

CROSBY REPORT NO. 3920 REVISION 1

JUSTIFICATION REPORT

OF

EPRI TESTING

OF

CROSBY STYLE HB-BP-86

PRESSURIZER SAFETY VALVES

PREPARED BY: D. Shibault

PROJECT ENGINEER

REVIEWED BY:

D. R. AYLOR

SENIOR PROJECT ENGINEER

APPROVED BY:

J. R. ZAHORSKA

CHIEF ENGINEER-SAFETY VALVES

DATE:

OCTOBER 13, 1981



Test Report No. 3920 Revision 1

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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 cr a specific portion of all Crosby Valves used as pressurizer safety valves.



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### 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 Ori	fice	K2 Ori	fice	Ml Or	ifice	M Ori	fice	N Or	ifice
Assem. No.	Quan. of Plants	Assem.	Quan. of <u>Plants</u>	Assem.	Quan. of Plants	Assem.	Quan. of Plants	Assem.	Quan. of <u>Plants</u>
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
		51.689	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.

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	1003/11A	Totoda Edison Co.	Dayle bense Unit No. 1	BLW	2	N54891	H-54891	x		38	<b>x</b> .	See Spec	cial Notes	x	Note 1
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	2 100 11 4	Vinglona Cleatede and Power	North Anna 3	HAH	2	N56264	D8C-56264	x		<b>x</b>	x	x	x	<b>x</b>	

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Motors - Plant Cancelled

Disc Holder

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

### M ORIFICE (CONTINUED)

M ORIFICE	(CONTINUED	<u>))</u>											·		Disc Holder Material and	ort No
Groaby Pactory Order No.	Ut 111cy	Station	Beactor Hfr.	Qty. of Valves	Croaby Assembly No.	Crosby Drawing No.	Body Cons	struction Studded	Inlet Fla. 1500 Lbs. Size 3" 4" 6"	2500 Lbs. Size	Outlet Flan 300 Lbs. Size 4" 6" 8"	ge Rating 600 Lbs. Size 4" 6" 8"	Loop Seal Yes No	Scating Haterials Stellite 19-90L	Construc- tion *Type 1 2 3	Spectal 92 Commenta 0
	Common- wealth	Byron Station Unit No. 1	W	3	N56964	DS-C-56964		x	<u>x</u>		<u> </u>	x x	х 10	X ,	х	O Revisio
พวัดวาร3	Tennessee Valley Authority	Bar Unit	.w	3 .	พ56964	DS-C-A5696	.4	x ·	x			. <b>x</b>	×,	x	x	ion 1
	Georgia Power and Light Co.		¥	3	พ56964	DS-C-56964		x	x			x	x	x	х	
พ303155	Georgia Power and Light Co.		<b>u</b> .	3	พ56964	DS-C-56964		<b>X</b>	x			<b>x</b> .	x	x	x	ب
N54020	Pacific Gas and Electric Company	Diablo Canyon	W	1	N51688	H-51688	<b>X</b>		. *			x	<b>'x</b>	<b>x</b>	K	
N303169-A	Service	Marble Hill Unit No. 1	<b>u</b> :	3	พ56964	DS-C-56964		x	. <b>x</b>			x	<b>x</b>	х .	x	
N303102	Public Service of N.H.	Seabrook Unit No. 2	W	3	N56964	DS-C-56964	·	x	x	. '		x	x	<b>x</b>	x	
N303145-B	South Carolina Electric and Gas	Virgil C. Summer Station	u	3	N56964-1	DS-C-56964	-1	x	<b>x</b>			¥	x	<b>x</b>	x	

\*Type
1 - 347 SST With Stellire Lands and Disc Bushing.
2 - Incomel 718 Without Bushing.
3 - Incomel 718 With Bushing.

Notes 1 - Plant Cancelled

Company

Test Report No.

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Es why knowing Order the	erlljig	Statton	Reactor Mfr.	Qcy. og Valves	Croaby Assembly No.	Crosby Draving No.	Plenged	Studded		Outlet Flenge Rating 300 Lbs. 600 Lbs. Size Size 4M 6M 8M 4M 6M 8M	Loop See		*100 *1700 1 2 1	Special Consents
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t tretain t	tomo vice Valley Author 14 y	Matta Ser Unit No. 8	¥	. 3	#56944	DS-C-A569	64	E	x	. **	x	<b>x</b>	z x	
91475,99	1	Arbanasa Nacional Anto No. 3	CZ	3	£6662	N-35603			<b>X</b>	<b>z</b> .				
dipater			W	6	H56923	DS-C-5692	<b>5</b> B		x	*	¥	<b>.</b>	1	
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ng a angresite	to Hana and Misle Igan Liber	B.C. Cook Unit No. 1		2	M36499	DS-C-5649	9 18		x	<b>4</b>	<b>x</b> .		X	Note 2
2 वीकि	waith	Brittens Station Dat No. :	y.	£	N36964	<b>85-C-369</b> €	54	¥	x		x	n	x	

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Plant Camelled Plant Cancell
 Space Valves

Disc

### (1941) 11411 BE PRESSURIZER SAFETY VALVES SUPPLIED FOR USE 18 114 415 411 411 MATER REACTOR RUCLEAR POWER PLANTS

The Control Committee (D)

Live Color Lives y Factory Order No.	October 1984)	Station	Reactor Mfr.	Qty. of <u>Valves</u>	Crosby Assembly	Croaby Brawing No.	Body Con Flanged	etruction Studded	Inlet Flange Rating  1500 Lbs. 2500 Lbs.  Size 3" 4" 6" 3" 4" 6"		Loop Sea		Bolder Bolder Haterial and Construction AType 1 2 3	Special Comments
1. 116.5	Care Elna Procacand Effekt Coa	Shearon Barris Bair No. 3	u	3	<b>N</b> 5696&	DS-C-56964		H	X	x	x	<b>x</b>	<b>x</b> .	
DistributA		Communiche Peak Buit Bu. 2	u	3	N56964	DS-C-56964	•	<b>x</b>	x	. <b>x</b>	х	x	x	
. 25-114-6	Parti.	Scattonk Dutt No. 1	u	3	N56964	DS-C-569 <b>6</b> 4		×	· <b>x</b>	x	x	· <b>x</b>	x	
a903104	Corract walth Edinon Co.	Braidwood Station - Valt No. 1	u	3	N56964 ·	DS-C-56964		×	x	g ·	x	x	x	
Bry Per/A	hone 191 and 14 ght Ing	Jamesport Volt No. 2	u	3	พ56964-4	DS-C-56964	-4	×	<b>x</b> .		×	<b>x</b>	<b>x</b>	3
p.103568A	Long 1. Land 1 Leht ling	Jamesport Unit Ro. 1	W	3	N56964-4	DS-C-56964	-4	x	a .		x	X .	x	3
:+411	e me a c Garanes l Elector le Louignary	Rolf Greek Daft Ro. 1	ដ	3	N60446	DS-C-60446	•	X	х .	x	<b>x</b>	. <b>x</b>	x	
264132	Colon Heatele Company	Callaway Station No. 1	u	3	N60446	DS-C-60446	<b>S</b>	x	х	<b>x</b>	<b>x</b>	<b>x</b>	x	

<sup>1 -</sup> monney /18 With Bushing.

<sup>-</sup> Shour Carcelled

<sup>2 -</sup> quart values, 1 - Frant Cancelled After Shipment of Valves.

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### 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 (3) 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).



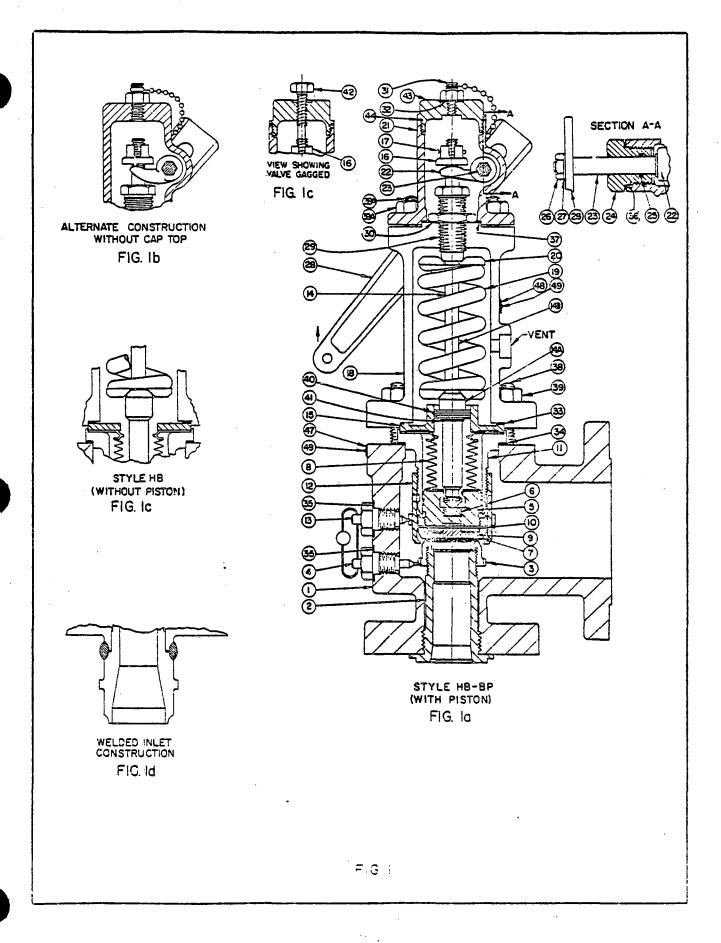
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### 3. Description of Valve (Continued)

### 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.



## Crosby Valve & Gage Company Wrentham, Massachusetts

Piece No.	Part Name
1	Body
2	Nozzle
3	Nozzle Ring
4	Nozzle Ring Set Screw
<del>9</del> ·5	Disc Holder
•	
<b>*6</b>	Disc Bushing
<b>*</b> 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
20	parrie e
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	Bonner Adapter Gasket
*34	Eductor Gasket
*35	Nozzle Ring and Adjusting Ring Set Screw Gasket
*36	Dog Shaft Bearing Gasket
*37	Cap Gasket
38	Bonner Stud
	wassee a popular

## Crosby Valve & Gage Company Wrentham, Massachusetts

Piece No.	Part Name
38A	Cap Stud
<b>3</b> 9	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

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



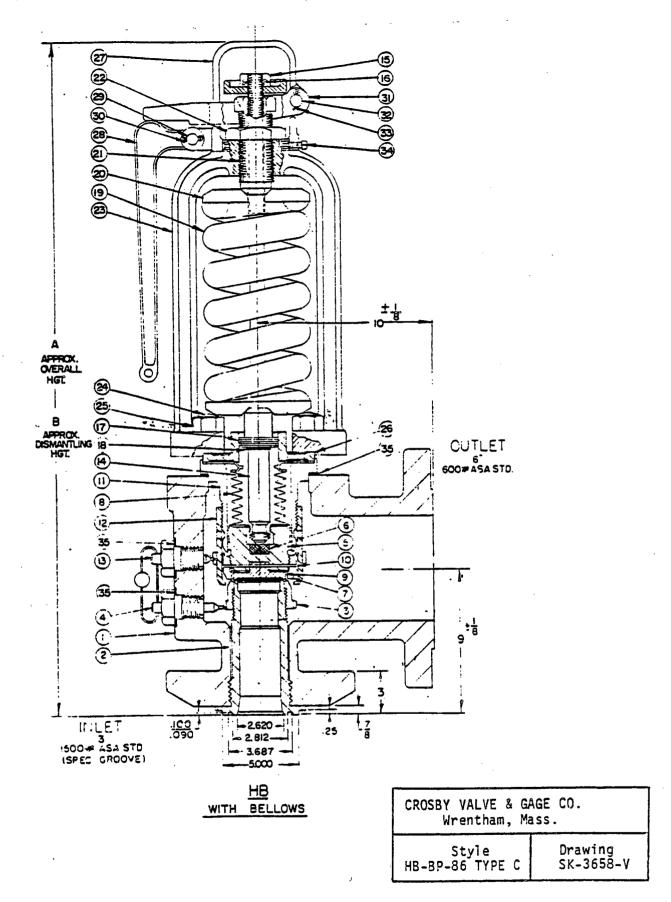
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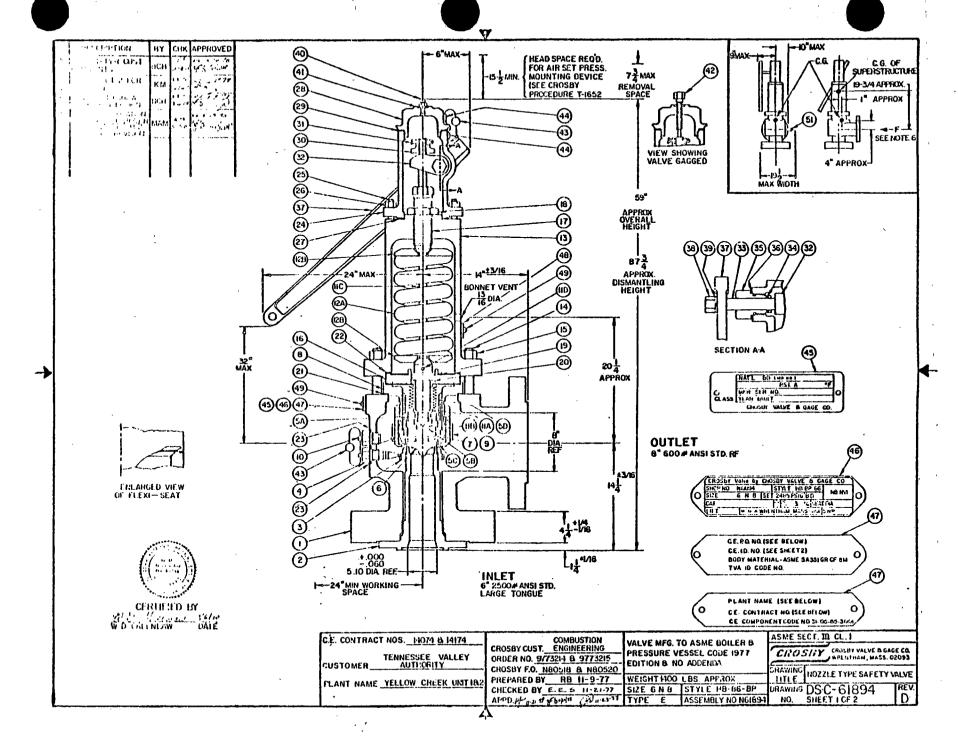
### 4. Selected Test Valves

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



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		26	" STUD	6	ALLOY STEEL STEEL	ALME SAIDA CH 2H		
		27 26	GASKET GASKET		CANTON STEEL	AISI 1010-1030 ASML SAPIC CR WCB		
MOSTARBIO BILL BASE BELLEVILLE		29 30	SIMME NUT		SIEEL SSI	ABI IOO IOSO ASTA ASSETYLE 416 C	1	
THE PROOF OF PARTY WITH THE FOLLOWING		30	COTTER		STECL.	COPILIT RETAL		
era redica Engine Ring		<u>32</u>	DOG SHAFT		SST STEEL	AS LES AFIN CL 150-12		HEAT TREATED
CONTRACTORIC NO SESSIO PETOS		34	O' RING		ATON A	RUBBER		
17 10 04 1410 NO 18074 - FE-701 0 - 74 VE NO 1875 NO 200, RC-201, RC-202, RC-203		. 35 36	" <u>" GSK1</u>		STELL	AISI 1000-1030		
STATE OF STORESTIC, INC. SURE RELIEF OF SATURATED	STEAM	_ 37	LEVER	<del>  -</del>	CARRON STEEL STEEL	ASME SAZIE GR WCB		
19 7 151 169 / HEMP 2495 PSIG / 700°F		33	* INCKWASIE	二		COMMENCIAL		
to the transmed carm has 460,000 lbs/hr satura	ITED STEAM	40	CAP PING GASKET	0		VI21 1010-1030		
a Caran Angres 3 % of See Pro Soure Coloro an est of See Francishre		43	GAG SCILEW	1 2	SET	ASTM ASAS TYPE 46 C	T QK	
to the formal a Surfadministration of Sign Buren up 700 i	PSIG	44	SPAL IN WINE		IFAD-SST	COMMERCIAL		
10 Una 1204 200 ISBN 016 1200 CAROUTT 504,962 145744		46	HAM HATE	<del>                                     </del>	•	<del>-</del>		
ALTHAL C-6 ACTY - SUL, 058 LESTIN		47	IL HUFTCATION PLATE	2	0			
		44	tanya salid W					
		<u>50</u> . 51	HALL CASKEY		CÓMM ÉCIAL-FLEXU SST	ALIC SPRING VERNE SIGNATURE		OR EQUIVALENT
		O	NISHED AS SUD-ASSEMBL	Y ONLY	1 <del></del>		i 12.	
	C.E CONTRACT NOS. 14074 B	14174	CONTRA	ISTION		ASSESSED ASSESSED	ME SICT. III C	 Il
	Tennessee va	IBET	CROSBY CUST. ENGIN	FLERING	BULESHOE VES	ASME BOILER &	CHOSHY "	I    III = VARVE BIGAGE CO   III   III AM, MASS   DZOS!
	CUSTOMER NITHERITY		ORDER NO 9773241 CHOSBY FO. NBOX19		≟—¶ENTINN A NO 6	DOENDA	Average (a. / h)	11 11 11 11 11 11 11 11 11 11 11 11 11
	PLANT NAME YELLOW CIKEK UN	34 U A PA 2			· · · · · · · · · · · · · · · · · · ·		Mag. (U)	THE CASE THE SALE.
	TEAMS WARE TELEMENTAL		CHECKED BY RB	1.0.77			AWING DS.C-	TYPE SAFETY WALVE



## CROSBY VALVE & GAGE COMPANY

Test Report No. 3920 Revision 1

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### 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.

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#### JUSTIFICIATON OF TEST VALVE DESIGN

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

CROSBY VALVE & GAGE COMPANY WRENTHAM, MASSACHUSETTS

	Justification	<del></del>				T	<del> </del>	<del></del>
Complete Listing	Note for			ication		Justification		1
of		Remaining Design	Note f	,	Remaining Design	Note for	Final Design	1
I	Selection of	Arrays Considered		ion of	Arrays Considered	Selection of	Arrays Considered	1
Design Arrays	Inlet Flange	for Test Selec-		Flange	for Test Selec-	Disc Holder	for Test Selec-	Selected
Note 1	Rating	tion	Rating		tion	Construction	tion	Test Valve
	ı F		1		NON-LOOP SEAL	,	1	1
1	1		ľ					
Assembly Nos. 50646	! . !	Cast Body-Flanged	ì		Cast Body-Flanged	)	ļ	١
and N54495	•	Inlet Flange-3"			Inlet Flange-3"	1		
Cast Body-Flanged	1	1500 Lbs.			1500 Lbs.		1	1
Inlet Flange-3"		Outlet Flange-6"			Outlet Flange-6"	1	1	
2500 Lbs.	1	600 Lbs.	ĺ		600 Lbs.		1	' 1
Outlet Flange-6"	,	Seating Material -			Seating Material -	i	•	
300 Lbs.		19-9DL	ĭ	/	19-9DL			1
Seating Material -	ı /l	Type 1 Disc Holder	\	/	Type 1 Disc Holder	V	1	
19-9DL SST	<b>(</b> / 1	Type I Disc Holder	!\	/	Type I Disc Holder	\	1	'
Type 1 Disc Holder	N — /		\ _	_ /	1	i\	1	ļ
	\/ <sub>\\</sub>		l \/	.\/		1\/\	Cast Body-Flanged	1
Quantity: 2 Plants	Note		XNo	teX	l	X Note >	, Inlet Flange - 3"	
1	<b>/</b> \/\		, /\3	_/\		/\4_/	1500 Lbs.	├─ (Note)
l				\		· <b>/</b>	Outlet Flange - 6"	5_/
Assembly No. N59336	71		/	\		Ĭ.	600 Lbs.	i l
Cast Body-Flanged	$\Lambda$	Cast Body-Flanged	ļ	\	Cast Body-Flanged	/ <sup>1</sup>	Seating Material -	1 ! !
Inlet Flange - 3"		Inlet Flange - 3"		\	Inlet Flange - 3"	'	19-9DL	, [ [
2500 Lbs.	'	\ 1500 Lbs.	ı	'	1500 Lbs.	1	11 1	,
Outlet Flange - 6"	!	Outlet Flange - 6"			Outlet Flange - 6"		Type 1 Disc Holder	1 1 1
300 Lbs.	.	600 Lbs.	[		600 Lbs.	·	l	1 1
Seating Material -		Seating Material -	'		Seating Material			·
19-9DL SST	'	19-9DL			19-9DL			( !
Type 3 Disc Holder	Ί.	Type 3 Disc Holder			Type 3 Disc Holder	\	1	, [ ]
Quantity: 1 Plant	.] ]	Type 5 Disc noider	1		Type 5 bisc noider	Ι'.	i	1 1 1
Quantity: 1 11ant	<u> </u>		' 			<u> </u>	· · · · · · · · · · · · · · · · · · ·	
	1		l		LOOP SEAL	1, 1	1	
	Ú l		1			1	j	
Crosby R&D Test	<b>!</b>		1			ì	•	1 1
Valve	,				1	- N		! !
Cast Body-Flanged	i İ	Cast Body-Flanged	1		Cast Body-Flanged	1.1	Cast Body-Flanged	, j
Inlet Flange - 3"	ا ا	Inlet Flange - 3"	} _		Inlet Flange - 3"	1.1 —	Inlet Flange - 3"	1 4 1
1500 Lbs.	<u>/</u> \	1500 Lbs.		\	1500 Lbs.		1500 Lbs.	/_ \
Outlet Flange - 6"	Note }	Outlet Flange - 6"		te}	Outlet Flange - 6"		- Outlet Flange - 6"	Note Note
600 Lbs.	2	600 Lbs.	, \3	3_/	600 Lbs.	1:\4	600 Lbs.	, \ <u>3</u> /
Seating Material -	ı (	Seating Material -	1 -		Seating Material -	11 -	Seating Material -	i i
Stellite 6B	,	Stellite 6B	}		Stellite 6B		Stellite 6B	1
Type 1 or 3 Disc	1	Type 1 or 3 Disc	<b>I</b> .		Type 1 or 3 Disc	1	Type 1 Disc Holder	-
Holder	ļ.	Holder			Holder	1,	1	' ]
	1		1			<b>-</b>	}	
Quantity: 0 Plants	]		ļ			1		1
	L		<u>!</u>			<u>l</u>	<u> </u>	

- 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 l disc holder construction has been selected for test since this construction is installed in two (2) of the three (3) domestic plants
- 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.

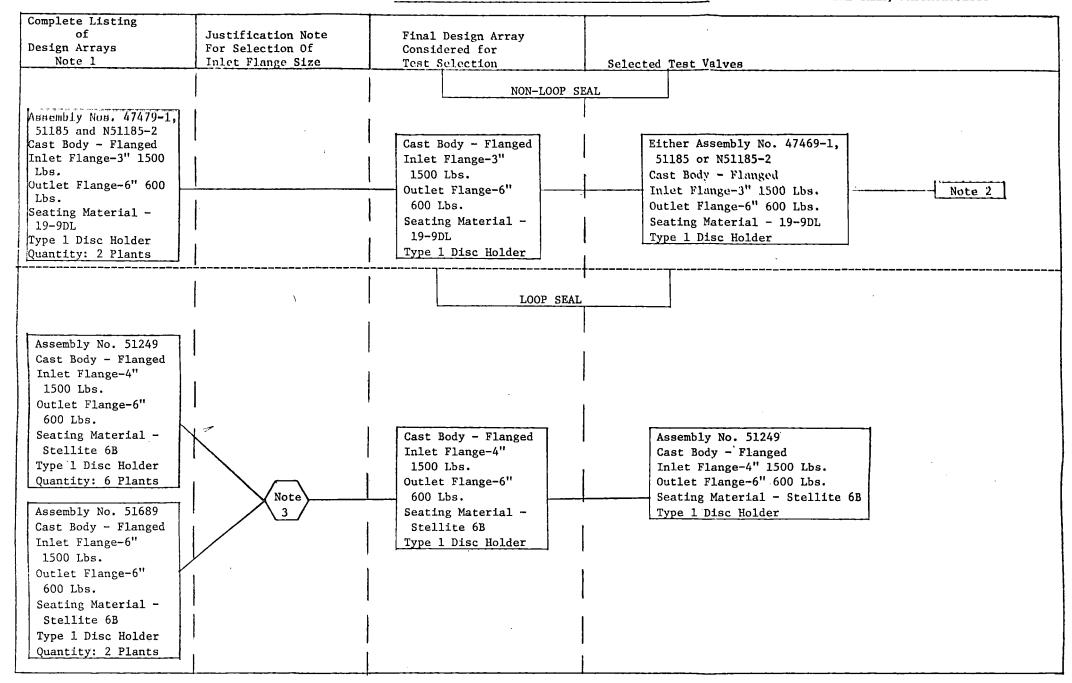
### DISC HOLDER CONSTRUCTION TYPES:

- 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.

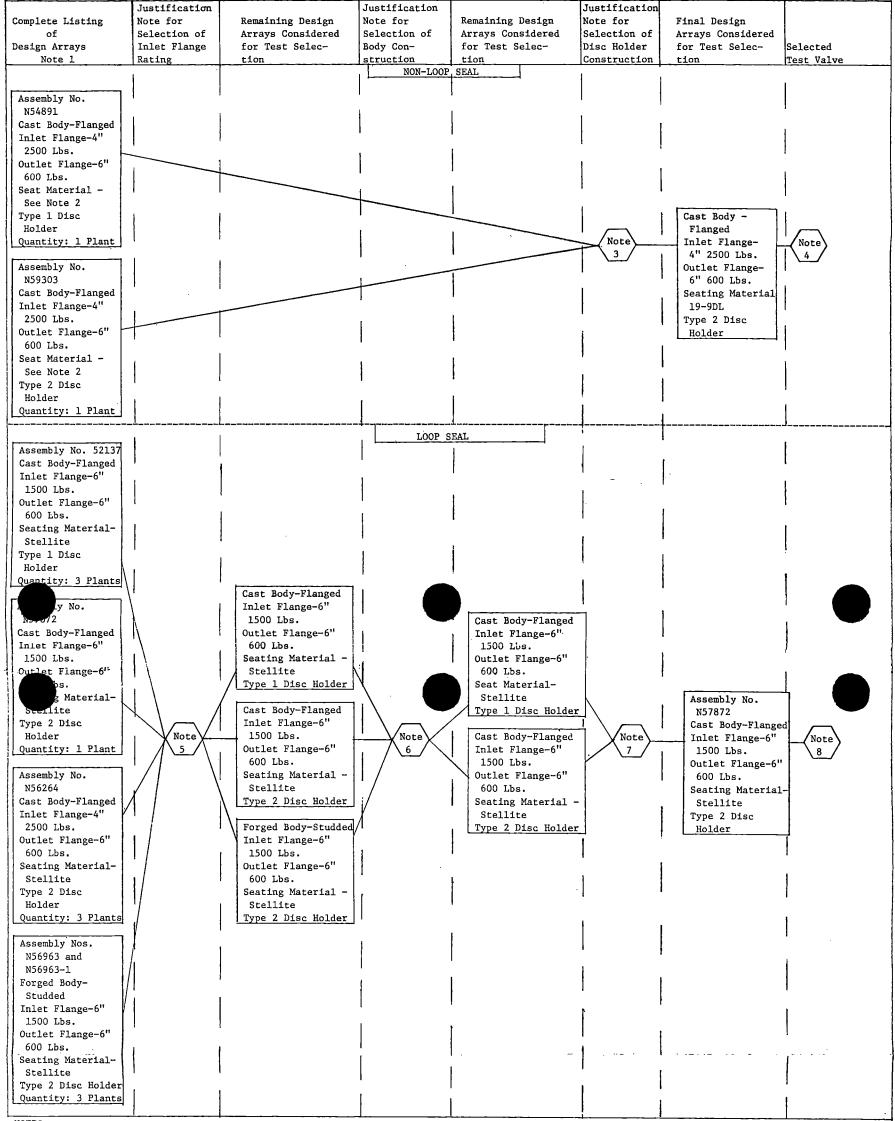
  DISC HOLDER CONSTRUCTION TYPES:

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



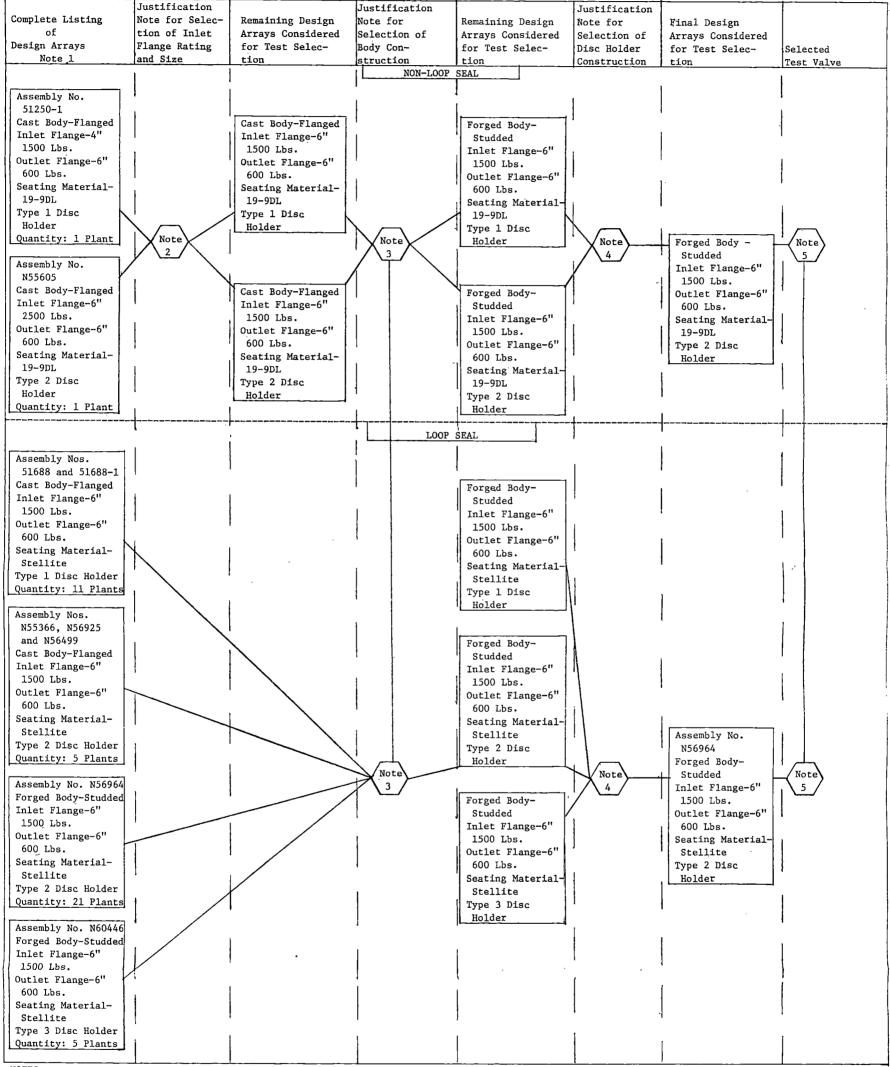
### NOTES:

- 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 Ml 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. 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



### 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.

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### JUSTIFICATION OF TEST VALVE DESIGN

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

CROSBY VALVE & GAGE COMPANY WRENTHAM, MASSACHUSETTS

	Justification	<del></del>	Justification	<del> </del>	Tr. 04262-44-4		<del></del>
Complete Listing	Note for	Remaining Design	Note for Selec-	Pomoining Decise	Justification Note for	Final Docina	
of	Selection of	Arrays Considered	tion of Inlet	Remaining Design		Final Design	
Design Arrays	Body Con-	1 -		Arrays Considered	Selection of	Arrays Considered	
	1 -	for Test Selec-	Flange Rating	for Test Selec-	Seating	for Test Selec-	Selected
Note 1	struction	tion	and Size	tion	Materials	tion	Test Valve
	Ì	ì	NON-LO	OP SEAL	1		
A	ŀ	1	•	1		ı	!
Assembly No.	i	1	1		•		1
N60582		1	1	ı	1	I	!
Cast Body-Flanged	1	ì	1	T.		1	
Inlet Flange-6"	1	_	1				
2500 Lbs.				l		·	i
Outlet Flange-8"			1			1	Ť
600 Lbs.		•		1			ļ
Seating Material-	_		1		'		1
19-9DL				1		Assembly No.	
Guiding-Stellite	1		1	I.	1	N61894	
on Stellite			<b>†</b>	1	1		
	1	1		[		Cast Body-Flanged	
Quantity: 2 Plants	4		_	_		Inlet Flange-6"	ĺ
<del> </del>	1					2500 Lbs.	
Assembly No.						Outlet Flange-8"	
N61894		1			Note	- 600 Lbs.	Note \
Cast Body-Flanged	1		1		2	Seating Design-	$\frac{3}{}$
Inlet Flange-6"				)		Flexi-Disc	
2500 Lbs.		-	i			Disc Insert-	
Outlet Flange-8"				1	j	SA637 Grade 718	1
600 Lbs.			1		•	Nozzle-SA182	
Seating Design-	<i>l</i> , /			1	1	Grade 316	•
Flexi-Disc	V \					Guiding-Stellite	ì
Disc Insert-SA637	1					on Stellite	
Grade 718			ŀ			on Sterrice	
Nozzle-SA182 Grade	1	,	1		•	1	1
						1	į.
316	1 \	1			ı		
Guiding-Stellite	. \			1		1	1
on Stellite	\		ĺ	1		•	ł
Quantity: 2 Plants	\				· F	1	ı
			- <del></del>			+	<del> </del> -
	\		L00	PSEAL		•	1
	' \	1		I	1		
Assembly No.	i \		NI .		1		
N60491		1	ightharpoons	'	1	<u> </u>	ı
Forged Body-	1	Cast Body-Flange	ed	Cast Body-Flange	i	Cast Body-Flanged	.1
Studded	, 1	Inlet Flange-6"		Inlet Flange-6"		Inlet Flange-6"	
Inlet Flange-6"	1 4	1500 Lbs.		2500 Lbs.		2500 Lbs.	,
1500 Lbs.	Note	Outlet Flange-8'	" Note	Outlet Flange-8"		Outlet Flange-8"	Note
Outlet Flange-8"	4	600 Lbs.	5	600 Lbs.		600 Lbs.	6
600 Lbs.	, \*	• • • • • • • • • • • • • • • • • • •		1 1		I I	: 🕓
		Seating Materia	<u>-</u>	Seating Material	-	Seating Material-	1
Seating Material-	1	Stellite		Stellite		Stellite	
Stellite	1	Guiding-Stellite	e	Guiding-Stellite		Guiding-Stellite	1
Guiding-Stellite		on Stellite	ᆛ	on Stellite	<b>-</b>	on Stellite	١,
on Stellite	1			1			1
Quantity: 2 Plants	1	1	\$ 1		I	1	1

### 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.



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### 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.



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### 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 Ml 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 (Ml. M. and N Orifice)

Studded inlet and outlet flange connections. See justification sheers 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 popula tion.

N Orifice - Represents largest valve size.



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### 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