Attachment 2
AECM-85/0191

MISSISSIPPI POWER AND LIGHT COMPANY

GRAND GULF UNIT 1

EVALUATION OF UNPROTECTED SUPPORTS EXPOSED TO ELEVATED TEMPERATURES ASSOCIATED WITH POSTULATED FIRES

Ref. DCA-NPE-4-035(18)
Bechtel Response 3

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EVALUATION OF UNPROTECTED SUPPORTS EXPOSED TO ELEVATED TEMPERATURES ASSOCITED WITH POSTUALTED FIRES

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1.0 INTRODUCTION

Bechtel Response 2 to DCA NPE-4-035(18) provided a preliminary evaluation of supports subjected to a fire. This preliminary evaluation summarized the concern, NRC criteria, and industry practice applicable to fire protection of supports. Also included in this evaluation was a description of the approach applied to Grand Gulf for analyzing unprotected supports exposed to the fire. Several alternatives were described to reduce conservatisms in the analysis and an action plan was recommended and initiated. The methodology, results, and conclusions of the analysis are included in this report.

2.0 METHODOLOGY

The evaluation of unprotected supports utilizes a heat transfer analysis to determine the acceptability of the combustible heat loads calculated for each fire zone. The analysis is similar to that applied to other projects (i.e., Limerick and Peach Bottom) and accepted by the NRC (Ref. Limerick SSER2, 9-6 as justification for not fire proofing supports.) The following methodology was utilized in the calculation.

2.1 Scope

The scope of the evaluation is limited to those types of supports for which the NRC has expressed concern, (i.e., tray supports which directly affect the integrity of the fire barrier). Therefore, in regard to cable tray supports, only those fire zones with protected raceway require evaluation. (Refer to NRC Generic Letter 85-01).

2.2 Critical Temperature

The critical temperature applied to cable tray supports is 1100°F. The basis for this temperature is included in the NFPA Fire Protection Handbook.

2.3 Credit for Sprinkler Systems

Partial Suppression Systems have been provided in the vicinity of protected raceway (Ref. Appendix C to this report). Early NRC guidance (verbal presentation at workshop) indicated that area-wide sprinkler systems could provide the basis for exemption from Appendix R fireproofing requirements. Modified guidance found in Generic Letter 85-01 indicates that qualification tests or structural analyses are required. Therefore, credit for sprinkler systems was not assumed.

2.4 Ventilation Openings

Each zone evaluated is assumed ventilated by at least one of the normally closed fire doors. This is a conservative assumption since fire doors are controlled by the Technical Specifications, but is postulated to account for fire brigade access and other potential air leaks. Where necessary to demonstrate the acceptability of unprotected supports only a single door of a double door arrangement was assumed open. This is a realistic assumption since fire doors are spring loaded. All nonrated doors and Unit 2 fire doors open for construction are assumed open.

2.5 Fire Duration

A maximum fire duration of one hour has been assumed. This is consistent with one hour barriers provided for cable for those areas with smoke detection and partial suppression (Ref. FPP-1 Appendix C Data, Rev. 1) and is a realistic time for extinguishing the fire. A shorter duration was assumed if all of the combustibles were consumed in less than an hour.

Those zones with three hour raceway protection also have three hour barriers applied to supports (Ref. Telecon between T. Barnett and R. McNally dated May 8, 1985), and, therefore, do not require evaluation.

2.6 Bulk Fire Analysis

The bulk fire model utilizes verified computer program FIRE MPROG to calculate acceptable heat loads which result in representative support temperatures less than 1100°F for various ratios of heat sink surface areas to volumes and heat release rates. The model considers the effects of combustion products and beam lengths on heat transfer. Conservatively, only the free volume and heat sinks above the highest source of ventilation in the compartment is considered.

2.7 Heat Release Rate

To utilize the results of the bulk fire model analysis, it is necessary to determine the heat release rate. The heat release rate for a ventilation limited fire is dependent on the ventilation opening and is independent of the type of combustible. This heat release rate is determined by the following equation:

$$Q = 77\ A\sqrt{H}$$

where, Q=heat release rate (BTU/Sec)
A=ventilation area (ft^2)
H=ventilation opening height (ft)

2.8 Cable Spreading Fire

A cable spreading fire is considered where necessary to reduce the quantity of combustibles. A twenty foot diameter cable spreading fire was considered appropriate for a one hour duration based on test results of similar cable (i.e., 10 ft/hr applied by Limerick according to EPRI test).

The twenty foot diameter is consistent with NRC guidance for separation and is conservative considering the low propogation rate of IEEE qualified cable. The point of maximum cable concentration (Ref. Calc. 7.3.105-N) was chosen as the initiation fire and instantaneous flame spread was considered for vertical raceways. The cable loading for the cable spreading fire was conservatively combined with all other combustibles in the fire zone and the resulting fire considered ventilation controlled.

2.9 Corridor Areas

Fire zones in corridor areas were evaluated by limiting the combustible loading to the fire zone of concern. This approach was considered reasonable on the basis of limited propagation of fires within a one hour period. Credit for adjacent zones was applied to volumes and heat sink surface areas. This assumption is considered to be consistent with the model and a realistic representation of the dissipation of heat.

2.10 Support Thickness

The thinner the structural member, the higher its temperature response will be. Therefore, a unistrut with a thickness of .105" was chosen as representative of the thinnest structural member utilized for raceway supports.

2.11 Localized Temperatures

Localized temperatures associated with plumes of pool fires were analyzed under a separate calculation. This calculation considered plume fires resulting from transient combustibles postulated for the zones of concern. The combustibles evaluated are one and two gallons of isopropyl alcohol and acetone plus twenty five gallons of lube oil. The plume analysis provides heights above the combustibles and plume diameters where temperatures exceed 1100°F.

Localized temperatures resulting from cable tray fires were not analyzed since the supports for the raceway on fire need not be functional and adequate separation exists between unprotected Divisions I and II.

3.0 RESULTS

3.1 Bulk Fire Analysis

The results of the bulk heat transfer analysis are presented in Appendix A to this report. It is evident from this figure that the heat release rate is the predominant variable in determining the duration of the fire and not the loading per square foot as postulated in the Fire Protection Handbook. This figure also demonstrates the effect of heat release rate, heat sink surface areas, combustible loads, and fire durations on temperatures. The heat release rate for a ventilation limited fire is only dependent on the ventilation opening and is readily applied to this figure because the heat release rate is considered constant. A fuel controlled fire could also be evaluated using this figure, but

only by assuming the maximum heat release rate for the combination of combustibles. Heat release rates for fuel controlled fires were not applied in this evaluation.

3.2 Bulk Fire Evaluation

Of the sixteen fire zones evaluated, six were determined to have three hour protection for raceway supports. (Ref. FPP-1, Appendix C Data, Rev. 1). The ten remaining zones are considered acceptable on the basis of the bulk fire analysis. A summary of the parameters calculated in this analysis are tabulated in Appendix B to this report.

3.3 Fire Plume Analysis

The results of the plume fire analysis are presented in Appendix C to this report. These results indicate that only localized areas will exceed 1100°F and, therefore, only individual supports should be affected. The failure of individual supports is not expected to result in the collapse of the raceway because the raceway is designed for a seismic event which need not be considered concurrent with the fire and weight stresses are generally small in comparison.

4.0 CONCLUSION

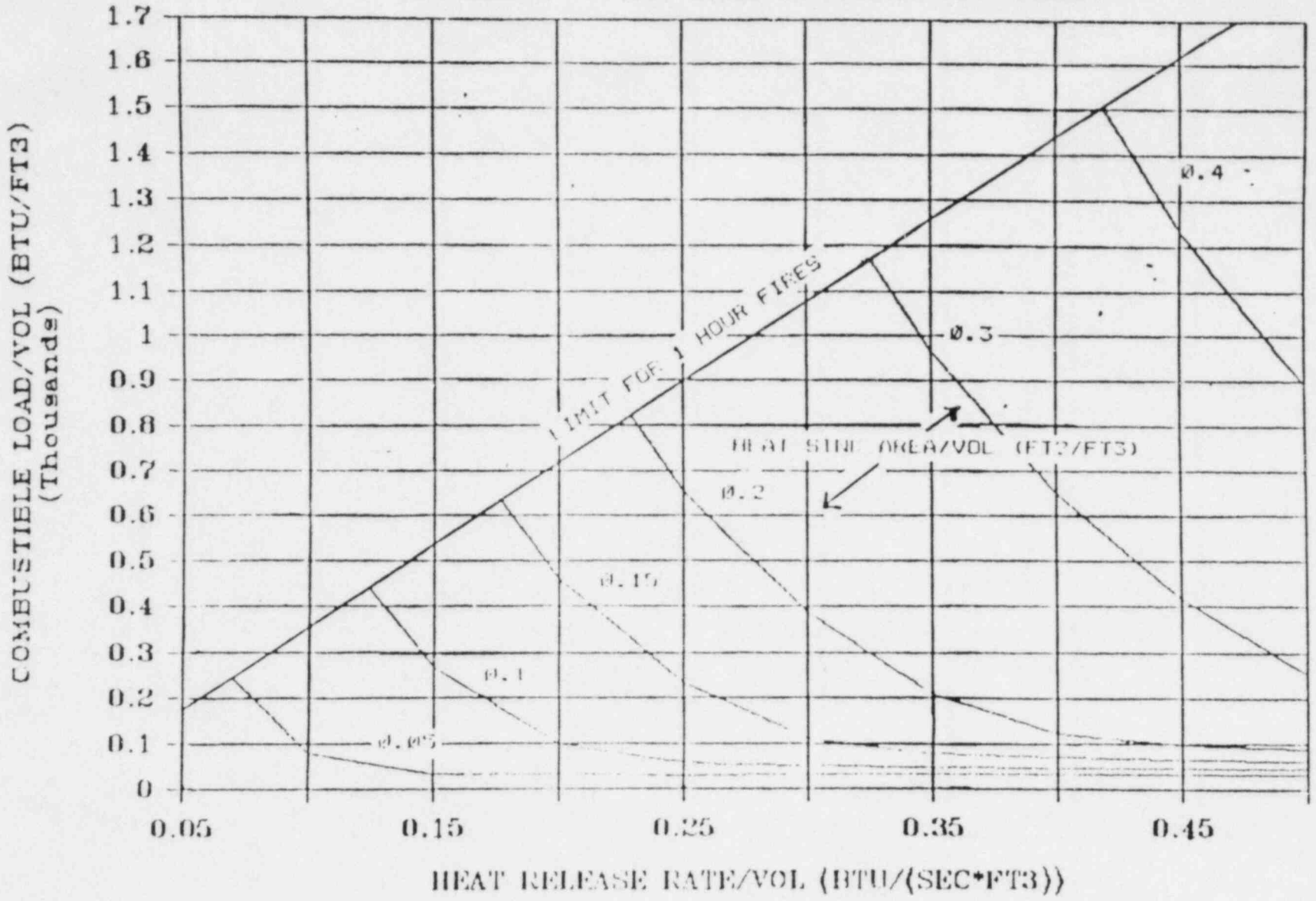
4.1 Bulk Fire Analysis

Based on the evaluation of support temperatures resulting from the bulk fire analysis, additional fire proofing is not required for raceway supports.

4.2 Plume Fires

Plume fires can produce localized temperatures which could affect the integrity of individual supports; however, this is not expected to result in the collapse of the raceway. Therefore, it is concluded that protection of the raceway supports for plume fires is not required.

GRAND GULF HEAT-UP ANALYSIS



SUMMARY OF FIRE PROTECTION EVALUATION OF RACEWAY SUPPORTS

AREA	ZONE	V VOLUME (ft^3)	A_s HEAT SINK AREA (FT^2)	Q HEAT RELEASE RATE (BTU/SEC)	Q TOTAL COMBUSTIBLE (BTU)	Q/V (BTU/ft^3)	Q/A (BTU/SEC/ft^2)	A/V (ft^{-1})	Q/V ACCEPTABLE (BTU/ft^3) MAX.	ACCEPTABLE	REMARKS
1	1A101	22,960	5,617	4,935	19.8×10^6	862 720[1]	.20	25	-	Yes	(1) One hour fire duration
1	1A117	52,475	11,098	4,935	25×10^6	476 206[1]	.085	.21	-	Yes	(1) One hour fire duration
6	1B211	63,572	9,769	8,870	50×10^6	787 504[1]	.14	.15	850	Yes	(1) One hour fire duration
11	1A316	86,411	11,203	13,938	62.4×10^6	734 288[1][2]	.08[2]	.13	600	Yes	(1) One hour fire duration (2) Value for single door open
19	1A401	60,660[2]	11,780[2]	13,938	14.13×10^6[1]	233[1]	.23	.19	600	Yes	(1) Considers cable loading for 20' cable spreading fire (2) Volumes and heat sinks include adjacent zones
19	1A417	70,907[2]	12,503[2]	13,938	24.6×10^6[1]	350[1]	.20	.17	668	Yes	(1) Considers cable loading for 20' cable spreading fire (2) Volumes and heat sinks include adjacent zones
31	0C202	27,395	5,364	10,454 5,227[2]	101×10^6	3,693 668[1][2]	.38 .19[2]	.19	-	Yes	(1) One hour fire duration (2) Value for single door open
38	0C215	27805	5,850	10,454 5,227[2]	32.6×10^6	1,251 [illegible][1][2]	.38 .19[2]	.191	917	Yes	(1) One hour fire duration (2) Value for single door open
42	0C402	24,409	7,524	4,935	15.18×10^6	8,115 [illegible][1][2]	.18[2]	.31	-	Yes	(1) One hour fire duration (2) Value for single door open
47	0C702	25,931	6,516	7,392 [illegible][1][2]	152×10^6	5,980 [illegible][1]	.29 [illegible][2]	.25	-	Yes	(1) One hour fire duration

Appendix C

Fire Plume Analysis

Combustible	Height Above Plume[1] (Ft)	(m)	Plume Diameter (Ft)
Isopropyl Alc. (1 gal.)	6	1.909	6.26
Isopropyl Alc. (2 gal.)	6.8	2.369	7.77
Acetone (1 gal.)	11	1.909	6.26
Acetone (2 gal.)	12	2.369	7.77
Lube Oil (25 gal.)	13	2.067	6.78

Area	Zone	Transient Combustible	Fire Protection
1	1A101	25 gal. lube oil	Partial Sprinkler
1	1A117	25 gal. lube oil	Partial Sprinkler
6	1A211	25 gal. lube oil	Partial Sprinkler
11	1A316	250 lb. charcoal[1]	Partial Sprinkler
19	1A401	250 lb. charcoal[1]	Partial Sprinkler
19	1A417	250 lb. charcoal[1]	Partial Sprinkler
31	0C202	1 gal. Isopropyl Alc.	CO_2
38	0C215	1 gal. Isopropyl Alc.	CO_2
42	0C402	1 gal. Isopropyl Alc.	CO_2; Sprinkler
47	0C702	1 gal. Isopropyl Alc.	CO_2; Sprinkler

NOTE: (1) Plume fires are not applicable to charcoal.