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Operating Reactors Branch #2
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

License No. DPR-35
Docket No. 50-293

Additional Information on
Block Walls (IE Bulletin 80-11)

Dear Sir:

The attachment to this submittal contains responses to a request for further information submitted to Boston Edison concerning IE Bulletin 80-11, and is the result of an NRC tour of Pilgrim Nuclear Power Station conducted June 16, and 17, 1982.

The following responses address five issues. The responses to the remaining requests are being developed, and will be the subject of a submittal in the near future.

We believe these responses satisfy your request for futher information. If, after reviewing this submittal, you require additional information regarding this issue, please contact us.

Very truly yours,

avmorisi

A001

Attachment

Request 1: Document the shear stresses for the safety related shear walls.

Allowable Stresses: OBE = 33 psi (minimum) 73 psi (maximum) SSE = 50 psi (minimum) 110 psi (maximum)

	Shear Stresses		
Wall No.	Actual OBE (psi)	Actual SSE (psi)	Allowable SSE (psi)
63.1	21.70	43.40	50.0
63.5	10.85	21.70	50.0
64.4/65.8	15.40	30.80	50.0
64.5	22.00	44.00	80.0
64.6/64.7/ 65.0(NS)	13.83/22.2/ 14.3	27.66/44.6/ 28.7	50.0/80.0/ 50.0
64.6/64.7(EW)	8.41/15.2	16.82/30.3	50.0/80.0
64.8/65.1	24.0/11.9	47.0/23.8	50.0
65.0/65.1	14.3/23.8	28.7/46.6	50.0
65.4	10.24	20.49	110.0
65.7	10.31	20.62	50.0
65.13	21.30	35.30	85.5
65.17	17.38	34.76	50.0
65.18/65.19	18.80	37.60	50.0
65.21	13.70	27.30	50.0
66.0	11.30	22.50	50.0
66.2	8.17	16.30	50.0
66.5/66.6	7.70	15.40	50.0
66.7	16.78	33.56	50.0
66.12	24.60	49.10	50.0
66.10(EW)	2.96	5.93	50.0
66.10/68.5(NS)	16.84	33.70	50.0

Request 1 (con't)

	Shear Stresses		
Wall No.	Actual OBE (psi)	Actual SSE (psi)	Allowable SSE (psi)
66.11	22.00	44.40	50.0
67.1	7.10	14.20	50.0
67.2	16.80	33.60	50.0
68.0	23.00	46.60	80.0
68.1	13.00	26.00	50.0
68.2	4.15	8.31	50.0
68.3	2.50	4.99	76.4
68.4	4.20	8.40	50.0
185.3/185.4	14.0/15.2	28.1/30.5	50.0
188.8	17.20	34.30	50.0
188.9	14.70	29.40	50.0

Request 2: Check the effect of block pull-out if only the horizontal joints are used to resist shear.

A comparison of the old pull-out values and the revised pull-out values are shown below:

Allowable Pull-Out Shears

Reinforced Masonry Wall Cases	A & B		C & D	
Wall Thickness	8"	12"	8"	12"
Old OBE	9735	14850	4895	6545
Old SSE	14691	22410	7387	9877
Revised OBE	6545	9955	3850	5308
Revised SSE	9877	15023	5810	8009
Reduction %	67	67	78	81

A reduction in the effective shear area for shield walls resulted in a 33% decrease in the pull-out loads. For partition walls, it is 19% and 22% for 8" and 12" walls, respectively.

The masonry wall calculations for pull-out were reviewed and none of the values exceeded the reduced allowables.

Request 3: Verify the use of the fourth order Branson Formula for computing effective stiffness.

A study was performed to show that Branson Formula is appropriate to use for computing the effective stiffness of concrete block walls. Hand and computer analyses were compared to test results. The test results were obtained from report - Results of Variation of "b" or Effective Width in Flexure in Concrete Block Panels, Masonry Institute of America, reprinted in 1971.

Both third and fourth order Branson Formulas were used for the analysis per the recommendation of ACI Committee 435, articles ACI 435.6R-74 and ACI 435.2R-66. Displacements were calculated using the same pressure loads as the test report. For the third order formula, the displacements were calculated by hand. For the fourth order formula, the displacements were calculated using the SAP IV computer program.

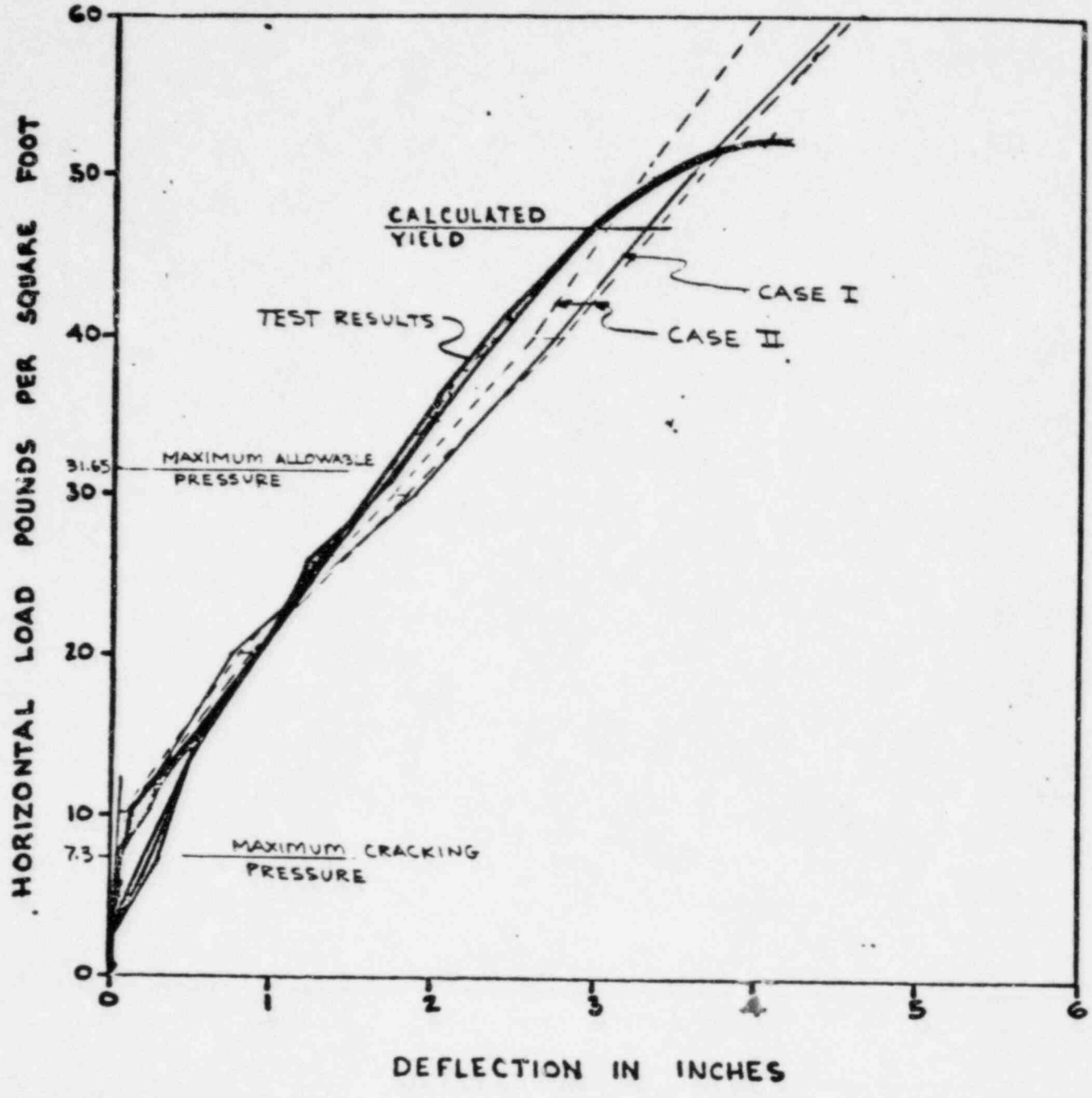
The results show that the Branson Formulas predict the displacements close to the test results. As the moment approaches the allowable, Branson's Formulas are conservative by producing larger displacements than the test results show (see Figure 1).

Comparison of Displacements

Pressure (PSF)	Case I Δ (Third Power)	Case II* Δ (Fourth Power)		From Test Report Δ
		Middle	Edge	
10	.081	.064	.075	.10
20	.766	.82	.872	.90
30	1.81	1.80	1.90	1.65
40	2.79	2.64	2.85	2.40
50	3.68	3.37	3.74	3.45
60	4.55	4.07	4.64	----

*The displacements are calculated at midheight and middle of wall.

Mcr occurs at .051 #/in/in or 7.3 psf
M_{allow} occurs at .219 #/in/in or 31.65 psf



NOTES:
2 - #7 BARS @ ℄ OF WALL - EQUIVALENT 8'-0" O.C.
EFFECTIVE DEPTH = 3.6' (MEASURED)
TEST REBOUNDED @ 15.6 #/0' TO 2.6 #/0'

Figure 1

Request 4: Masonry Wall 64.4 was observed to have significant cracks. Verify that these cracks do not have any significant effect on the results of the analysis.

Wall 64.4 is a 12" shield wall with vertical reinforcing of #5 @ 16" and a bond beam spanning horizontally at 8'-0" from the base. Due to the observed cracking, the analysis was revised to adjust the horizontal properties in the wall. The bond beam was modeled with one horizontal strip of finite elements. The remainder of the wall was modeled with zero stiffness in the horizontal direction to reflect the cracking in the wall. Therefore, only the bond beam has load carrying capacity in the horizontal direction.

The results of the reanalysis showed that the wall still qualified for an SSE Level 2 analysis. Shown below is the comparison of the moments and displacements from each analysis.

Original Analysis	Revised Analysis	
Wall	Wall	Bond Beam
M_{xx} = 1925 < 2430	M_{xx} = 0.00	M_{xx} = 2720 < 5372
M_{yy} = 2280 < 3620	M_{yy} = 1876 < 3620	M_{yy} = 2079 < 3620
$\triangle$ = 0.095" f = 8.511hz	$\triangle$ = 0.16" f = 5.878hz	

Request #5: Justify the increase from 1.3 to 1.5 for allowable tension.

The basis for the 1.5 factor is justified in Attachment B of the Design Criteria. However, it was not actually used in the wall qualification since it applies only to unreinforced walls.