IMPELL CORPORATION

CALCULATION/PROBLEM COVER SHEET

Calculation/Problem No: M-27

Title: Thermal Load Position Paper

Client: Tugco Project: CPSES

Job No: 0210-040

Design Input/References:

Noted Within

Assumptions:

Noted Within

Method:

Noted Within

Remarks:

This calculation summarizes Tugco's position on the evaluation of thermal loads for cable tray hangers.

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1.0 INTRODUCTION

This paper describes Texas Utilities Generating Company's (TUGCO) licensing position regarding the evaluation of thermal loading as part of the design verification of cable tray systems at Comanche Peak Steam Electrical Station (CPSES) Units 1 and 2.

Thermal loading was not initially evaluated in the design verification of cable tray systems at CPSES. As part of the Comanche Peak Independent Assessment Program (IAP), Cygna commented that thermal effects should be considered where such loads occur. Based on the considerations presented in this paper, TUGCO's position is that it is not necessary to consider thermal loads in the evaluation of cable tray systems.

2.0 BEHAVIOR OF CABLE TRAY SYSTEMS UNDER THERMAL LOADS

2.1 Nature of Thermal Loads

Thermal stresses in cable tray systems can be classified as secondary stresses since they are developed as a result of self-constraint and are not generated by external loads. Local yielding, joint slippage, or minor distortions of the system can satisfy the expansion conditions which cause the stresses to occur.

Thermal loading is not significant for cable tray systems due to the secondary nature of the loads and due to the flexibility of the cable tray systems which can adequately accommodate thermal growth without generating significant loads. The flexibility of these systems results from the high flexibility of the trays and supports in addition to the existence of gaps in bolted splices and clips.

As a result of the above considerations, the general industry practice is to neglect thermal loading in the design of cable tray systems.

2.2 Thermal Loading Conditions

Two thermal loading conditions exist: T_o and T_a. T_o is defined as the thermal loading that occurs during normal operation or shutdown conditions and T_a is defined as thermal loading during a postulated break inside containment.

The maximum temperature change under T_o conditions is +32 degrees Fahrenheit (Reference [1]). Since this small temperature change occurs gradually, the building structures will heat up at the same rate as the enclosed cable tray systems. Therefore, an effective coefficient of expansion equal to the difference in the coefficients of expansion of steel and concrete can be used to evaluate thermal effects. Since the coefficient of thermal expansion of concrete is nearly equal to that of steel (the difference is approximately 1.0×10^{-6}) and the temperature change for this load case is relatively small, T_o conditions will not result in significant thermal loads.

T_a conditions are limited to the reactor building. For this load case the temperature change is considerably higher; however, as mentioned in the following section, it is not required to evaluate T_a conditions for cable tray systems.

3.0 FSAR LOAD COMBINATIONS

Cable trays systems are designed for load combinations specified for "other structures" in Section 3.8.4 of the CPSES FSAR (Reference [2]). The following is a summary of these load combinations as they apply to the evaluation of cable tray systems:

(1) $S = D + L + F_{eqo}$

(2) $1.5\ S = D + L + T_o + F_{eqo}$

(3) $1.6\ S = D + L + T_o + F_{eqs}$

(4) $1.6\ S = D + L + T_a + F_{eqo}$

(5) $1.7\ S = D + L + T_a + F_{eqs}$

where: S = required section strength based on the elastic design methods as defined in Part I of the AISC Manual of Steel Construction (Reference [3])

D = dead load

L = live load

T_o = thermal loads during normal operation or shutdown conditions

T_a = thermal loads under thermal conditions generated by the postulated break and including T_o

F_{eqo} = loads generated by half the SSE

F_{eqs} = loads generated by the SSE

Per Section 3.8.4 of the FSAR, thermal loads do not have to be considered in load combinations (3), (4), and (5) when the material is ductile since they are secondary and self-limiting in nature. Additionally, the overall high system flexibility, including general looseness of connections, prevents potentially nonductile components such as concrete anchors from experiencing thermal loads. Therefore, it is not necessary to evaluate T_a conditions to satisfy FSAR commitments.

4.0 PRECEDENT

Based on a review of the FSARs and other design documents, Millstone 3, Braidwood, Byron, and Catawba have not considered thermal loads in the evaluation of cable tray systems. All of these plants are of the same vintage Westinghouse NSSS design as CPSES and share the same licensing position presented herein.

5.0 CONCLUSION

In accordance with FSAR commitments it is not necessary to consider T_a conditions for cable tray systems. Since T_0 conditions will not be significant, it is not necessary to consider either thermal load case in the evaluation of cable tray systems. This position has been successfully applied to other plants of the same vintage desigr as CPSES.

REFERENCES

[1] "General Instructions for Cable Tray Hanger Analysis for Comanche Peak Steam Electrical Station No. 1 and 2," Revision R2, December 20, 1985, by Ebasco Services Incorporated.

[2] Comanche Peak Steam Electric Station, Final Safety Analysis Report (Amendment 55, July 19, 1985).

[3] AISC - Manual of Steel Construction 7th Edition, including Supplements No. 1, 2, and 3.