



CHARLES CENTER • P.O. BOX 1475 • BALTIMORE, MARYLAND 21203

ELECTRIC ENGINEERING  
DEPARTMENT

April 29, 1982

Office of Nuclear Reactor Regulation  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Attn: Mr. Robert A. Clark, Chief  
Operating Reactors Branch #3  
Division of Licensing

Subject: Calvert Cliffs Nuclear Power Plant  
Units Nos. 1 & 2; Dockets Nos. 50-317 & 50-318  
Fire Protection

Reference: Letter from A. E. Lundvall, Jr. to R. A. Clark  
dated April 6, 1982.

Gentlemen:

Calculations submitted with the referenced letter have been amended at the request of Mr. Eberly. A copy of the revised calculations is provided as an enclosure to this letter. The conclusions of the original submittal are not affected by these changes.

If you have any further questions in this matter, please do not hesitate to ask.

Very truly yours,

R. C. L. Olson  
Principal Engineer

RCLO/smn  
Enclosure

cc: J. A. Biddison, Esquire  
G. F. Trowbridge, Esquire  
Mr. D. H. Jaffe

DESIGNATED ORIGINAL

Certified By

A006

ADD:

R. Eberly

CALCULATION TO DEMONSTRATE ADEQUACY OF WATER SUPPLY PRESSURE TO MOST REMOTE WATER CURTAIN (IE DEDICATED SPRINKLERS) SPRINKLER SYSTEMS. VERIFY THAT AT LEAST 100 PSI IS AVAILABLE.

### ASSUMPTIONS

- ① MOST REMOTE DEDICATED SPRINKLER IS AT DOORWAY TO CHARGING PUMP ROOM 115 FROM CORRIDOR 100 AT ELEVATION (-) 10'-0" OR THE DOORWAY TO ROOM 228 FROM CORRIDOR 200.
- ② WATER SUPPLY CONSISTS OF 1-2500 GPM AT 125 PSI RATED HEAD FIRE PUMP LOCATED IN THE PUMP HOUSE AT ELEVATION 45'-0"
- ③ TOTAL FLOW IS CONSERVATIVELY ASSUMED TO BE THREE ONLY ONE LOOP FROM PUMP HOUSE TO WEST SIDE OF THE AUXILIARY BUILDING FOR CONSERVATISM.

- ④ HAZEN & WILLIAMS FORMULA  $C = 120$

$$P = \frac{4.52 \times Q^{1.85}}{C^{1.85} \times d^{4.87}}$$

$$K = \frac{4.52}{C^{1.85} \times d^{4.87}}$$

$$P = K \times Q^{1.85}$$

- ⑤ THE DEDICATED SPRINKLER HEAD IS SUPPLIED FROM HYDRAULICALLY DESIGNED SPRINKLER PIPING SYSTEMS. IT IS CONSERVATIVE TO ANTICIPATE ALL SYSTEM SPRINKLER HEADS FLOWING SIMULTANEOUSLY AND ONE DEDICATED SPRINKLER HEAD AT THE DOORWAY IN THE ROOM OF FIRE ORIGIN. REALISTICALLY, FIVE SPRINKLERS ARE SUFFICIENT TO CONTROL THE MAJORITY OF FIRES.

## REFERENCES

- ① NFPA CODES : STD 13 - SPRINKLERS  
STD 14 - STANDARDS & HOSE
- ② CCNIPD INGS : 61-523 & 61-527-E (UNDERGROUND)  
60-347-E DENS (Aux. Bldg)
- ③ ASCO & PULTECH INGS - F.P.F. # 12-261 SH. 3  
AND HYDRAULIC CALC. FOR SYSTEM No  
115 (IE 451.6 GPM AT 92.71 PSI) & SYSTEM No 100  
(IE 726.9 GPM AT 87.71 PSI) & Sys No 200 (IE 1054 AT 119.1)
- ④ BECHTEL CALC. No 80-12 - FIRE PROTECTION SYSTEM
- ⑤ RGE CALCULATIONS FOR 74-1049 DATED 7/16/81  
PREPARED BY D.C. MARTINI.
- ⑥ VIKING HYDRAULIC TABLES, TABLE 1, PRESSURE  
LOSS (PSI/FT) OR  $\Delta P = L \times K \text{ FACTOR} \times Q^{1.85}$   
  
PIPE SIZE / FACTOR  
  

$$K_4 = 7.30 \times 10^{-7}$$

$$K_6 = 9.91 \times 10^{-8}$$

$$K_8 = 2.46 \times 10^{-8}$$

$$K_{12} = 3.45 \times 10^{-9}$$
- ⑦ CCNIPD FIRE PUMP PERFORMANCE CURVES  
PUMP No 54783 - DIESEL ENG. DRIVEN  
PUMP No 54782 - ELECTRIC MOTOR DRIVEN
- ⑧ GRINNELL PROTECTOSPRAY NOZZLE CUT SHEETS  
a) DATA SHEET  
b) DISCHARGE CURVES  
c) DISCHARGE VS PRESSURE TABULATION
- ⑨ SOUTHWEST RESEARCH INSTITUTE REPORT No 01-6763-  
201 DATED 2/82 - FIRE EVALUATION

CALCULATION - ELEVATION (-) 10'-0"

PIPING SUMMARY - SEE REF (4), SHEET 2  
 LENGTH OF PIPE:  
 FROM PUMPS TO UNIT 1/2 SPLIT

786' OF 12" CICL  
 50' OF 8" CICL  
 420' OF 8" CS

FROM SPLIT TO HS (-) 15-21 & SPRINKLER SYSTEM 100  
 (EAST RISER)

335.5' OF 6" CS  
 249' OF 4" CS  
 + 233' OF 4" CS FROM HS (-) 15-21 TO #100

FROM SPLIT TO HS (-) 10-22 & SPRINKLER SYSTEM 100  
 (WEST RISER)

53' OF 6" CS  
 135' OF 4" CS  
 + 51' OF 4" CS FROM HS (-) 10-22 TO #100

FROM REFERENCE (3)  $Q = 726.9$  GPM AT 87.7 PSI  
 FOR ALL HEADS FLOWING IN SYSTEM #100.

ADD TO THAT 55 GPM FOR ONE DEDICATED  
 SPRINKLER - SEE REFERENCE (8). TOTAL FLOW

WILL BE 781.9 GPM. THE CORRELATING  
 PRESSURE REQUIREMENT EQUALS  $\frac{Q_1}{Q_2} \sqrt{\frac{P_2}{P_1}}$

$$\therefore \left[ \frac{781.9}{726.9} \sqrt{87.7} \right]^2 = 101.5$$

FROM REFERENCE (7), THE PUMP CURVE  
 SHOWS WITH 781.9 GPM FLOWING, THE  
 PUMP DISCHARGE PRESSURE IS 146 PSI.

LOSSES TO THE RESPECTIVE AUTOMATIC  
 SPRINKLER SYSTEMS ARE CALCULATED  
 USING REFERENCE (6) TO DETERMINE  
 $\Delta P_{TOTAL}$  FROM PUMP HOUSE TO SYSTEM.

Elec. Eng.

TO SUPPLY SYSTEM #100 ASSUME FLOW  
SPLITS BETWEEN EAST & WEST RISERS -  
LOSSES FOR EAST RISER - EQUIV. PIPE  
 $2.8 \times 3355 \text{ FT OF } 6" \phi = 939.4 \text{ FT OF } 4" \phi$   
 $+ \frac{482.}{1421} \therefore 23\%$

VS LOSSES FOR WEST RISER - EQUIV PIPE  
 $2.8 \times 53 \text{ FT OF } 6" \phi = 148$   
 $\frac{1186}{334} \therefore 77\%$

$Q_{\text{TOTAL}} = 781.9 \text{ OR ROUND OFF} = 780 \text{ GPM}$   
 $Q_{\text{WEST}} = 75\% \times 780 = 585 \text{ GPM} - \text{WEST RISER}$   
 $Q_{\text{EAST}} = 25\% \times 780 = 195 \text{ GPM} - \text{EAST RISER}$

$Q_{\text{WEST}}^{1.85} = 131,600$   
 $Q_{\text{EAST}}^{1.85} = 17,240$   
 $Q_{\text{TOTAL}} = 224,050$   
 $\Delta P = L \times K \times Q^{1.85}$

$$\Delta P_T = \Delta P_{12} + \Delta P_P + \Delta P_G + \Delta P_U$$

WEST RISER PRESSURE LOSSES

$$\begin{aligned} \Delta P_{12} &= 786 (3.45 \times 10^{-9}) (224050) = 0.61 \text{ PSI} \\ \Delta P_P &= 470 (2.46 \times 10^{-8}) (224050) = 2.59 \text{ PSI} \\ \Delta P_G &= 53 (9.91 \times 10^{-8}) (131,600) = 0.69 \\ \Delta P_U &= 186 (7.30 \times 10^{-7}) (131,600) = 17.86 \\ &\quad \underline{21.75 \text{ PSI}} \end{aligned}$$

EAST RISER PRESSURE LOSSES:

$$\begin{aligned} \Delta P_{12} &= 0.61 \text{ PSI} \\ \Delta P_P &= 2.59 \\ \Delta P_G &= 335.5 (9.91 \times 10^{-8}) (17240) = \underline{5.73} \text{ 0.57 PSI} \\ \Delta P_U &= 482. (7.30 \times 10^{-7}) (17240) = 6.06 \\ &\quad \underline{14.99} \text{ 9.83 PSI} \end{aligned}$$

EAST/WEST  $\Delta P = \underline{6.75} \text{ 11.92 PSI}$

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Project -

CONPS - FIRE PROTECTION

Est. No. Rev #1, 4/26  
Eng'r *PH* Date 2/31

Elec. Eng.

REVISE FLOW SPLIT TO REDUCE  $\Delta P$ 

$$Q_T = 780$$

$$Q_{WEST} = \cancel{70\% \times 780 = 546} \quad 63\% \times 780 = 490$$

$$Q_{EAST} = \cancel{30\% \times 780 = 234} \quad 37\% \times 780 = 290$$

$$Q_{WEST}^{1.85} = \cancel{115,140} \quad 94,814$$

$$Q_{EAST}^{1.85} = \cancel{24,350} \quad 35,930$$

WEST RISER

$$\Delta P_{12} = 786 (3.45 \times 10^{-9}) (224,050) = 0.61 \text{ PSI}$$

$$\Delta P_8 = 470 (2.46 \times 10^{-8}) (224,050) = 2.59$$

$$\Delta P_6 = 53 (9.91 \times 10^{-8}) (\cancel{115,140}) = \cancel{5.6} + 0.50$$

$$\Delta P_4 = 186 (7.30 \times 10^{-7}) (\cancel{115,140}) = \cancel{15.67} + 12.87$$

$$\frac{14.48}{16.57}$$

EAST RISER

$$\Delta P_{12} = (\text{ABOVE}) = 0.61$$

$$\Delta P_8 = (\text{ABOVE}) = 2.59$$

$$\Delta P_6 = 335.5 (9.91 \times 10^{-8}) (\cancel{24,350}) = \cancel{8.10} + 1.20$$

$$\Delta P_4 = 182 (7.30 \times 10^{-7}) (\cancel{24,350}) = \cancel{8.57} + 12.63$$

$$\text{EAST/WEST } \Delta P = \frac{17.03 - 16.57}{14.87 - 14.48} = 0.39 \text{ PSI}$$

WHICH IS ACCEPTABLE

Now VERIFY THAT SYSTEM 100 IS MOST REMOTE HYDRAULICALLY VS SYSTEM 115. FROM REFERENCE (3) FLOW TO SYSTEM 115 IS 451.6 AT 92.71 PSI + 55 GPM FOR THE DEDICATED HEAD AT THE DOORWAY GIVES A FLOW REQUIREMENT OF 506.6 GPM AT A CORRECTED PRESSURE EQUAL TO  $\frac{Q_1 \sqrt{P_2}}{Q_2 \sqrt{P_1}}$

Computed by

LPH

Date

2/21

Checked by

JAY

Date 4-2-82 Sheet

5 of 11

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Project -

CCNPP - FIRE PROTECTION

Est. No.

Eng'r RPH Date 2/3/

$$\therefore \left[ \frac{506.6}{451.6} \sqrt{92.71} \right]^2 = P_1 = 116.67 \text{ PSI}$$

PIPING SUMMARY - SEE SHEET 3 OF THIS CALCULATION.

TO SUPPLY SYSTEM 115 IT IS NECESSARY TO ADD APPROXIMATELY 138' OF 4" Ø CS TO CALCULATION SHOWN ON SHEET 3 OF 11

∴ FOR CALCULATION OF SYSTEM 115:  
 WEST RISER  $\Delta P_4 = 186 + 138 = 324 \text{ FT}$   
 EAST RISER  $\Delta P_4 = 482 + 138 = 620 \text{ FT}$

$$Q_{\text{TOTAL}} = 506.6$$

$$Q_{\text{WEST}} = 70\% \times 506.6 = 355$$

$$Q_{\text{EAST}} = 30\% \times 506.6 = 152$$

$$Q_{\text{WEST}}^{1.85} = 52,230$$

$$Q_{\text{EAST}}^{1.85} = 10,874$$

$$Q_{\text{TOTAL}}^{1.85} = 100,220$$

$$\Delta P = L \times K \times Q^{1.85}$$

$$\Delta P = \Delta P_{12} + \Delta P_8 + \Delta P_6 + \Delta P_4$$

WEST RISER

$$\Delta P_{12} = 786(3.45 \times 10^{-9})(100,220) = 0.27$$

$$\Delta P_8 = 470(2.46 \times 10^{-8})(100,220) = 1.16$$

$$\Delta P_6 = 53(9.91 \times 10^{-8})(52,230) = 0.27$$

$$\Delta P_4 = 324(7.3 \times 10^{-7})(52,230) = 12.35$$

$$\underline{14.05}$$



Project -

CONV - Free Protection

Est. No.

REV 1, 4/26/82

Eng'r

Date

2/21

Elec. Eng.

EAST RISER

$$\Delta P_{12} = (\text{ABOVE})$$

$$= 0.27$$

$$\Delta P_8 = (\text{ABOVE})$$

$$= 1.16$$

$$\Delta P_6 = 335.5 (9.91 \times 10^{-8}) (10,874) = \underline{\underline{3.64}} \quad 0.36$$

$$\Delta P_4 = 620 (7.70 \times 10^{-7}) (10,874) = \underline{\underline{4.92}}$$

$$9.96 \quad 6.71$$

$$7.34$$

$$\text{EAST/WEST } \Delta P = \underline{\underline{4.69 \text{ PSI}}}$$

REVISE FLOW SPLIT TO REDUCE  $\Delta P$ 

$$\text{TEST: } Q_{\text{EAST}}^{1.85} 10,874 \times \frac{18/10}{18/10} = 13,048 \quad \text{or } 207 \text{ PSI/GPM}$$

$$Q_{\text{TOTAL}} = 50 \text{ GPM} \therefore Q_{\text{TOTAL}}^{1.85} = 100,220 \text{ GPM}^{1.85}$$

$$Q_{\text{WEST}} = 336 \text{ GPM} \quad Q_{\text{WEST}}^{1.85} = 47,177 \text{ GPM}^{1.85}$$

$$Q_{\text{EAST}} = 170 \text{ GPM} \quad Q_{\text{EAST}}^{1.85} = 13,370 \text{ GPM}^{1.85}$$

WEST RISER

$$\Delta P_{12} + \Delta P_8 = 1.43 \text{ PSI}$$

$$\Delta P_6 = 53 (9.91 \times 10^{-8}) \left( \frac{38250}{47,177} \right) = \underline{\underline{0.20}}$$

$$\Delta P_4 = 324 (7.70 \times 10^{-7}) \left( \frac{38250}{47,177} \right) = \underline{\underline{9.96}}$$

$$12.84$$

$$10.68$$

EAST RISER

$$\Delta P_{12} + \Delta P_8 = 1.43 \text{ PSI}$$

$$\Delta P_6 = 335.5 (9.91 \times 10^{-8}) \left( \frac{19,255}{47,177} \right) = \underline{\underline{0.64}}$$

$$\Delta P_4 = 620 (7.70 \times 10^{-7}) \left( \frac{19,255}{47,177} \right) = \underline{\underline{2.71}}$$

$$3.35$$

$$10.78$$

$$\text{EAST/WEST } \Delta P = \underline{\underline{0.10 \text{ PSI}}}$$

WHICH IS ACCEPTABLE. NO FURTHER CORRECTION IS REQUIRED.



Project -

CNIP - FIRE PROTECTION

Est. No. REV #1, 4/26  
Eng'r RPH Date 3/31

Elec. Eng.

THE FIRE PUMPS ARE LOCATED AT ELEVATION 45'-0" WHILE SYSTEMS 100 AND 115 ARE LOCATED AT ELEVATION(-) 10'-0". THE DIFFERENCE IN ELEVATION WILL REDUCE (PIPE FRICTION) LOSSES BY  $55 \text{ FT} \times 0.433 \text{ PSI/FT} = 23.81 \text{ PSI}$ .

THE NET PRESSURE AVAILABLE AT SYSTEM 100 ALARM CHECK VALVE, WITH ALL SPRINKLER HEADS FLOWING INCLUDING THE DEDICATED HEAD AT THE DOORWAY, EQUALS THE NET DISCHARGE PRESSURE OF THE FIRE PUMP = 146 PSI, PLUS THE NET PRESSURE GAIN FOR DIFFERENCE IN ELEVATION = 23.81 PSI, LESS FRICTION LOSSES IN PIPING FROM THE PUMP DISCHARGE TO SYSTEM 100 = ~~14.87~~ <sup>17.03</sup> ~~147.94~~ <sup>152.78</sup> PSI.

$$\text{OR } 146 + 23.81 - 14.87 = 149.94 \text{ PSI}$$

SIMILARLY, THE NET PRESSURE AVAILABLE TO SYSTEM 115 ALARM CHECK VALVE IS:

$$\text{OR } 147 + 23.81 - 10.78 = 160.03 \text{ PSI}$$

SYSTEM 100 REQUIRES 101.5 PSI VS AVAILABLE HEAD PRESSURE ~~149.94~~ 152.78 PSI

SYSTEM 115 REQUIRES 116.67 VS AVAILABLE HEAD PRESSURE ~~157.97~~ 160.03 PSI

∴ AT ELEVATION (-) 10'-0" HEAD PRESSURES EXCEED 100 PSI TO MOST REMOTE SPRINKLER HEADS AT DOORWAYS. (SEE SUBSEQUENT CALCULATIONS FOR ELEVATION 5'-0" SYSTEMS.)

Elec. Eng.

Project - CINCP - FIRE PROTECTION Est. No.             
CALCULATION - ELEVATION 5'-0" Eng'r RPH Date 2/31  
 VERIFY THAT SYSTEMS AT ELEVATION 5'-0" ARE  
 NOT MORE HYDRAULICALLY REMOTE THAN ELEV(-)10'-0"  
PIPING SUMMARY - COMPILED FROM 60-347-E  
TAKE-OFFS FOR SYSTEMS 200 & 228.

NORTH HEADER - SUPPLY FROM WEST SIDE OF  
AUXILIARY BUILDING (18 SINGLE LOOP)

FROM AUX BUILD SPLIT TO SYSTEM 228

338 FT OF 6" Φ CS

Q<sub>228</sub> = 1076 @ 93 PSI

SOUTH HEADER - SUPPLY FROM WEST SIDE OF  
AUXILIARY BUILDING ONLY.

FROM AUX BLDG SPLIT TO SYSTEM 200

149 FT OF 6" Φ CS

62 FT OF 4" Φ CS

Q<sub>200</sub> = 1054 GPM @ 119.1 PSI

FROM REFERENCE (3), SHEET 2, SYSTEM 200  
IS MOST REMOTE HYDRAULICALLY:

SYSTEM 200 Q = 1054 GPM @ 119.1 PSI WITH  
ALL HEADS FLOWING. ADD 55 GPM FOR DEDICATED  
HEADS AT ROADWAY - Q<sub>TOTAL</sub> = 1054 + 55 = 1109 GPM

$$\frac{Q_1}{Q_2} = \frac{\sqrt{P_1}}{\sqrt{P_2}} \quad \therefore \left( \frac{1109}{1054} \sqrt{119.1} \right)^2 = P = 131.85$$

VERIFY ONE SUPPLY LOOP IS ADEQUATE.

$$Q = 1109 \text{ GPM} \quad Q^{1.85} = 361,400$$

$$\Delta P_2 = 786 (3.45 \times 10^{-9}) (361,400) = 0.98$$

$$\Delta P_8 = 470 (2.46 \times 10^{-8}) (361,400) = 4.18$$

$$\Delta P_6 = 149 (9.91 \times 10^{-8}) (361,400) = 5.34$$

$$\Delta P_4 = 62 (7.3 \times 10^{-7}) (361,400) = 16.36$$

26.86 PSI

DIFFERENCE IN ELEVATION WITH FIRE PUMPS  
AT ELEV 45'-0" IS CORRIDOR #200 AT ELEV  
5'-0" REDUCES HEAD LOSS 40 FT X .433#/FT OR 17.32

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Project -

KNPP - FIRE PROTECTION

Est. No.

Eng'r RPH Date 3/31

FROM PUMP CURVE REFERENCE (7),  
SHEET 2, DISCHARGE PRESSURE IS 145 PSI  
WITH 1109 GPM FLOWING.

145 PSI AT PUMP, ELEV 45-0  
LESS 28.86 PSI FRICTION LOSS IN PIPING  
ADD 17.32 PSI HEAD GAIN WITH SYSTEM #200  
AT ELEV 5-0

∴ 133.46 PSI IS AVAILABLE VS 131.85 PSI  
REQUIRED BY SYSTEM #200

NOTE: NO CREDIT IS TAKEN FOR SYSTEM  
GRID. FRICTION LOSSES WOULD BE  
REDUCED OVER 50% IF MULTIPLE  
FLOW PATHS ARE CALCULATED.

THE GRINNELL PROTECTOSPRAY NOZZLES  
UTILIZED AS DEDICATED SPRINKLER  
HEADS AT DOORWAYS ARE SOLID  
CONE PATTERN, U/L APPROVED  
WATERSRAY NOZZLES TYPE EA-1, 95°  
DISCHARGE PATTERN, 175°F RATED WITH  
1/2" ORIFICE. THE VENDOR DESCRIPTION  
AND DISCHARGE CURVE ARE ATTACHED.  
FOR "VOLUME VS PRESSURE" RELATIONSHIP  
USE K FACTOR = 5.56

∴ SYSTEM #200 APPEARS TO BE THE  
MOST HYDRAULICALLY DEMANDING  
SYSTEM SHOWN ON THE WATER  
CURTAIN LISTING SUBMITTED BY  
LETTER DATED FEBRUARY 18, 1982 FROM  
A.E. LUNOVALL, JR TO ROBERT A. CLARK

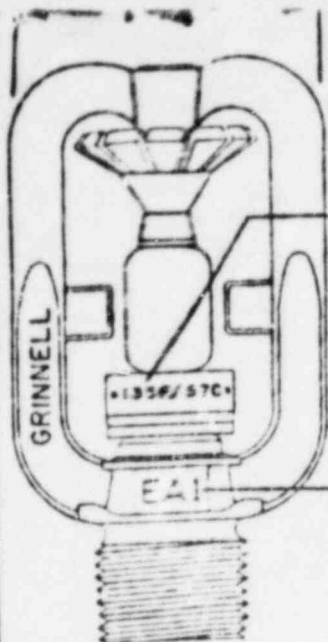
As shown by Reference (9), throughout the duration of the fire test of the dedicated sprinkler at doorway water curtain, inlet pressure was maintained at 100 PSI. The fire endurance test demonstrated water curtains can provide acceptable 3 hour fire resistance at doorways.

### CONCLUSIONS

More than 100 PSI is available to supply the most remote dedicated sprinkler head at a doorway water curtain.

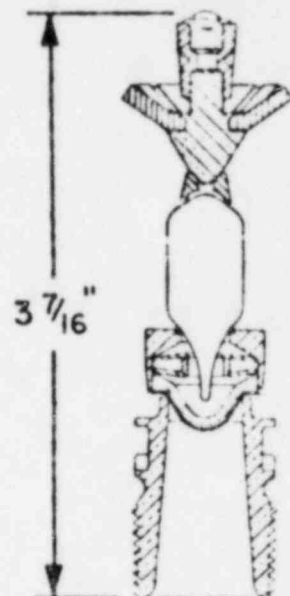
### ATTACHMENTS

- 1) CCNPP Fire Pump Performance Curves (Reference (7))
- 2) GRINNELL PROTECTOSPRAY Nozzle Cut Sheets (Reference (8))



TEMPERATURE RATING.

SIZE STAMPED ON REVERSE SIDE OF  $\frac{3}{8}$ " &  $\frac{1}{4}$ " ORIFICE NOZZLES.



TEMPERATURE RATING & COLOR CODE:

135° - PLAIN	325° - RED
250° - BLUE	400° - GREEN
	500° - ORANGE

INCLUDED ANGLE OF DISCHARGE PATTERN:

65°	80°	110°
125°	140°	160°
		180°

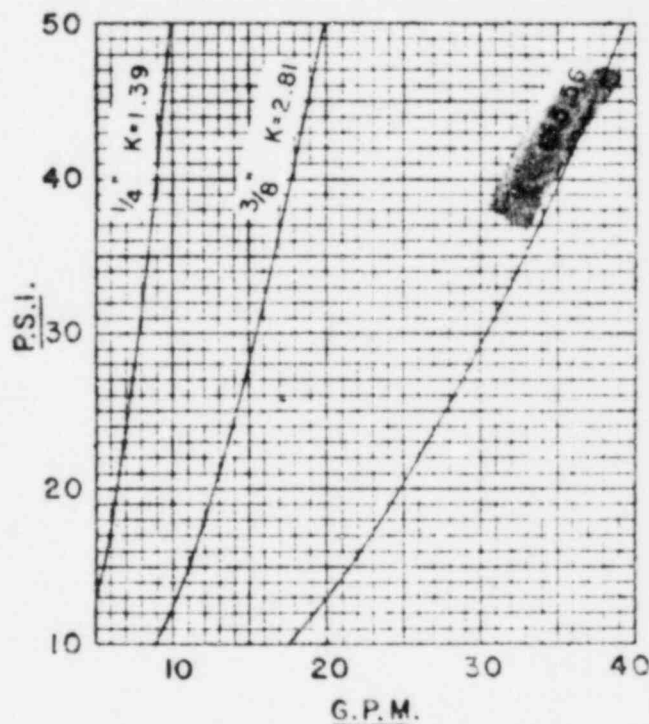
ORIFICE SIZE:  $\frac{3}{8}$ " OR  $\frac{1}{4}$ ".

PIPE THREAD CONNECTION:  $\frac{1}{2}$ " NPT.

MATERIAL & FINISH: BRASS - PLAIN, LEAD COATED OR CHROME PLATED.  
FURNISHED WITH PLAIN FINISH UNLESS OTHERWISE SPECIFIED.

TO ORDER SPECIFY:

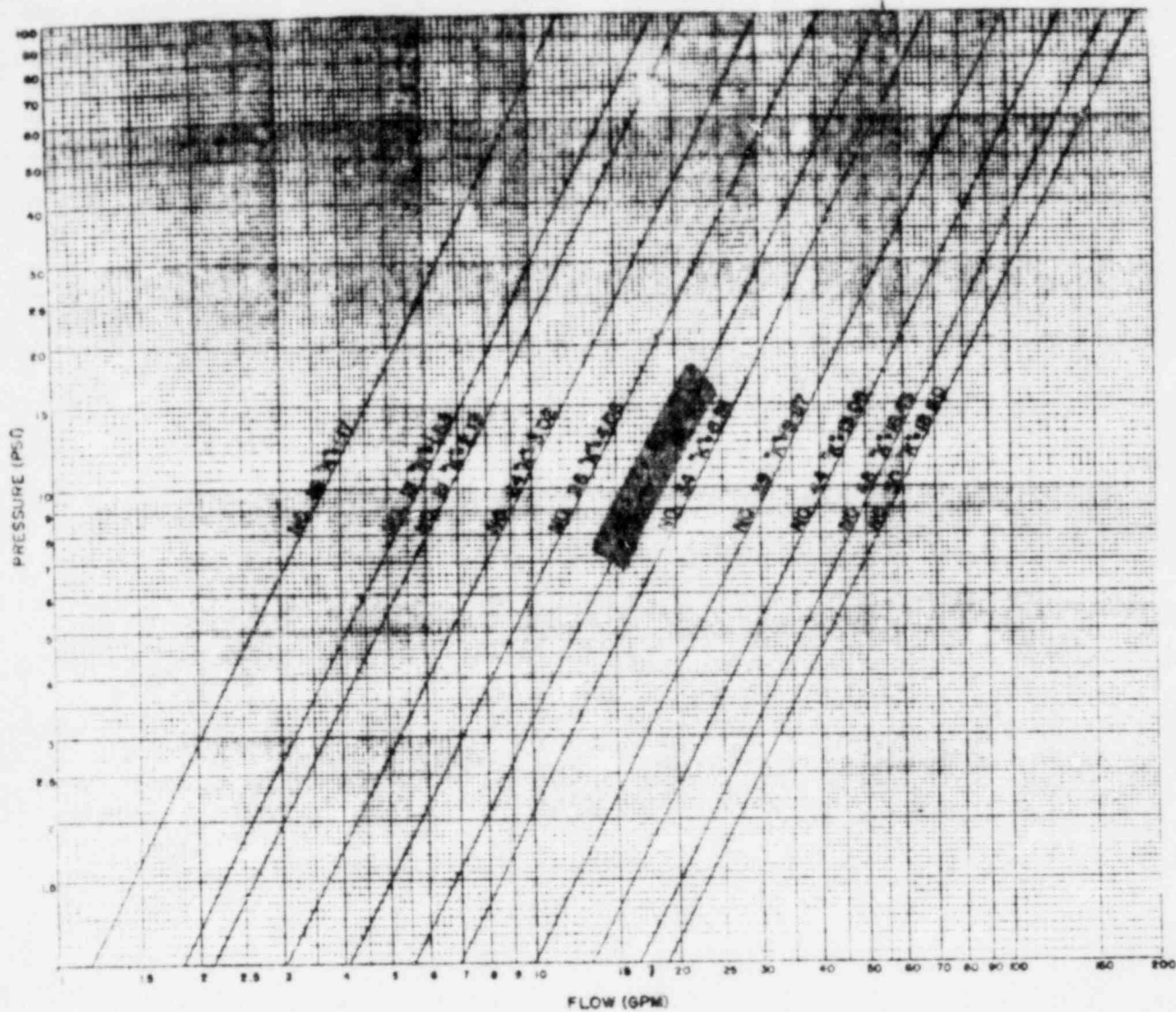
GRINNELL (ORIFICE SIZE) (TEMPERATURE RATING) (SPECIFY FINISH IF OTHER THAN PLAIN BRASS IS REQUIRED) PROTECTOSPRAY NOZZLE, TYPE EA-1 (ANGLE OF DISCHARGE PATTERN). - - - - - (QUANTITY)



DISCHARGE CURVE

# GRINNELL PROTECTOSPRAY NOZZLE TYPE EA-1





NOTE:  
 $\frac{1}{4}$ ,  $\frac{3}{8}$ , &  $\frac{1}{2}$  EA-1 PROTECTOSPRAY NOZZLES  
 HAVE THE SAME DISCHARGE AS SPRINKLERS

## GRINNELL PROTECTOSPRAY NOZZLES DISCHARGE CURVES

## DISCHARGE IN GALLONS PER MINUTE

PSI	No. 16	No. 18	No. 21	No. 24	No. 28	No. 34	No. 39	No. 44	No. 48	No. 50
1	1.2	1.8	2.1	3.0	4.1	5.6	7.0	10.0	13.1	18.8
2	1.7	2.6	3.0	4.3	5.8	7.9	9.8	14.2	18.5	26.6
3	2.0	3.2	3.7	5.2	7.1	9.6	12.3	17.3	22.7	32.6
4	2.3	3.7	4.3	6.0	8.2	11.1	13.8	19.9	26.2	37.6
5	2.6	4.1	4.8	6.8	9.1	12.4	15.5	22.3	29.3	42.2
6	2.9	4.5	5.2	7.4	10.0	13.6	16.9	24.4	32.1	46.1
7	3.1	4.8	5.6	8.0	10.8	14.7	18.3	26.4	34.6	49.8
8	3.3	5.2	6.0	8.6	11.6	15.7	19.5	28.2	37.1	53.3
9	3.5	5.5	6.4	9.1	12.3	16.7	20.7	29.9	39.3	56.5
10	3.7	5.8	6.7	9.6	13.0	17.6	21.8	31.5	41.4	59.5
11	3.9	6.1	7.1	10.0	13.6	18.4	22.9	33.1	43.4	62.4
12	4.1	6.3	7.4	10.5	14.2	19.2	23.9	34.6	45.4	65.2
13	4.2	6.6	7.7	10.9	14.7	20.0	24.9	36.0	47.2	67.9
14	4.4	6.9	8.0	11.3	15.3	20.8	25.8	37.3	49.0	70.4
15	4.5	7.1	8.3	11.7	15.8	21.5	26.7	38.6	50.7	72.9
16	4.6	7.3	8.5	12.1	16.3	22.2	27.6	39.9	52.4	75.3
17	4.8	7.5	8.8	12.5	16.8	22.9	28.5	41.1	54.0	77.6
18	5.0	7.8	9.1	12.8	17.3	23.6	29.3	42.3	55.5	79.8
19	5.1	8.0	9.3	13.2	17.8	24.2	30.1	43.5	57.0	82.0
20	5.2	8.2	9.5	13.5	18.3	24.8	30.9	44.6	58.5	84.2
21	5.4	8.4	9.8	13.8	18.7	25.4	31.6	45.7	60.0	86.3
22	5.5	8.6	10.0	14.2	19.2	26.0	32.4	46.8	61.5	88.4
23	5.6	8.8	10.2	14.5	19.6	26.6	33.2	47.9	62.8	90.2
24	5.7	9.0	10.4	14.8	20.0	27.2	33.9	48.9	64.1	92.2
25	5.9	9.2	10.7	15.1	20.4	27.8	34.6	49.9	65.4	94.1
26	6.0	9.3	10.9	15.4	20.8	28.4	35.2	50.9	66.7	95.0
27	6.1	9.5	11.1	15.7	21.2	28.9	35.9	51.9	68.0	97.8
28	6.2	9.7	11.3	16.0	21.6	29.4	36.6	52.8	69.3	99.6
29	6.3	9.9	11.5	16.3	22.0	29.9	37.2	53.7	70.5	101.3
30	6.4	10.0	11.7	16.5	22.4	30.4	37.8	54.6	71.7	103.0
31	6.5	10.2	11.9	16.8	22.8	30.9	38.5	55.5	72.9	104.8
32	6.6	10.4	12.0	17.1	23.1	31.4	39.1	56.4	74.0	106.5
33	6.7	10.5	12.2	17.4	23.5	31.9	39.7	57.3	75.2	108.1
34	6.8	10.7	12.4	17.6	23.8	32.4	40.3	58.2	76.4	109.7
35	6.9	10.8	12.6	17.9	24.2	32.9	40.9	59.0	77.5	111.3
36	7.0	11.0	12.8	18.1	24.5	33.4	41.5	59.9	78.5	112.8
37	7.1	11.1	13.0	18.4	24.8	33.8	42.0	60.7	79.6	114.3
38	7.2	11.3	13.1	18.6	25.2	34.3	42.6	61.5	80.7	115.9
39	7.3	11.4	13.3	18.9	25.5	34.7	43.1	62.3	81.8	117.5
40	7.4	11.6	13.5	19.1	25.8	35.2	43.7	63.0	82.8	119.0
41	7.5	11.7	13.6	19.3	26.2	35.6	44.2	63.8	83.9	120.5
42	7.6	11.9	13.8	19.6	26.5	36.0	44.8	64.6	84.9	122.0
43	7.7	12.0	14.0	19.8	26.8	36.4	45.3	65.4	85.9	123.4
44	7.8	12.1	14.1	20.0	27.1	36.9	45.8	66.1	86.9	124.8
45	7.9	12.3	14.3	20.2	27.4	37.3	46.4	66.9	87.8	126.1
46	7.9	12.4	14.5	20.5	27.7	37.7	46.9	67.6	88.8	127.5
47	8.0	12.5	14.7	20.7	28.0	38.1	47.4	68.3	89.8	129.9
48	8.1	12.7	14.8	21.0	28.3	38.5	47.9	69.0	90.7	130.3
49	8.2	12.8	14.9	21.2	28.6	38.9	48.4	69.8	91.6	131.7
50	8.3	12.9	15.1	21.4	28.9	39.3	48.9	70.5	92.6	133.0
51	8.4	13.1	15.2	21.6	29.2	39.7	49.4	71.2	93.5	134.3
52	8.4	13.2	15.4	21.8	29.4	40.1	49.9	71.9	94.4	135.6
53	8.5	13.3	15.5	22.0	29.7	40.5	50.4	72.6	95.3	136.9
54	8.6	13.4	15.7	22.2	30.0	40.8	50.8	73.3	96.2	138.2
55	8.7	13.6	15.8	22.4	30.3	41.2	51.2	74.0	97.1	139.5
56	8.8	13.7	15.9	22.6	30.6	41.6	51.7	74.6	98.0	140.8
57	8.8	13.8	16.1	22.8	30.8	42.0	52.1	75.3	98.8	141.0
58	8.9	13.9	16.2	23.0	31.1	42.3	52.6	76.0	99.7	143.2
59	9.0	14.1	16.4	23.2	31.4	42.7	53.1	76.6	100.6	144.5
60	9.1	14.2	16.5	23.4	31.6	43.1	53.5	77.2	101.4	145.8
62	9.2	14.4	16.8	23.8	32.2	43.8	54.4	78.5	103.0	148.1
64	9.4	14.6	17.0	24.2	32.7	44.5	55.3	79.7	104.6	150.5
66	9.5	14.9	17.3	24.6	33.2	45.2	56.1	81.0	106.2	152.9
68	9.7	15.1	17.6	24.9	33.7	45.9	57.0	82.2	107.9	155.3
70	9.8	15.3	17.8	25.3	34.2	46.5	57.8	83.4	109.5	157.6
72	9.9	15.5	18.1	25.6	34.6	47.2	58.6	84.6	111.0	159.8
74	10.1	15.7	18.3	26.0	35.1	47.9	59.4	85.8	112.5	161.9
76	10.2	15.9	18.5	26.4	35.6	48.5	60.2	86.9	114.0	164.0
78	10.3	16.2	18.8	26.7	36.1	49.1	61.0	88.0	115.5	166.1
80	10.5	16.4	19.1	27.0	36.6	49.8	61.8	89.1	117.0	168.1
82	10.6	16.6	19.3	27.4	37.0	50.4	62.5	90.3	118.5	170.2
84	10.7	16.8	19.5	27.7	37.4	51.0	63.3	91.4	120.0	172.3
86	10.9	17.0	19.8	28.0	37.9	51.6	64.1	92.5	121.4	174.4
88	11.0	17.2	20.0	28.4	38.3	52.2	64.9	93.5	122.8	176.5
90	11.1	17.4	20.2	28.7	38.7	52.8	65.6	94.5	124.1	178.5
92	11.2	17.6	20.4	29.0	39.2	53.4	66.3	95.6	125.4	180.3
94	11.4	17.7	20.7	29.3	39.6	54.0	67.0	96.6	126.8	182.3
96	11.5	17.9	20.9	29.6	40.0	54.5	67.7	97.6	128.1	184.2
98	11.6	18.1	21.1	29.9	40.4	55.0	68.4	98.7	129.5	186.1
100	11.7	18.3	21.3	30.2	40.8	55.5	69.1	99.7	130.8	188.0



# CALVERT COFFEE NUCLEAR PLANT ELECTRIC FIRE PUMP

PUMP NO. 15221-054702 STAGES 1 SIZE FIGURE 8" 5828F  
 TESTED LOW 1500 RPM TO 1000 RPM REFERENCE C1 IMPELLER DESIAN  
 PLOTTED JB 6-30-61 DRIVER ENG 283 IMP DIA 18 1/2"  
 TOTAL SUCTION 6.9 FT MAXIMUM ON TEST R.P.M. 1770

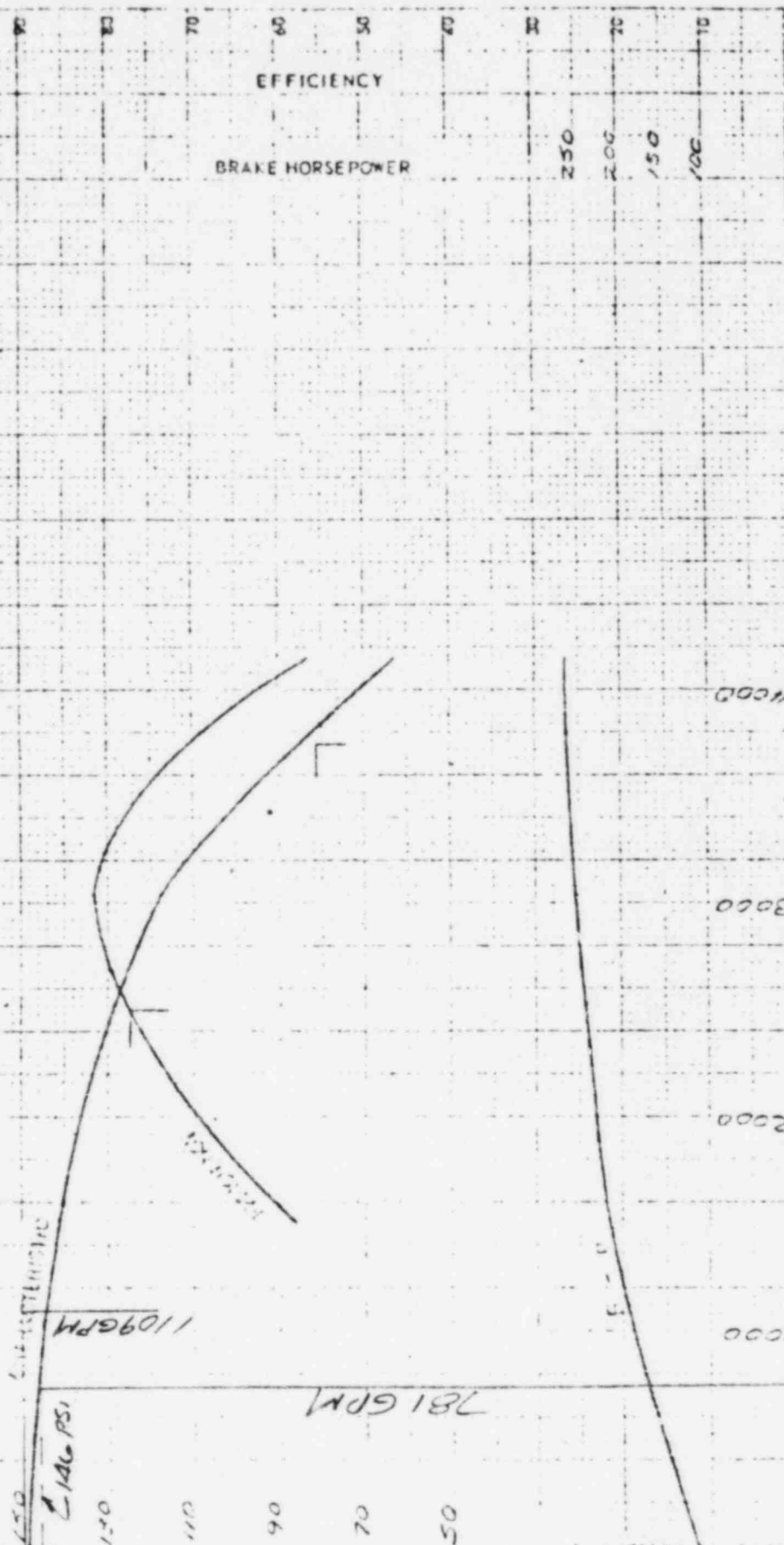
## CERTIFIED PUMP PERFORMANCE CURVE

Certified Copy

ENGR.

DATE

*[Signature]*  
6/30/61



U.S. GALLONS PER MINUTE

REF #7