November 9, 1979

Chairman, Atomic Safety and Licensing Board Panel
U.S.N.R.C.
Washington, D.C. 20555

Dear Sir:

The enclosed calculations have made me suspect of Table 8.3-18 of the Zimmer Power Station, Unit 1 FSAR. These calculations are based on ICEA P-54-440. Furthermore, there will be significant lengths of power cable trays which will be covered by fire retardant insulation thus creating a differential of slightly greater heat accumulation within the power cable trays.

This would not ordinarily be a concern if Sargeant and Lundy (architect-engineer for ZPS-1) had included the operating amperage of each cable at ZPS-1 on the cable pull-card tabulation which is computer assisted information. The lack of a central information bank which could easily determine the ampacity of every power cable tray at ZPS-1 is negligence. The cable routing pull-cards could have easily had the additional information of operating amperage load.

Given the lack of centralized cable tray ampacity calculating ability, the design specifications of ZPS-1 FSAR Table 8.3-18 deserve whatever attention available.

I do not believe that,in light of the San Onofre fires and the information handling capacity of modern computers, any nuclear power station should be granted an operating license without knowledge of the ampacity of every power cable tray in that station.

Sincerely,

Doug Gillman

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Calculations Comparing Zimmer Power Station Unit 1 FSAR Table 8.3-18
with ICEA-NEMA Standards Publication (ICEA P-54-440/NEMA WC 51-1975)
Ampacities in Open-top Cable Trays

Section 8.3.3.1.3 of the ZPS-1 FSAR states an allowable cross sectional area of cables to be no more than 60% of the cross sectional area of the cable tray. All of these calculations take the conservative figure of 55% of a cable tray of dimensions 6inches by 24 inches. 6"x24"x0.55= 79.2 sq. in.

For a given cable size the area of the cable is calculated from the given diameter by finding the radius, squaring and multiplying by pi. This cable area is then divided into the 55% area figure, or 79.2 sq. in. This computation gives the number of cables comprising a 55% fill. The number of cables is used in the equation on page i of the ICEA Publication P-54-440 to arrive at what this publication calls the "calculated depth of cables in trays". This number becomes a column heading in the use of the tables in this publication. The P-54-440 ampacity is compared with the power cable ampacities in Table 8.3-18 as a percent ratio of their difference over the P-54-440 ampacity. This percentage is then interpreted as the amount of underrating or overrating by the utility. The claim by the utility that it has derated its ampacities does not agree with the calculations which are based on open-top cable trays which have the advantage of circulating air to cool the cables. ICEA P-54-440 is based on the work of J. Stolpe who first investigated cable tray ampacities in response to the San Onofre cable tray fires since he was employed by the utility that owns San Onofre. Stolpe's original calculations appeared in the "San Onofre Nuclear Generating Station, Unit 1, Report on Cable Failures, 1968" before he published his paper, IEEE Paper 70 TP 557-PWR, "Ampacities for Cables in Randomly Filled Trays."

6AWG, 1kv, 1/c
O.D. (overall diameter of cable)= 0.31 in. (data from Anaconda)
r= .155 in.
79.2 sq. in./(pi(.155in.)^2)= 1049 cables
Calculated Depth of Cables in Trays(CDCT)=1049(.31in)^2/24 = 4.2 in.
Table 10 (P-54-440): 18 amp.
FSAR TABLE 8.3-18: 21 amp
(21-18)/18 = 16% over-rated

6AWG, 1kv, 3/c
O.D.= 0.84 in. (data from Anixter-Cleveland)
r= 0.42 in.
79.2 sq. in./(pi(.42in.)^2)= 142 cables
CDCT = 142(.84in.)^2/24 in. = 4.2 in.
Table 12 (P-54-440): 28 amp.
FSAR Table 8.3-18: 30 amp.
(30-28)/28 = 7% over-rated

4AWG, 1kv, 3/c
O.D. = .99 in. (Anixter-Cleveland)
r = .495 in.
79.2 sq. in./(pi(.495in.)^2) = 102 cables
CDCT = 102(.99in)^2/24in. = 4.16 in.
Table 9 (P-54-440): 39 amp.
FSAR table 8.3-18: 43 amp.
43-39/39= 10% over-rated

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4/0 AWG, 5kv, 3/c
O.D. = 1.99 in. (Anixter-Cleveland)
r = .995 in.
79.2 sq.in./(pi(.995 in.)^2) = 25 cables
CDCT = 25(1.99in.)^2/24 in. = 4.12 in.
Table 16 (P-54-440): 169 amp.
FSAR Table 8.3-18: 204 amp.
204-169/169 = 20% over-rated

250 MCM, 1kv, 1/c
O.D. = .77 in. (Anaconda)
r = .385 in.
79.2 sq.in./(pi(.385 in.)^2) = 170 cables
CDCT = 170(.77in.)^2/24in. = 4.19 in.
Table 10 (P-54-440): 136 amp.
FSAR Table 8.3-18: 159 amp.
159-136/136 = 16% over-rated

250 MCM, 1kv, 3/c
O.D. = 1.90 (Anixter-Cleveland)
r = .95 in.
79.2 sq.in./(pi(.95in.)^2) = 27 cables
CDCT = 27(1.90in.)^2/24 in. = 4.06 in.
Table 12 (P-54-440): 190 amp.
FSAR Table 8.3-18: 212 amp.
212-190/190 = 11% over-rated

350 MCM, 1kv, 3/c
O.D. = 2.14 in. (Anixter-Cleveland)
r = 1.07 in.
79.2 sq.in./(pi(1.07 in.)^2) = 22 cables
CDCT = 22(2.14 in.)^2/24 in. = 4.19 in.
Table 12 (P-54-440): 250 amp.
FSAR Table 8.3-18: 278 amp.
278-250/250 = 11% over-rated

Unfortunately, ICEA P-54-440 does not include a column for 4 inch 'calculated depth of cables in trays'.

However, if the reviewer believes that using a 5% cable tray fill is not conservative enough, the reviewer is advised to use a 50% (6" x 24" x .50 = 72 sq. in.) criterion. The reviewer will find that that using a 50% criterion reduces the 'calculated depth of cables in trays' from a little more than 4 inches to around 3½ inches and the same column in the tables (the 3" column) will again be used for 50% tray fill calculations, leaving the over-rating percentages for each type of power cable unchanged.

ICEA P-54-440 (NEMA WC 51-1975) (ICEA-NEMA Standards Publication, Ampacities, Cables in Open-top Cable Trays) is available from: Standards Publications Editor, National Electrical Manufacturers Association, 2101 L. St., N.W., Washington, D.C. 20037.

2AWG, 1kv, 3/c
O.D. = 1.14 in. (Anixter-Cleveland)
r= .57 in.
79.2sq. in./(pi(.57in.)^2) = 77 cables
CDCT = 77(1.14in.)^2/24 in. = 4.16 in.
Table 12 (P-54-440): 55 amp.
FSAR Table 8.3-18: 61 amp.
61-55/55 = 10% over-rated

1/0 AWG, 1kv, 1/c
O.D.= .54in. (Anaconda)
r= .27in
79.2 sq.in./(pi(.27in.)^2) = 345 cables
CDCT = 345(.54in.)^2/24in. = 4.19 in.
Table 10 (P-54-440): 61 amp.
FSAR Table 8.3-18: 72 amp.
72-61/61 = 18% over-rated

1/0 AWG, 1kv, 3/c
O.D.= 1.36in. (Anixter-Cleveland)
r= .68in.
79.2sq.in./(pi(.68in.)^2) = 54 cables
CDCT = 54(1.36in.)^2/24in. = 4.16 in.
Table 12 (P-54-440): 86 amp.
FSAR Table 8.3-18: 96 amp.
96-86/86= 11% over-rated

2/0 AWG, 5kv, 3/c
O.D.= 1.70in. (Anixter-Cleveland)
r = .85in.
79.2 sq.in./(pi(.85in.)^2) = 34 cables
CDCT = 34(1.70in.)^2/24in. = 4.09 in.
Table 16 (P-54-440): 108 amp.
FSAR Table 8.3-18: 144 amp.
144-108/108 = 33% over-rated

3/0 AWG, 1kv, 3/c
O.D. = 1.55 in. (Anixter-Cleveland)
r= .775 in.
79.2sq.in./(pi(.775in.)^2) = 41 cables
CDCT = 41(1.55in.)^2/24 in. = 4.10 in.
Table 12 (P-54-440): 124 amp.
FSAR Table 8.3-18: 138 amp.
138-124/124 = 11% over-rated

4/0 AWG, 1kv, 3/c
O.D. = 1.69 in. (Anixter-Cleveland)
r = .845 in.
79.2 sq.in./(pi(.845in.)^2) = 35 cables
CDCT = 35(1.69in.)^2/24in. = 4.16 in.
Table 12 (P-54-440): 156 amp.
FSAR Table 8.3-18: 167 amp.
167-156/156 = 7% over-rated