
[illegible]	[illegible] Valley Authority	Sequoyah	W	2	N51688	N-51688	X				X								X		X		X		X		Note 2
[illegible]	[illegible] Valley Authority	Sequoyah	W	1	N51688	N-51688	X				X								X		X		X		X		Note 2

Types
1 - [illegible] Seal With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes:
1 - Plant Cancelled
2 - Spare valves.

[illegible] PRESSURIZER SAFETY VALVES SUPPLIED FOR USE
[illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

[illegible]

Crosby Factory Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Disc Holder Material and Construction			Special Comments
									1500 Lbs.			2500 Lbs.			300 Lbs.			600 Lbs.							*Type		
									Size			Size			Size			Size									
							Flanged	Studded	3"	4"	6"	3"	4"	6"	4"	6"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	1	2	3	
[illegible]	[illegible] Valley Authority	Watts Bar	W	2	N56964	DS-C-56964		X			X								X		X		X			X		Note 2
[illegible]	Portland General Electric Company	Trojan No. 1	W	1	N55366	DS-C-55366	X				X								X		X		X			X		Note 2
[illegible]	Carolina Power & Light Co.	Shearon Harris Unit No. 4	W	3	N56964	DS-C-56964		X			X								X		X		X			X		

*Type
1 - 17/4 SH With Stellite Lands and Disc Bushing.
2 - Inconel 718 Without Bushing.
3 - Inconel 718 With Bushing.

Notes
1 - Plant Cancelled
2 - Spare valves.

Test Report No. 3920 Revision 1

[illegible] OF PRESSURIZER SAFETY VALVES SUPPLIED FOR USE [illegible] PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS

Crosby Purchase Order No.	Utility	Station	Reactor Mfr.	Qty. of Valves	Crosby Assembly No.	Crosby Drawing No.	Body Construction		Inlet Flange Rating						Outlet Flange Rating						Loop Seal		Seating Materials		Special Connection
									1500 Lbs.			2500 Lbs.			300 Lbs.			600 Lbs.							
									Size			Size			Size			Size							
							Flanged	Studded	3"	4"	6"	3"	4"	6"	3"	4"	8"	4"	6"	8"	Yes	No	Stellite	19-9DL	
[illegible]	[illegible] Lighting and Power Company	South Texas Unit No. 1	W	3	N60491	DS-C-60491		X			X									X	X		X		Note 2
[illegible]	[illegible] Lighting and Power Company	South Texas Unit No. 2	W	3	N60491	DS-C-60491		X			X									X	X		X		Note 2
[illegible]	[illegible] Public Power [illegible]	WPPSS Unit No. 3	CE	4	N60582	DS-C-60582	X					X								X		X		X	Note 2
[illegible]	[illegible] Public Power [illegible]	WPPSS Unit No. 5	CE	4	N60582	DS-C-60582	X					X								X		X		X	Note 2
[illegible]	[illegible] Valley Authority	Yellow Creek Unit No. 1	CE	4	N61894	DS-C-61894	X					X								X		X		Note 1	Note 2
[illegible]	[illegible] Valley Authority	Yellow Creek Unit No. 2	CE	4	N61894	DS-C-61894	X					X								X		X		Note 1	Note 2

Notes:

1 - [illegible] with Stellite Lands and Disc Bushing.
2 - [illegible] 718 Without Bushing.
3 - [illegible] 718 With Bushing.

Notes:

1 - Direct disc design. Nozzle material ASME SA-182 Gr. 316. Disc insert material - ASME A-637 Gr. 718.
2 - Disc ring material - 304 SST with Stellite Lands. Disc holder construction - Inconel 718 with Stellite Bushing.

3. Description of Valve

3.1 Valve Construction

3.1.1 Figure 1 is a generic illustration of the Crosby Style HB-BP-86 Safety valve. Use part numbers noted in following description to locate parts in Figure 1.

3.1.2 Inside the body (1) is housed the upper portion of the nozzle (2), nozzle ring (3), disc ring (7), adjusting ring (12), eductor (11), and the bellows assembly consisting of the bellows (8) to which is welded the disc holder (5). The disc insert (9) is held in place in the disc holder (5) by insert pin (10).

3.1.3 The eductor (11), bellows assembly and the bonnet adapter (15) are retained between the valve body (1) and the bonnet (18) by bonnet studs (38) and bonnet stud nuts (39).

3.1.4 Housed in the bonnet (18) is the spring (19) and spring washers (20) carried by the spindle assembly (14), the lower end of which is positioned on the bushing (6) in the disc holder (5).

3.1.5 Adjusting bolt (29) is locked in place by the adjusting bolt nut (30) at the top of the bonnet (18), within the cap (21).

3.1.6 Manual lifting means is provided by lever (28), dog shaft (23), dog (22) and spindle nut (16) and spindle nut cotter (17).

3.1.7 Cap plug (31) is screwed into the top of cap (21) or cap top (43) when gagging screw is not in use.

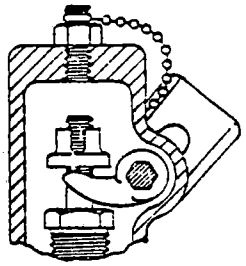
3.2 Valve Operation

3.2.1 A typical valve operating cycle on steam is as follows: As pressure in the pressurizer vessel increases to the safety valve set point, the valve will open to a lifted position. After the valve opens, steam passes through the annular openings between the nozzle ring (3) and adjusting ring (12) and a series of annular flow passages between the disc ring (7) and the adjusting ring (12) and the eductor (11) and the adjusting ring (12). This flow of steam through these annular passages and the exhaust through the openings in the adjusting ring (12), controls the pressure in the chamber above the disc ring (7) and between the eductor (11) and bellows (8). As pressure in the pressurizer vessel decays, the dynamic forces on the lower face of the disc ring (7) and disc insert (9) are reduced and the safety valve will close by the force developed by the spring which is also assisted by the pressure in the chambers above the disc ring (7).

3. Description of Valve (Continued)

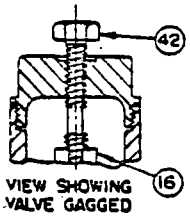
3.2 Valve Operation (Continued)

3.2.2 The primary purpose of the nozzle ring (3) is to control the popping action of the valve. This ring is factory set for a minimum warn and sharp popping action and is seldom field adjusted. The primary function of the adjusting ring (12) is to control the valve blowdown. Raising the adjusting ring (12) decreases the blowdown and conversely lowering this ring increases the blowdown.



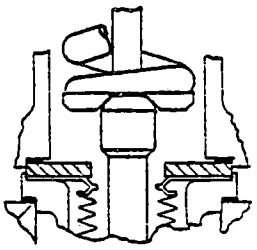
ALTERNATE CONSTRUCTION
WITHOUT CAP TOP

FIG. 1b



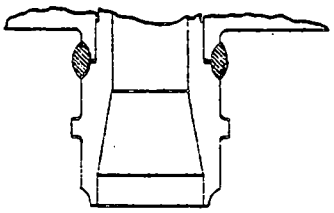
VIEW SHOWING
VALVE GAGGED

FIG. 1c



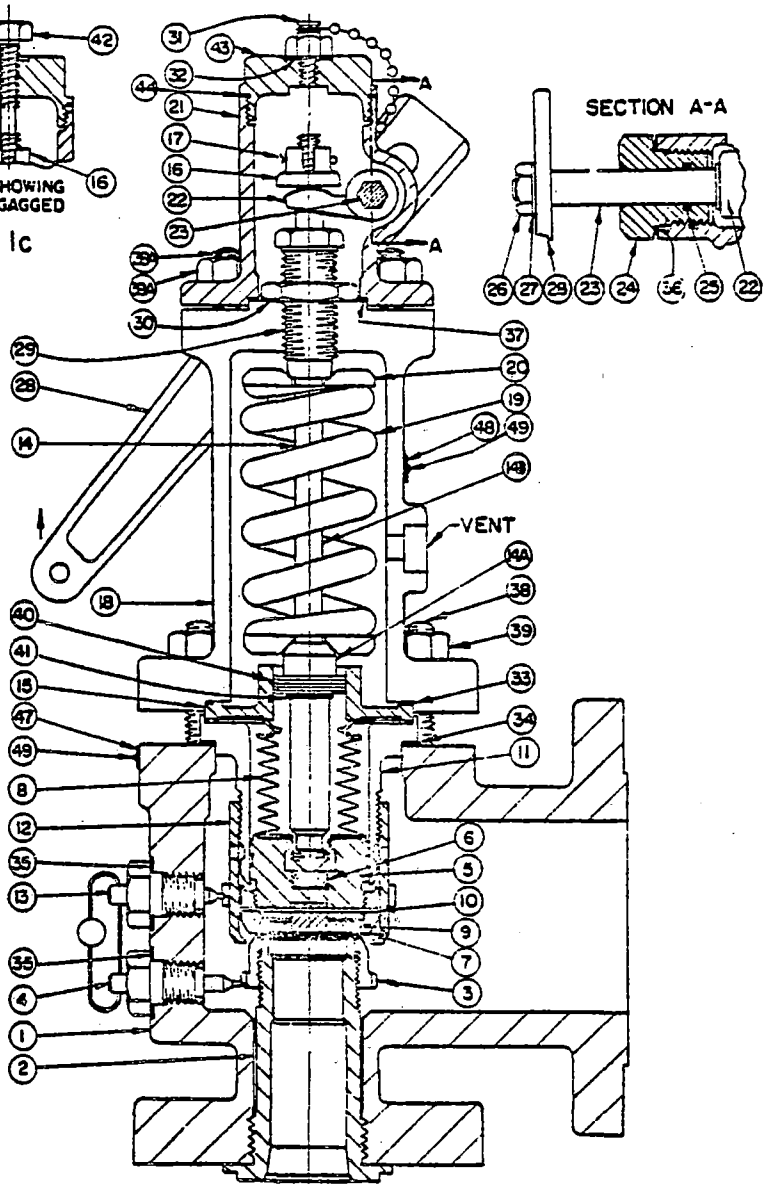
STYLE HB
(WITHOUT PISTON)

FIG. 1c



WELDED INLET
CONSTRUCTION

FIG. 1d



STYLE HB-BP
(WITH PISTON)

FIG. 1a

FIG 1

Crosby Valve & Gage Company
Wrentham, Massachusetts

Piece No.	Part Name
1	Body
2	Nozzle
3	Nozzle Ring
4	Nozzle Ring Set Screw
*5	Disc Holder
*6	Disc Bushing
*7	Disc Ring
*8	Bellows
*9	Disc Insert
*10	Disc Insert Pin
11	Eductor
12	Adjusting Ring
13	Adjusting Ring Set Screw
14	Spindle Assembly
14A	Spindle Point
14B	Spindle Rod
15	Bonnet Adapter
16	Spindle Nut
17	Spindle Nut Cotter
18	Bonnet
19	Spring
20	Spring Washer
21	Cap
22	Dog
23	Dog Shaft
24	Dog Shaft Bearing
*25	Dog Shaft "O" Ring
26	Dog Lever Nut
27	Dog Lever Lockwasher
28	Lever
29	Adjusting Bolt
30	Adjusting Bolt Nut
31	Cap Plug
*32	Cap Plug Gasket
*33	Bonnet Adapter Gasket
*34	Eductor Gasket
*35	Nozzle Ring and Adjusting Ring Set Screw Gasket
*36	Dog Shaft Bearing Gasket
*37	Cap Gasket
38	Bonnet Stud

Figure 1
Sheet 2 of 3

Crosby Valve & Gage Company
Wrentham, Massachusetts

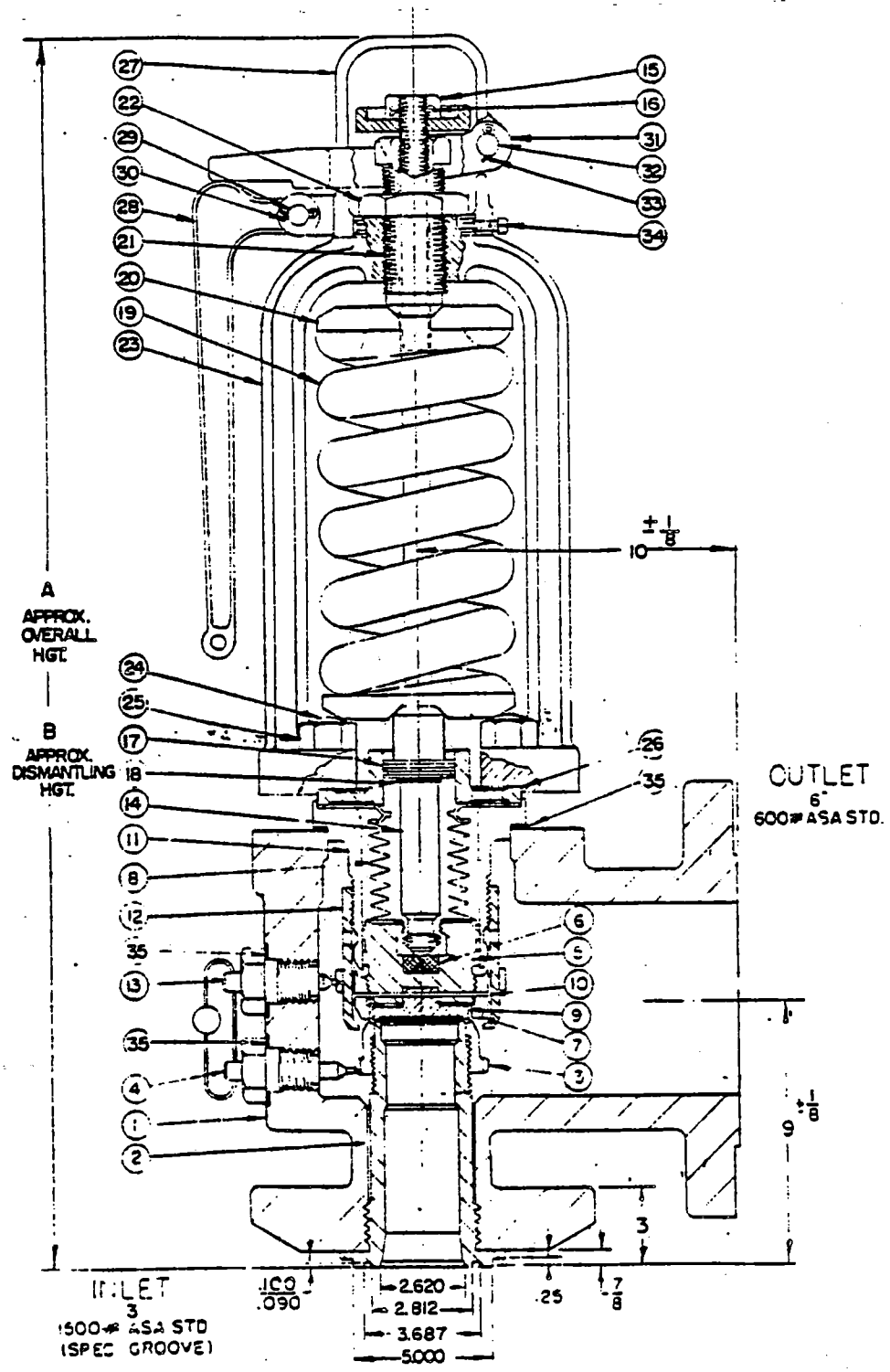
Piece No.	Part Name
38A	Cap Stud
39	Bonnet Stud Nut
39A	Cap Stud Nut
40	Piston
41	Piston Lockclip
42	Gag Screw
43	Gag Top
*44	Cap Top Gasket
45	Canopy Ring
46	Gasket (Special)
47	Nameplate and Identification Plate
48	Caution Plate
49	Drive Screws

*Parts noted with an asterisk (*) are manufacturer's recommended spare parts. Note Pieces No. 5, 6, 7 and 8 are purchased as an assembly.

4. Selected Test Valves

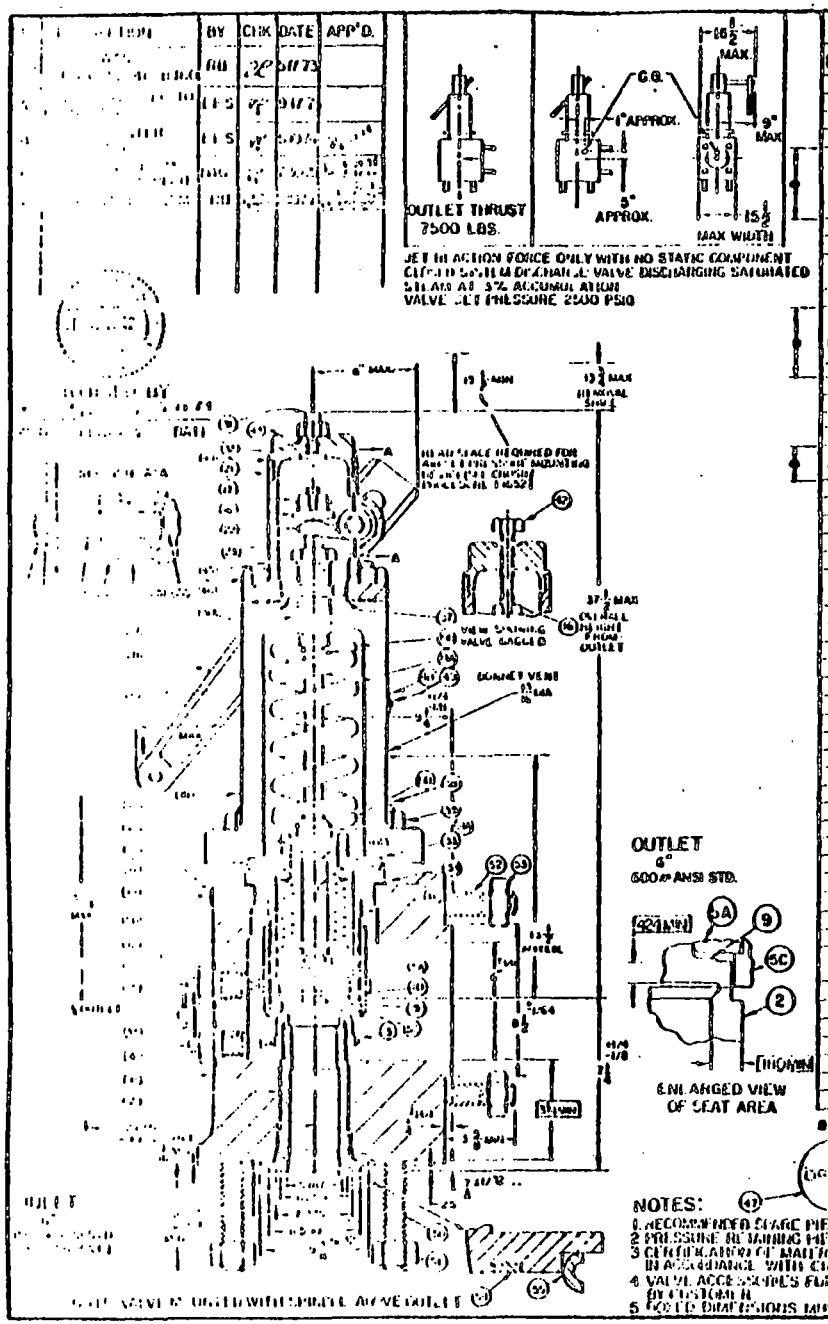
4.1 Tabulated below are the Crosby Style HB-BP-86 Safety Valves selected for the EPRI testing at Combustion Engineering-KDL Labs. Also included in this section are data sheet drawings for each of the selected test valves.

Selected Test Valve	Valve Origin	Valve Drawing No.
3xKx6 HB-BP-86	Crosby Test Valve	SK-3658-V
6xMx6 HB-BP-86 Crosby Assembly No. N56964	Crosby Factory Order No. N303167 Shearon Harris Unit No. 4	DS-C-56964
6xNx8 HB-BP-86 Crosby Assembly No. N61894	Crosby Factory Order Nos. N80518 or N80520 TVA Yellow Creek 1 and 2	DS-C-61894



HB
WITH BELLOWS

CROSBY VALVE & GAGE CO. Wrentham, Mass.	
Style HB-BP-86 TYPE C	Drawing SK-3658-V



LIST OF MATERIALS

PC NO.	DESCRIPTION	NO REQD	MATERIAL	MAT'L SPEC.	SEE NOTES	REMARKS
1	BODY	1	SST	ASTM A182 F 316	2,3	
2	NOZZLE	1	"	"	2,3	STELLITE SEAT
3	NOZZLE RING	1	"	ASTM A582 TYPE 416 COND T		
4	" SET SCREW	1	"	"		
5 A	DISC HOLDER	1	NI CR ALLOY	ASTM A637 GR 718	1,2,3	HEAT TREATED
5 C	DISC RING	1	SST	ASTM A479 TYPE 304	1	
5 D	BELLOWS	1	INCONEL	INCONEL 718	1	
9	LOCK SCREW	1	HAYNES ALLOY	HAYNES STELLITE NO 6B	1,2,3	
10	" PIN	1	" "	HAYNES ALLOY NO. 25	1	
11	ADJUSTING RING	1	" "	HAYNES ALLOY NO 6		
12	GUIDE BUSHING	1	SST	ASTM A276 TYPE 416 COND T		
13	" SET SCREW	1	"	ASTM A276 TYPE 416 COND T		
14 A	NOZZLE POINT	1	"	ASTM A193 GR B6	2,3	
14 B	" ROD	1	"	"		
14 C	" BALL (BEARING)	1	"	ASTM A276 TYPE 440 C	2,3	
14 D	" PIN	1	"	TYPE 416		
15	NOZZLE ADAPTER	1	"	ASTM A276 TYPE 410 COND T		
16	NOZZLE NUT	1	"	ASTM A276 TYPE 416 COND T		
17	" COTTER	1	STEEL	COMMERCIAL		
18	BONNET	1	CARBON STEEL	ASTM A105 GR II	2,3	
19 A	SPRING	1	ALLOY STEEL	ASTM A304 GR 5250H	2,3	
19 B	" WASHER	2	CARBON STEEL	ASTM A105 GR II	2,3	
21	CAP	1	" "	ASTM A216 GR WCB		
22	DOG	1	ALLOY STEEL	ASTM A148 GR 150-125		
23	" SHAFT	1	SST	ASTM A582 TYPE 416 COND A		HEAT TREATED
24	" BEARING	1	STEEL	AISI B1113-B120		
25	" "O" RING	1	RUBBER	VITON A	1	
26	" LEVER NUT	1	STEEL	ASTM A194 GR 2H		
27	" LOCKWASHER	1	"	COMMERCIAL		
28	LEVER	1	CARBON STEEL	ASTM A216 GR WCB		
29	ADJUSTING BOLT	1	SST	ASTM A193 GR B6	2,3	
30	" NUT	1	"	ASTM A276 TYPE 416 COND T		
31	CAP PLUG	1	STEEL	AISI B1010-1020		
32	" GASKET	1	"	"	1	
33	BONNET ADAPTER GASKET	1	"	"	1	
34	ADJUSTING GASKET	1	"	"	1	
35	SET SCREW GASKET	2	"	"	1	
36	DISC HOLDER RING GASKET	1	"	"	1	
37	CAP GASKET	1	"	"	1	
38	BONNET STUD	8	SST	ASTM A453 GR 660	2,3	1"-8 UNC
39	" NUT	8	"	ASTM A193 GR B6	2,3	1"-8 UNC
40	PISTON	1	HAYNES ALLOY	HAYNES STELLITE NO 6B		
41	" LOCKCLIP	1	SST	TYPE 300 SERIES		
42	GAG SCREW	1	"	ASTM A276 TYPE 416 COND T		
43	CAP TOP	1	CARBON STEEL	ASTM A216 GR WCB		
44	[illegible]	1	[illegible]	[illegible]	1	[illegible]
45	CAP STUD	6	ALLOY STEEL	ASTM A193 GR B7		5/8-11 UNC
46	" NUT	6	STEEL	ASTM A194 GR 2H		5/8-11 UNC
47	[illegible]	1	SST	COMMERCIAL		
48	[illegible]	1	"	"		
49	DRIVE SCREW	6	COMMERCIAL	"		
50	INLET STUD	12	SST	ASTM A453 GR 660	2,3	1 3/4-8 UN
51	" NUT	12	"	ASTM A193 GR B6	2,3	1 3/4-8 UN
52	OUTLET STUD	12	"	ASTM A453 GR 660		1"-8 UNC
53	" NUT	12	"	ASTM A193 GR B6		1"-8 UNC
54	[illegible] (INLET)	1	COMMERCIAL	[illegible]	4	
55	CANOPY RING	1	SST	ASTM A240 GR M (316)	4	

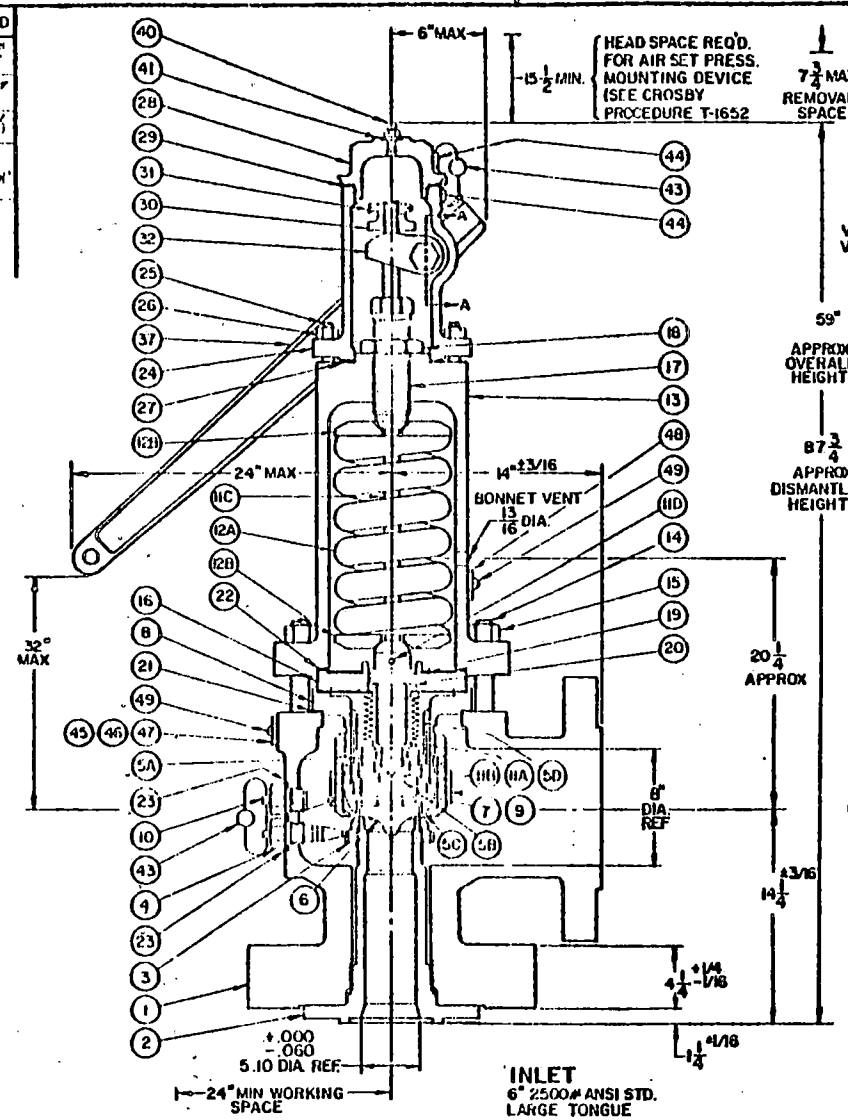
* FURNISHED AS SUB ASSEMBLY ONLY

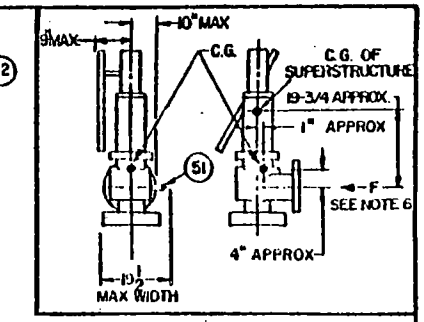
TOLERANCES - DECIMAL DIM ± .010
UNLESS OTHERWISE NOTED

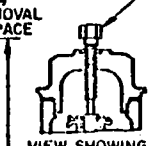
ASME SECT III CLASS 1
WEIGHT 900 LBS APPROX.

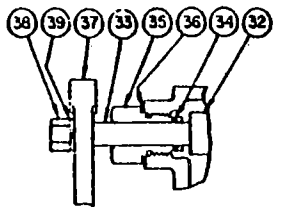
WHES IDENT NO 6-RV08-MSB	SIZE 6 M 6 / STYLE HB-BP-86
CROSBY CUST. WESTINGHOUSE ORDER NO.	TYPE E / ASSEMBLY NO 1142964
CROSBY F.O.	CROSBY CROSBY VALVE & GAGE CO WRENTHAM, MASS 02093
PREPARED BY E.E.S. DATE 9-15-8	DRAWING TITLE NOZZLE TYPE SAFETY VALVE
CHECKED BY [illegible] DATE 9-15-8	DRAWING NO. DS-C-56964 / REV C
CERTIFIED BY: [illegible] DATE	

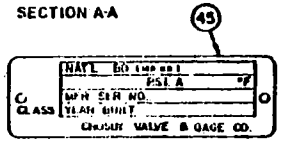
DESCRIPTION	BY	CHK	APPROVED
[illegible]	BCH	[illegible]	[illegible]
[illegible]	KM	[illegible]	[illegible]
[illegible]	BCH	[illegible]	[illegible]
[illegible]	MAM	[illegible]	[illegible]



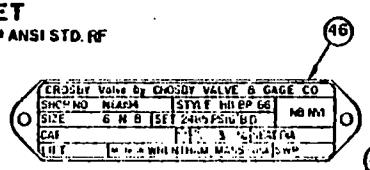


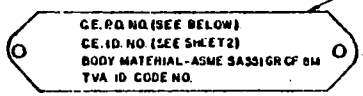


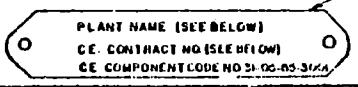




OUTLET
8" 600# ANSI STD. RF







CERTIFIED BY
W. D. GREENAW
DATE

C.E. CONTRACT NOS. 14074 & 14174	CROSBY CUST. COMBUSTION ENGINEERING	VALVE MFG. TO ASME BOILER & PRESSURE VESSEL CODE 1977	ASME SECT. III CL. 1
CUSTOMER TENNESSEE VALLEY AUTHORITY	ORDER NO. 9773214 & 9773215	EDITION & NO ADDENDA	CROSBY VALVE & GAGE CO. WRENTHAM, MASS. 02093
PLANT NAME YELLOW CREEK UNIT 1&2	CROSBY P.O. N80518 & N80520	WEIGHT 1100 LBS APPROX	DRAWING TITLE NOZZLE TYPE SAFETY VALVE
	PREPARED BY RB 11-9-77	SIZE 6 N 8 / STYLE HB-86-BP	DRAWING NO. DSC-61894 SHEET 1 OF 2 / REV. D
	CHECKED BY E.E.S. 11-21-77	TYPE E / ASSEMBLY NO N61894	
	APPD.		

	DESCRIPTION	BY	CHK	APPROVED
[illegible]	[illegible]	DCH	[illegible]	[illegible]
[illegible]	[illegible]	KM	[illegible]	[illegible]
[illegible]	[illegible]	DCH	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES

1. RECOMMENDED SPARE PIECE
2. PRESSURE RETAINING PIECE
3. CERTIFICATION OF MATERIAL AND NON-DESTRUCTIVE TESTING IN ACCORDANCE WITH CROSBY QAI-32095
4. VALVE ACCESSORIES FURNISHED ONLY WHEN ORDERED BY CUSTOMER
5. NIPPLE TO BE 1/2 IPS SCH.80 6" LONG, SOCKET WELDED TO BODY
6. THE DISCHARGE FORCE ACTING ALONG THE OUTLET CENTERLINE DEVELOPED WHEN THE VALVE IS FLOWING SATURATED STEAM AT 3% ABOVE SET PRESSURE & DISCHARGING TO ATMOSPHERE IS 47,306 LBS (INCLUDES MOMENTUM COMPONENT & DESIGN OUTLET PRESSURE UNBALANCE & DUE OF I.D.).

LIST OF MATERIALS

PC.NO		DESCRIPTION	NO. REQ'D	MATERIAL	MAT'L SPEC.	SEE NOTES	REMARKS
1		BODY	1	SST	ASME SA351 GR CF8M	2,3	
2		NOZZLE	1	"	ASME SA182 GR. F316	2,3	
3		" RING	1	"	ACI-CF8M		
4		SEAT SCREW	1	"	ASME SA479 TYPE 316		
5	A	DISC HOLDER	1	Ni-CR-FE	ASME SA637 GR 718	1,2,3	
	B	" BONNING	1	CO-CR-ALLOY	STELLITE NO 6B	1,2,3	
	C	" RING	1	SST	ASME SA479 TYPE 304	1	
	D	BELLOWS	1	Ni-CR-FE	INCONEL 718	1	ONE EQUIVALENT
6		DISC HOLDER	1	SST	ASME SA637 GR 718	1,2,3	HEAT TREATED
7		" PIN	1	Co-CR ALLOY	STELLITE NO 6B	1	
8		GUIDE	1	" " "	STELLITE NO 6		
9		ADJUSTING RING	1	SST	ACI-CF8M		
10		SET SCREW	1	"	ASME SA479 TYPE 316		
11	A	SPINDLE POINT	1	"	ASME SA479 GR 316	2,3	
	B	" BALL (DIA)	1	"	ASTM A276 TYPE 440 C	2,3	
	C	" ROD	1	"	ASME SA193 GR B6		
	D	" " PIN	1	"	400 SERIES		
12	A	SPRING	1	ALLOY STEEL	ASTM A231	2,3	CADMIUM PLATED
	B	" WASHER	2	CARBON STEEL	ASME SA105	2,3	
13		BONNET	1	"	"	2,3	
14		" STUD	12	ALLOY STEEL	ASME SA193 GR B7	2,3	
15		" " NUT	12	STEEL	ASME SA194 GR 2H	2,3	
16		" ADAPTER	1	SST	ASTM A276 TYP 440 C HT		
17		ADJUSTING BOLT	1	"	ASME SA193 GR B6	2,3	
18		" " NUT	1	"	ASTM A582 TYPE 416 COND T		
19		PISTON	1	CO-CR ALLOY	STELLITE NO 6B		
20		" LOCKCLIP	1	SST	300 SERIES		
21		BODY-BONNET GASKET	1	STEEL	AISI 1010-1030	1	
22		INLET GASKET	1	" "	" " "	1	
23		SET SCREW GASKET	2	"	" " "	1	
24		CAP	1	CARBON STEEL	ASME SA216 GR WCB		
25		" STUD	6	ALLOY STEEL	ASME SA193 GR B7		
26		" " NUT	6	STEEL	ASME SA194 GR 2H		
27		" GASKET	1	"	AISI 1010-1030	1	
28		" TOP	1	CARBON STEEL	ASME SA216 GR WCB		
29		" " GASKET	1	STEEL	AISI 1010 1030	1	
30		SPINDLE NUT	1	SST	ASTM A582 TYPE 416 COND T		
31		" " COTTER	1	STEEL	COMMERCIAL		
32		DOG	1	ALLOY STEEL	ASTM A148 GR 150-125		
33		" SHAFT	1	SST	ASTM A582 TYPE 416 COND A		HEAT TREATED
34		" " "O" RING	1	VITON A	RUBBER	1	
35		" " BEARING	1	STEEL	AISI 1113-1120		
36		" " " GSKT	1	"	AISI 1010-1030	1	
37		LEVER	1	CARBON STEEL	ASME SA216 GR WCB		
38		" NUT	1	STEEL	ASME SA194 GR 2H		
39		" LOCKWASHER	1	"	COMMERCIAL		
40		CAP PLUG	1	"	AISI 1010-1030		
41		" " GASKET	1	"	" " "	1	
42		GAG SCREW	1	SST	ASTM A582 TYPE 416 COND T		
43		SEAL WIRE	2	LEAD-SST	COMMERCIAL		
44		" CLIP	2	SST	"		
45		DATA PLATE	1	"	"		
46		NAME PLATE	1	"	"		
47		IDENTIFICATION PLATE	2	"	"		
48		CAUTION PLATE	1	"	"		
49		DRIVE SCREW	4	"	"		
50		INLET GASKET	1	COMMERCIAL-FLEXITALLIC SPIRAL WOUND #163-24		4	ONE EQUIVALENT
51		DRAIN PIPE	1	SST	ASME SA312 TYPE 316	5	

● FURNISHED AS SUB-ASSEMBLY ONLY

[illegible] INFORMATION

VALVE IS [illegible] IN ACCORDANCE WITH THE FOLLOWING
[illegible] CODES, CODES, AND STANDARDS

[illegible] CONNECTION ENGINEERING
[illegible] SPEC NO 14580 PE-701
[illegible] SPEC NO 14074 - PE-701
[illegible] VALVE ID NOS NC-200, NC-201, NC-202, NC-203
[illegible] TYPE CONNECTION, PRESSURE RELIEF OF SATURATED STEAM

[illegible] / TEMP: 2485 PSIG / 700°F
[illegible] / TEMP: 2235 PSIG / 653°F
[illegible] CAPACITY = 460,000 LBS/HR SATURATED STEAM
ACCUMULATION = 3% OF SET PRESSURE
BLOWDOWN = 5% OF SET PRESSURE
[illegible] = SUPERIMPOSED 310 PSIG, BUILT UP 700 PSIG
[illegible] 2485 PSIG ±1%
RATED CAPACITY = 504,932 LBS/HR
ACTUAL CAPACITY = 561,056 LBS/HR

C.E CONTRACT NOS. 14074 & 14174
CUSTOMER TENNESSEE VALLEY AUTHORITY
PLANT NAME YELLOW CREEK UNIT 1&2

CROSBY CUST. COMBUSTION ENGINEERING
ORDER NO 977341-1 & 977342
CROSBY P.O. NB0619 & NB0620
PREPARED BY RB 11-9-77
CHECKED BY [illegible]
APPD [illegible]

VALVE MFG. TO ASME BOILER & PRESSURE VESSEL CODE 1977 EDITION & NO ADDENDA

SIZE 6 N B | STYLE HB-86-DP
TYPE E | ASSEMBLY NO. NG1894

ASME SECT. III CL. 1

CROSBY CROSBY VALVE & GAGE CO. WRENTHAM, MASS. 02093

DRAWING TITLE: NOZZLE TYPE SAFETY VALVE

DRAWING NO. DSC-61894 SHEET 2 FINAL | REV D

5. Design Variations and Effects On Operability

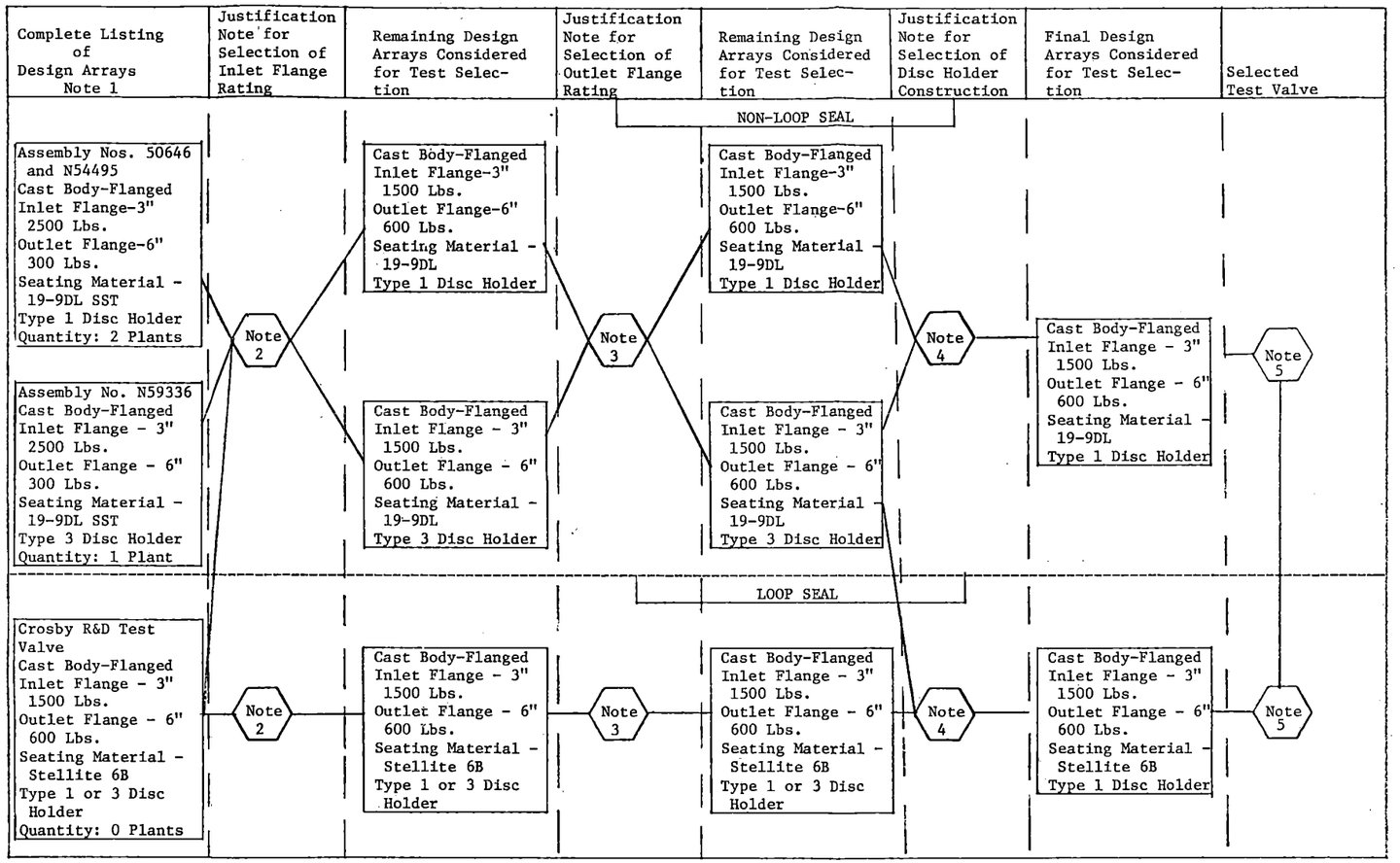
5.1 Included in this section is a justification report sheet for each valve orifice size of the Crosby Style HB-BP-86 Safety Valve. The purpose of these justification sheets is to outline the reasoning involved in selecting a particular valve model to represent each valve size. Note from the previous section that a valve for each orifice size was not selected for the EPRI testing. Refer to Section 6 of this report for justification of chosen test valves across orifice sizes.

5.2 The left most column of each justification sheet groups into arrays all valve assemblies with identical significant design features. Each remaining column identifies and selects the specific design features chosen for testing. The reasoning for selection which includes effects of design parameters on valve operability is included in the notes at the lower end of each justification sheet. Each sheet is separated into non-loop seal and loop seal installations.

JUSTIFICIATON OF TEST VALVE DESIGN

CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVE
K ORIFICE

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASSACHUSETTS



NOTES:

1 - This listing groups into arrays all assemblies which are identical in all significant design parameters. The quantity of domestic plants having each array are included in the listing. See the attached Crosby listing of all Crosby Style HB Safety Valves installed in domestic PWR Nuclear Power Plants.

2 - The 1500 lb. inlet flange rating has been selected. Use of a 1500 lb. rating as compared to a 2500 lb. rating would be the most rigorous test on the valve design based on possible effects on valve performance during possible applications of external loads to the valve.

3 - The 600 lb. outlet flange rating has been selected for test. The rating of the outlet flange (600 lbs. versus 300 lbs.) will have negligible effect on valve performance. The 600 lb. outlet flange rating is the only rating presently available with the 1500 lb. inlet flange rating.

4 - The Type 1 disc holder construction has been selected for test since this construction is installed in two (2) of the three (3) domestic plants having K Orifice Valves.

5 - The selected test valve for non-loop seal applications is the Crosby R&D Test Valve purchased by EPRI. The valves flange ratings, seating material and disc holder construction are as listed in the final design array column for non-loop seal testing. For loop seal testing the same valve will be utilized with the nozzle, disc insert and disc holder assembly replaced with the material and construction listed under the final design array column for loop seal testing. There are some dissimilarities in design between the selected test valve and the K Orifice Valves installed in the field. The design differences are as follows:

5.1 The test valve has an open bonnet and cap construction whereas the K Orifice Valves installed in the field have closed bonnet and cap assemblies. The differences in bonnet construction will have minimal effect on valve performance.

5.2 The contours of the valve body for the test valve are dissimilar to the K Orifice Valves installed in the field. The radii making up the shape of the test valve body are somewhat sharper. The difference in body shape will not effect valve performance except possibly during application of nozzle loads to the valve with the test valve body being the most stringent test.

5.3 The valve body is constructed of cast carbon steel versus cast stainless steel used in valves installed in the field.

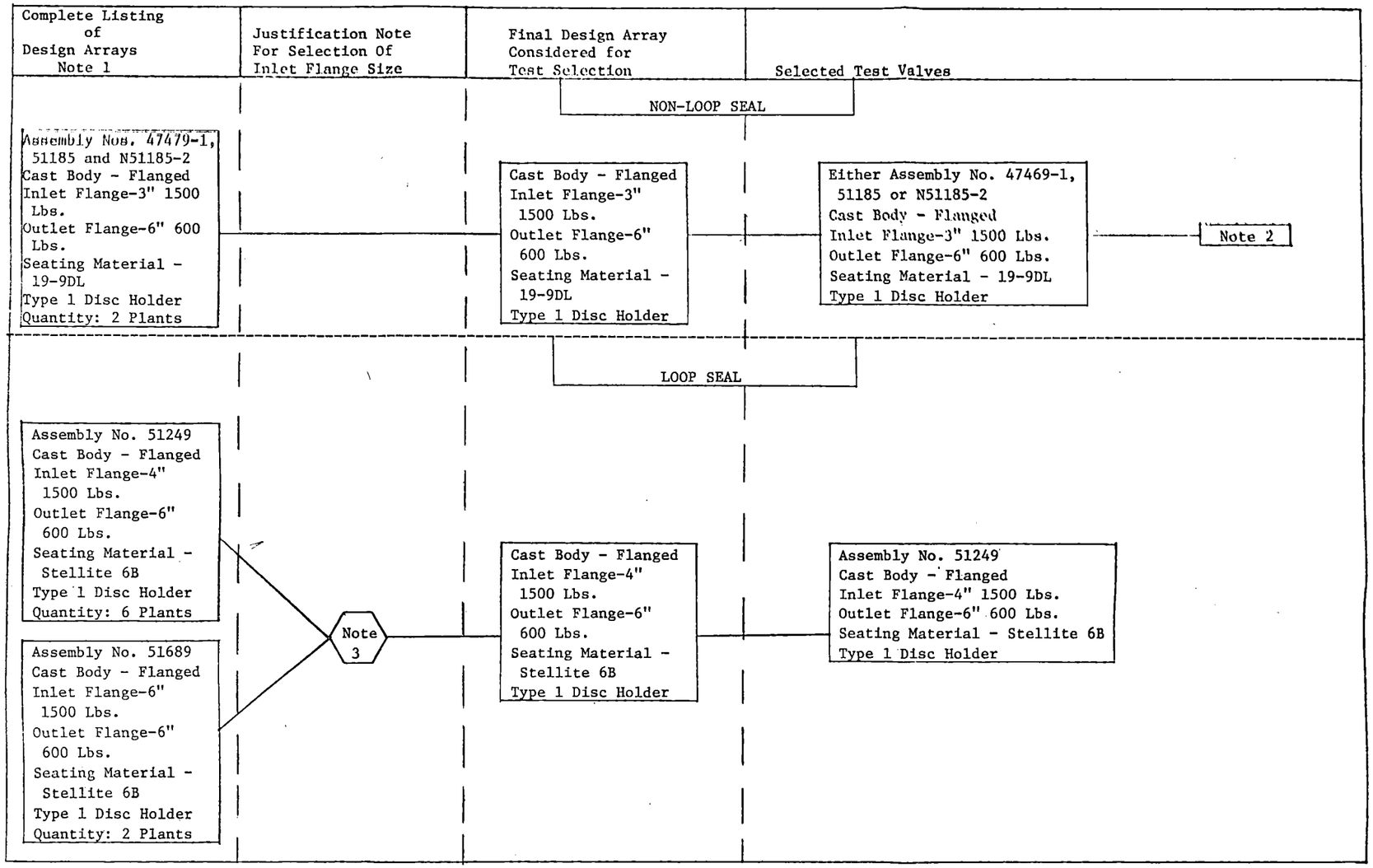
DISC HOLDER CONSTRUCTION TYPES:

Type 1 - 347 Stainless Steel With Stellite Lands and Stellite Disc Bushing.
Type 2 - SA637 Grade 718 Without Bushing.
Type 3 - SA637 Grade 718 With Stellite Disc Bushing.

JUSTIFICATION OF TEST VALVE DESIGN

CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVE
K2 ORIFICE

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASSACHUSETTS



NOTES:

1 - This column groups into arrays all assemblies which are identical in all significant design parameters. The quantity of domestic plants having each design array are included in the listing. For further details see the attached Crosby listing of all Crosby Style HB Safety Valves installed in domestic PWR Nuclear Power Plants.

2 - The three (3) listed assembly numbers are all identical in design and materials and are the only K2 Orifice Valves installed on non-loop seal installations. Therefore, any one of the three (3) assemblies can be selected for test.

3 - The only dissimilar parameter between the two (2) designs is the valve inlet size. The valves have equal nozzle bore diameters and the ratio of nozzle bore to inlet size are maintained within a given value to assure chocked flow at the nozzle bore section. Therefore, the flow coefficient, and valve operation will not be effected by the different inlet sizes. The smaller inlet size (4") would be the most stringent test on the valve design. Also, the 4" valve design is found in greater amounts in the field. Therefore, the design the the 4" inlet has been selected for test.

DISC HOLDER CONSTRUCTION TYPES:

Type 1 - 347 Stainless Steel with Stellite Lands and Stellite Disc Bushing.

JUSTIFICATION OF TEST VALVE DESIGN

CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVE
M1 ORIFICE

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASSACHUSETTS

Complete Listing of Design Arrays Note 1	Justification Note for Selection of Inlet Flange Rating	Remaining Design Arrays Considered for Test Selection	Justification Note for Selection of Body Construction	Remaining Design Arrays Considered for Test Selection	Justification Note for Selection of Disc Holder Construction	Final Design Arrays Considered for Test Selection	Selected Test Valve
			NON-LOOP SEAL				
Assembly No. N54891 Cast Body-Flanged Inlet Flange-4" 2500 Lbs. Outlet Flange-6" 600 Lbs. Seat Material - See Note 2 Type 1 Disc Holder Quantity: 1 Plant					Note 3	Cast Body - Flanged Inlet Flange-4" 2500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material 19-9DL Type 2 Disc Holder	Note 4
Assembly No. N59303 Cast Body-Flanged Inlet Flange-4" 2500 Lbs. Outlet Flange-6" 600 Lbs. Seat Material - See Note 2 Type 2 Disc Holder Quantity: 1 Plant							
			LOOP SEAL				
Assembly No. 52137 Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material- Stellite Type 1 Disc Holder Quantity: 3 Plants		Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material - Stellite Type 1 Disc Holder		Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seat Material- Stellite Type 1 Disc Holder		Assembly No. N57872 Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material- Stellite Type 2 Disc Holder	
[redacted] y No. N5[redacted]72 Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" [redacted]bs. [redacted] Material- [redacted]ellite Type 2 Disc Holder Quantity: 1 Plant	Note 5	Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material - Stellite Type 2 Disc Holder	Note 6	Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material - Stellite Type 2 Disc Holder	Note 7		Note 8
Assembly No. N56264 Cast Body-Flanged Inlet Flange-4" 2500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material- Stellite Type 2 Disc Holder Quantity: 3 Plants		Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material - Stellite Type 2 Disc Holder					
Assembly Nos. N56963 and N56963-1 Forged Body- Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material- Stellite Type 2 Disc Holder Quantity: 3 Plants							

NOTES:

1 - This colum groups into arrays all assemblies which are identical in all significant design parameters. The quantity of domestic plants having each design array are included in the listing, For further details see the attached Crosby listing of all Crosby Style HB Safety Valves installed in domestic PWR Nuclear Power Plants.

2 - Assembly Nos. N54591 and N59303 (spare valve) are installed only at Toledo Edison-Davis Besse I. The valves are presently installed on loop seals with Stellite seating material. Toledo Edison has considered removing the valve from the loop seal and replacing the seating material with 19-9DL Stainless Steel material. Therefore, these two (2) assemblies will be considered for non-loop seal testing with 19-9DL seating material.

3 - The Type 2 Disc Holder has been selected for M1 Orifice non-loop seal testing since the Type 1 Disc Holder was selected for non-loop seal testing for both the K and K2 Orifice.

4 - Either assembly may be used for test providing the nozzle and disc insert are of 19-9DL Stainless Steel material.

5 - The 1500 lb. inlet flange rating has been selected for test. Use of a 1500 lb. rating as compared to a 2500 lb. rating would be the most rigorous test on the valve design based on possible effects on valve performance during possible applications of external loads to the valve.

6 - The cast body construction has been selected for test based on the following reasoning:

6.1 The greater quantity of cast body M1 Orifice Valves installed in the field.

6.2 The cast body design would be the most rigorous test on the valve style based on possible effects on valve performance during application of nozzle loads to the valve.

7 - The Type 2 Disc Holder construction has been selected for test due to the greater quantity in the field. Also, the Type 1 Disc Holder types have been selected for loop seal tests on the K and K2 Orifice Valves respectively.

8 - Assembly No. N57872 possesses all the selected design parameters and therefore is the selected test valve for M1 Orifice loop seal testing.

DISC HOLDER CONSTRUCTION TYPES:

Type 1 - 347 Stainless Steel with Stellite Lands and Stellite Disc Bushing.

Type 2 - SA637 Grade 718 without bushing.

T[redacted] - SA637 Grade 718 with Stellite Disc Bushing.

JUSTIFICATION OF TEST VALVE DESIGN

CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVE
M ORIFICE

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASSACHUSETTS

Complete Listing of Design Arrays Note 1	Justification Note for Selection of Inlet Flange Rating and Size	Remaining Design Arrays Considered for Test Selection	Justification Note for Selection of Body Construction	Remaining Design Arrays Considered for Test Selection	Justification Note for Selection of Disc Holder Construction	Final Design Arrays Considered for Test Selection	Selected Test Valve
NON-LOOP SEAL							
Assembly No. 51250-1 Cast Body-Flanged Inlet Flange-4" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 1 Disc Holder Quantity: 1 Plant	Note 2	Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 1 Disc Holder	Note 3	Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 1 Disc Holder	Note 4	Forged Body - Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 2 Disc Holder	Note 5
Assembly No. N55605 Cast Body-Flanged Inlet Flange-6" 2500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 2 Disc Holder Quantity: 1 Plant		Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 2 Disc Holder		Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-19-9DL Type 2 Disc Holder			
LOOP SEAL							
Assembly Nos. 51688 and 51688-1 Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 1 Disc Holder Quantity: 11 Plants	Note 3		Note 4	Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 1 Disc Holder	Note 5	Assembly No. N56964 Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 2 Disc Holder	
Assembly Nos. N55366, N56925 and N56499 Cast Body-Flanged Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 2 Disc Holder Quantity: 5 Plants				Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 2 Disc Holder			
Assembly No. N56964 Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 2 Disc Holder Quantity: 21 Plants				Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 3 Disc Holder			
Assembly No. N60446 Forged Body-Studded Inlet Flange-6" 1500 Lbs. Outlet Flange-6" 600 Lbs. Seating Material-Stellite Type 3 Disc Holder Quantity: 5 Plants							

NOTES:

1 - This column groups into arrays all assemblies which are identical in all significant design parameters. The quantity of domestic plants having each design array are included in the listing. For further details see the attached Crosby listing of all Crosby Style HB Safety Valves installed in domestic PWR Nuclear Power Plants.

2 - The 1500 lb. inlet flange rating has been selected for test. Use of a 1500 lb. rating as compared to a 2500 lb. rating would be the most rigorous test on the valve design based on possible effects on valve performance during possible application of external loads to the valve. The valves have equal nozzle bore diameters and the ratio of nozzle bore to inlet size are maintained within a given value to assure choked flow at the nozzle bore. Therefore, the flow coefficient and valve operation will not be effected by the different inlet flange sizes. The 6" size was selected for test based on the greater amount installed in the field.

3 - The cast body construction has been selected for K, K2, M1 and N Orifice testing. Therefore, to assure testing of both body designs, the forged body construction has been selected for M Orifice testing.

4 - The Type 2 disc holder construction has been selected for test based on a larger quantity installed in the field and also Crosby considers the use of the Type 2 design material combination the most stringent test selection. In addition, the Type 1 disc holder designs have been selected for test for other orifice sizes.

5 - The valve design per Crosby Assembly No. N56964 possesses all the selected design parameters and will be used for test. The disc insert and nozzle will be removed and replaced with parts of 19-9DL material for non-loop seal testing.

DISC HOLDER CONSTRUCTION TYPES:

Type 1 - 347 Stainless Steel with Stellite Lands and Stellite Disc Bushing.

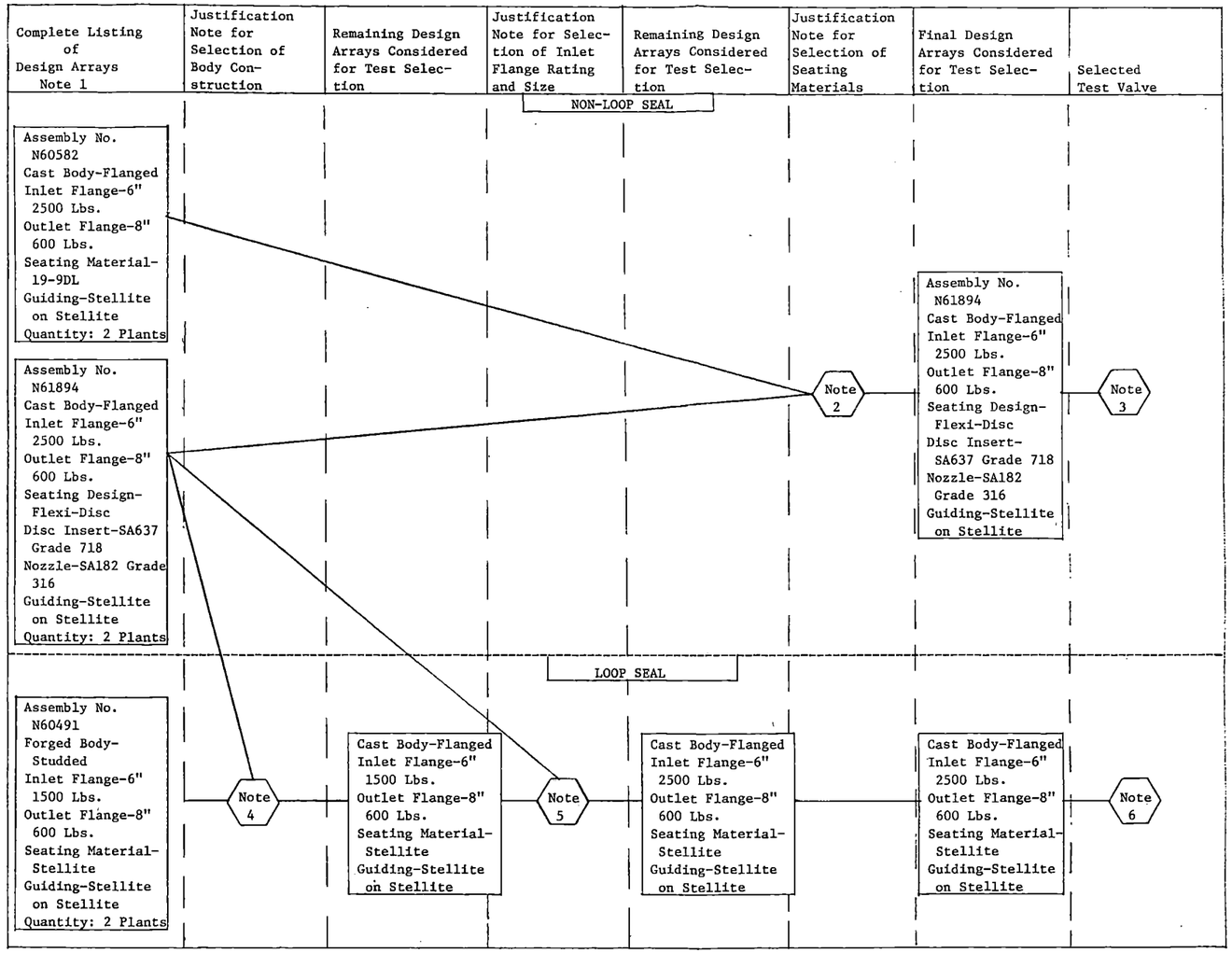
Type 2 - SA637 Grade 718 without bushing.

Type 3 - SA637 Grade 718 with Stellite Disc Bushing.

JUSTIFICATION OF TEST VALVE DESIGN

CROSBY STYLE HB-BP-86 PRESSURIZER SAFETY VALVE
N ORIFICE

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASSACHUSETTS



NOTES:

1 - This column groups into arrays all assemblies which are identical in all significant design parameters. The quantity of domestic plants having each design array are included in the listing. For further details see the attached Crosby listing of all Crosby Style HB Safety Valves installed in domestic PWR Nuclear Power Plants.

2 - The two (2) designs for non-loop seal installations are identical except for seating designs. The 19-9DL material has been selected for tests for all other orifice sizes. Therefore, the Flexi-disc design has been selected for the N Orifice testing.

3 - Assembly No. N61894 possesses all the selected design parameters and will be used as the test valve.

4 - The cast body design would be the most rigorous test on the valve style based on possible effects on valve performance during application of nozzle loads to the valve.

5 - Crosby has never manufactured a cast body N Orifice HB Pressurizer Safety Valve with a 1500 lb. inlet flange rating. Therefore, the 2500 lb. inlet flange rating has been selected.

6 - Assembly No. N61894 shall be used as the test valve with the nozzle and disc insert removed and replaced with parts having Stellite seats.

DISC HOLDER CONSTRUCTION TYPES:

Type 1 - 347 Stainless Steel with Stellite Lands and Stellite Disc Bushing.
Type 2 - SA637 Grade 718 without bushing.
Type 3 - SA637 Grade 718 with Stellite Disc Bushing.

6. Conclusion

6.1 Summary of Design Differences

Listed below is a summary of the design differences delineated in the justification sheets of Section 5 of this report.

6.1.1 Valve Size

Listed below are all the sizes of Crosby Pressurizer Safety Valves presently installed or to be installed in domestic PWR Plants.

Letter Designation	Nozzle Bore Diameter (Inch)
K	1.531
K2	1.800
M1	1.952
M	2.154
N	2.362

6.1.2 Seat Material

The following list of seal material combinations are used in Crosby Pressurizer Safety Valves installed in or to be installed in domestic PWR Plants.

6.1.2.1 Valves Installed On Loop Seals

Stellite 6B disc insert against hard faced Stellite 6 nozzle.

6.1.2.2 Valves Installed Without Loop Seal

6.1.2.2.1 Disc insert and nozzle constructed of 19-9DL Stainless Steel, ASTM A458 Grade 651 or ASTM A477 Grade 651.

6.1.2.2.2 Flexi-disc design (N Orifice only) - disc insert of ASME SA637 Grade 718 against nozzle of ASME SA182 Grade F316.

6.1.3 Disc Holder Construction

The following disc holder constructions are used in the Crosby Pressurizer Safety Valves installed in or to be installed in domestic PWR Plants.

6. Conclusion (Continued)

6.1 Summary of Design Differences (Continued)

6.1.3 Disc Holder Construction (Continued)

Type 1 (Used in K, K2, M1 and M Orifice Valves) - 347 Stainless Steel disc holder with Stellite lands and disc bushing.

Type 2 (Used in M1 and M Orifice) - ASME SA637 Grade 718 disc holder without disc bushing.

Type 3 (Used in K and M Orifice Valves) - ASME SA637 Grade 718 disc bushing with Stellite disc bushing.

6.1.3.1 All N Orifice Valves have an identical disc holder construction which is a different design from those listed above. Guiding surfaces are constructed of Stellite. See Drawing No. DS-C-61894 on Page 25 for detail of construction.

6.1.4 Valve Body Construction

The following body constructions are used in the Crosby Pressurizer Safety Valves installed in or to be installed in domestic PWR Plants.

6.1.4.1 Cast Body Construction

All valve sizes integral cast inlet and outlet flanges. See justification sheets in Section 5 of this report for detail breakout of flange ratings.

6.1.4.2 Forged Body Construction (M1, M, and N Orifice)

Studded inlet and outlet flange connections. See justification sheets in Section 5 of this report for detail breakout of flange ratings.

6.2 Selected Design Parameters

6.2.1 The following three (3) valve sizes have been selected for test.

K Orifice - Represents smallest valve size.

M Orifice - Represents the intermediate size with the greatest population.

N Orifice - Represents largest valve size.

6. Conclusion (Continued)

6.2 Selected Design Parameters (Continued)

6.2.2 Selected Disc Holder Constructions

The Type 1 disc holder construction was selected for the K Orifice testing. The Type 2 disc holder construction was selected for the M Orifice testing. Therefore, both materials will undergo testing. The Type 3 disc holder construction will not undergo testing since it is identical to the Type 2 except for the addition of a disc bushing. Crosby recommends tests with the Type 2 rather than the Type 3 since the Type 1 construction which has a disc bushing has been selected for test in the K Orifice Valve. The N Orifice Valve disc holder construction is unique to the other valve disc holder constructions and will undergo tests with the N Orifice Valve.

6.2.3 Seating Materials

All seating material combinations will undergo testing as delineated in the justification sheets of Section 5 to this report. A brief summary is listed below.

K Orifice - Loop Seal - Stellite Seats
Non-loop Seal - 19-9DL Stainless Steel Seats

M Orifice - Loop Seal - Stellite Seats
Non-loop Seal - 19-9DL Seats

N Orifice - Loop Seal - Stellite Seats
Non-loop Seal - Flexi-disc construction

6.2.4 The K and N Orifice Valves will be tested with the cast body construction. The M Orifice Valve will be tested with the forged body construction. Therefore, both body designs will undergo testing.

6.3 The selected test valves represent the Crosby Valves installed on or to be installed in PWR Plants and the EPRI test results are fully applicable to the Crosby Valves installed or to be installed in PWR Plants.

A2 - DRESSER INDUSTRIES