CALCULATION TITLE PAGE

TEXAS UTILITIES ELECTRIC CO. / CPSES UNIT 2

PAGE 1
TOTAL NO. OF PAGES 49

CALCULATION TITLE (Indicative of the Objective):
RACEWAY AND FIREZONE R
CABLE SUPPORTS ANALYSIS

CALCULATION CLASSIFICATIONS:
☒ CLASS I or II
☐ NON-SAFETY

CALCULATION IDENTIFICATION

ORGANIZATION: SWEC

CALCULATION NUMBER
TYPE: FPT2
NUMBER: 2-FP-0085

WPST NUMBER
— — — — —
(OR)
WPN 5 6 K

COMPUTER OUTPUT
YES ☐ NO ☒
ATTACHED
YES ☐ NO ☒

SYSTEM/SUB-SYSTEM
(GENERIC) N/A

APPROVALS - PRINT NAME, SIGN, AND DATE			REV. NO.	~~SUPPLEMENTS~~ SUPERSEDES (TYPE/NUM./REV.)	CONFIRMATION REQUIRED	
PREPARER(S)	CHECKER(S)/ REVIEWER(S)	APPROVAL(S)/ INDEPENDENT REVIEWER(S)			YES	NO
JOHN G. CROWTHER John G. Crowther 6/17/92	AARON ADRIAN 6-17-92	AARON ADRIAN 6-17-92	1	REV 0	X PAGE 15	

DISTRIBUTION:
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9206250270 920619
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FIGURE 7.4
COMPUTER OUTPUT/CROSS REFERENCE

ORGANIZATION: STONE AND WEBSTER JOB NO. 01531.01

CALC NO.: 2-FP-0085 REV. 1 PAGE 2

COMPUTER RUN UNIQUE IDENTIFIER					
1JOB DATE	PROG. NAME2	VERSION/LEVEL2	LIBRARY NAME2	COMPUTER 1JOB NUMBER*	ADD/ DELETE
		N/A			

*or unique identification number
1) Mandatory
2) Optional, as appropriate

CROSS REFERENCE

CALC. TYPE	CALC. NUMBER	REVISION	ADD/DELETE
IMFP	0210-063-0002	4	ADD
IMFP	0210-063-0005	4	ADD
IMFP	0210-063-0006	4	ADD
IMFP	0210-063-0058	2	ADD
FPT2	2-FP-0081	Ø	ADD

SUPPLEMENTS

DO EXISTING SUPPLEMENTS APPLY TO NEW REVISION? ☐ YES ☐ NO NA

STONE & WEBSTER ENGINEERING CORPORATION

REVIEW STATEMENT FOR CALCULATIONS

CALCULATION IDENTIFICATION NUMBER			PAGE 3
CALCULATION NO.	REVISION NO.	CALC. CHANGE NOTICE NO.	
2-FP-0085	1	N/A	

REVIEW OF THIS CALCULATION WAS BASED ON THE METHODS BELOW

			INITIAL UPON COMPLETION
1)	REVIEW OF:		
	A) INPUTS TO ASSURE THAT THEY HAVE BEEN PROPERLY SELECTED AND CORRECTLY USED IN THE CALCULATION. (CHECK ONE)		
	I) LIMITED REVIEW (PROVIDE JUSTIFICATION)	☒	NA
	II) LINE BY LINE REVIEW	☐	ALA
	B) ASSUMPTIONS TO ASSURE THEIR VALIDITY AND NEED FOR LATER CONFIRMATION.	☒	ALA
	C) METHODOLOGY TO ASSURE THE APPROPRIATENESS OF THE OVERALL APPROACH, ITS IMPLEMENTATION, AND THE CORRECTNESS OF THE SPECIFIC EQUATIONS UTILIZED. (CHECK ONE)		
	I) LIMITED REVIEW (PROVIDE JUSTIFICATION)	☒	NA
	II) LINE BY LINE REVIEW	☐	ALA
	D) RESULTS TO ASSURE REASONABLENESS AND ACCURACY.	☒	ALA
	E) IF ALTERNATE CALCULATION IS PERFORMED TO VERIFY C) AND D) CHECK HERE AND ATTACH CALCULATION AS AN APPENDIX.	☐	NA
2)	CHECK OF CALCULATION (CHECK ONE)		
	A) COMPLETE NUMERICAL CHECK	☒	ALA
	B) NUMERICAL CHECK OF CRITICAL ITEMS (STATE ITEMS AND JUSTIFICATION BELOW)	☐	NA
3)	ADMINISTRATIVE CHECK OF FORMAT AND CONTENT	☒	ALA
4)	COMMENTS/JUSTIFICATION		

REVIEW METHODS SELECTED AS INDICATED ABOVE

AARON ADRIAN 6-17-92
INDEPENDENT REVIEWER — DATE

R.L. DIBLE 6/17/92
SUPERVISOR CONCURRENCE — DATE

SATISFACTORY COMPLETION OF REVIEW (CALCULATION IS APPROVED FOR ISSUE)

AARON ADRIAN 6-17-92
CHECKER — DATE

AARON ADRIAN 6-17-92
REVIEWER — DATE

AARON ADRIAN 6-17-92
INDEPENDENT REVIEWER — DATE

2SW-5.08-2, REVISION 0
RECORD TYPE CODE: 5A.100

2SW5089-2

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 The Unit 2 Fire Safe Shutdown Analysis (Ref. 5.1) and Physical Separation Analysis (Ref. 5.2) establish the electrical raceways requiring a one-hour fire-rated barrier (i.e., Thermo-Lag 330-1 System) to meet the separation requirements of DBD-ME-020 (Ref. 5.3). In some instances, one-hour fire-rated cable (Firezone R cable) is credited to meet separation requirements. The purpose of this evaluation is to assess the ability of supports associated with Thermo-Lagged raceways and the support mechanisms associated with Firezone R (FZR) cable to withstand the effects of a design basis fire as postulated by the Fire Hazards Analysis.

1.2 This evaluation is based on the provision of NRC Generic Letter 86-10 (Ref. 5.4) whereby licensees may analyze the fire loading and automatic fire suppression system capability in given plant areas to determine if fire barrier material application of raceway (and one-hour fire-rated cable) supports is required.

1.3 Raceways protected with Thermo-Lag include both cable tray and conduit systems. The Thermo-Lag installation on raceway supports extends a distance of 9" (min.) to 11" (max.) as measured from the outside of the raceway protective envelope (Ref. 5.5). The remaining portions of supports for Thermo-Lagged raceways are exposed.

1.4 FZR cable is primarily installed in cable trays. FZR cable has been qualified for a one-hour fire endurance rating (Ref. 5.6), however the cable trays and associated tray supports are exposed. Similarly, for the minor amount of FZR cable installed in free air, the associated support assemblies (clamps, tube tracks, etc.) are also exposed.

1.5 Sprinkler system coverage is provided in all areas where Thermo-Lag barriers and FZR cables are located except the six (6) firezones identified in Attachment A. These firezones are evaluated in detail in Section 6.0 Sprinkler systems are installed in accordance with NFPA 13 (Ref. 5.16), such that sprinkler heads positioned at the ceiling and under obstructions ensure full spray coverage through-out the respective room and/or Firezone. Additionally, sprinkler protection for congested cable tray arrays is provided in accordance with American Nuclear Insurers' criteria (Ref. 5.16). Sprinkler system hydraulic designs are conservative and consider the occupancy hazards of each protected area. Therefore, the cooling effects of sprinkler system spray coverage for cable trays and associated supports will maintain design basis fire temperatures well below the critical temperature of steel as described in Sections 2.3 and 3.9.

2.0 DEFINITIONS

2.1 Combustible Loading

The total heat release of an area, in British Thermal Units (BTU's) of in-situ combustibles, divided by the square feet of the area to give a BTU/Sq. FT. rating.

2.2 Controlled Storage Area

Rooms where Class A combustible material (wood, paper, cardboard, cloth, etc.) can be utilized without compensatory measures. All other classes of combustible materials (oils, paints, solvents, plastic, rubber, etc.) require compensatory measures when left unattended. In no case shall any class of combustible materials be stored under cable trays which are protected by a fire barrier such as Thermo-Lag (Ref. 5.7).

2.3 Critical Temperature

The critical temperature for steel is normally considered to be 1100°F. At this temperature, the steel loses sufficient strength to reduce the yield stress to the value commonly used for the working stress design. Consequently, the load carrying capacity is reduced to approximately the design load capacity. The temperature of 1100°F is, therefore, considered to be the approximate failure temperature of steel. This is consistent with the AISC guidelines which are utilized in the design for the cable trays and supports (Ref. 5.8 through 5.10).

2.4 Fire Protection Installation Release

The Fire Protection Installation Release (FPIR) is the site document for authorizing the installation of Thermo-Lag material on electrical raceways. The use of this form is controlled by Construction/Quality procedure CQP-CV-107 (Ref. 5.11).

2.5 Fire Area

A fire area is that portion of a building or plant that is separated from other fire areas by fire barriers (walls, floors or roofs) with openings and penetrations protected by seals or closures having a fire resistance rating at least equal to the rating assigned to the barrier. The fire areas may extend through more than one elevation.

2.6 Fire Severity/Fire Duration

The approximate time, expressed in minutes, that combustible material will burn. The duration is based on the heat release that will produce an exposure equivalent to the Standard Time-Temperature Curve ("E" Curve) or, in some instances, the "C" curve where justification is provided (Ref. 5.12).

2.7 Fire Zone

A subdivision of a Fire Area that may or may not have rated boundaries.

2.8 Fire Zone R Cable

Fire resistent cable which has been qualified to remain functional by a one-hour fire endurance test in accordance with the Standard Time Temperature Curve ("E" Curve), (Ref. 5.12). The cable is constructed of a continuously welded corrugated 12 mil thick stainless steel sheath with high temperature nickel-clad copper conductors, glass braid cable jacket and a 600 V composite

insulation consisting of silicone rubber, mica and ceramic tape. This cable will be used in power and control circuits for fire safe shutdown applications. This cable is predominately installed in cable trays with a minor amount supported in free air.

2.9 In-situ Combustibles

Combustible materials which are permanently installed (i.e., exposed cabling, fire hose, cloth, etc.).

2.10 Maximum Permissible Fire Load (MPFL)

The maximum permissible fire loading (MPFL) is the maximum fire loading (Btu/sq. ft.) which can be expected to be contained within a fire area by the fire area boundaries without compromising safe shutdown capability. It represents the maximum loading which can be substantiated by an engineering evaluation to justify that safe shutdown capability will not be compromised during a fire event. It is calculated by analyzing both the fire area boundary and the fire protection features provided for protection of redundant safe shutdown equipment. Each area of concern identified in the analysis is reviewed and the most restrictive of all the features is then used to assign the MPFL. For example: If a fire area has boundaries which are capable of containing a 3 hour fire, but also has redundant safe shutdown equipment protected by 1 hour barriers, the MPFL for that area would be 80,000 Btu/sq. ft., or 1 hour.

2.11 No Storage Area

Rooms that require compensatory measures whenever transient combustibles are brought into them. These rooms are designated as "No Storage Areas" based on deviations in the Fire Protection Report, Partial Sprinkler Coverage Evaluation, Cable Tray Hanger Analysis, Commitments, and areas where a high fire load already exists (Ref. 5.7).

2.12 Storage

Any transient combustible left unattended.

2.13 Thermo-Lag

A Thermal Science, Inc. (TSI) protective barrier envelope which, as used at Comanche Peak Steam Electric Station (CPSES), consists of Thermo-Lag Stress Skin Type 330-69 and Thermo-Lag 330-1 Subliming Material designed and installed to provide a one hour rated fire barrier system. (Ref. 5.5)

2.14 Transient Combustibles

Combustible materials that are not designed into the plant, but are brought into the plant due to operation, maintenance, or plant modification activities.

2.15 The following are defined from a combustible loading standpoint only:

ANTI-C STATION

Wheeled storage units which store anti-contamination clothing and equipment. Total weight of combustibles in a typical station is approximately 210 lbs. for 1 cabinet and 365 lbs. plus 9 cubic feet of wood benches for 2 cabinet. For the 1 cabinet station, 45% of the combustible loading is ordinary combustibles such as cloth coveralls, liners, hoods, and lab coats, cardboard boxes and rolls of masking tapes. 55% of the combustible loading is rubber and plastic gloves shoe covers and suits. For a 2 cabinet arrangement, the type of combustibles is the same but 70% of the combustible loading is ordinary combustibles. Combustibles are stored on metal shelves in boxes or stored in well arranged stacks.

FRISKER STATION

The total weight of combustibles in a typical Frisker Station is approximately 53 lbs. and vinyl covering for lead blankets. 70% of the combustible loading is plastic bags and tags and 30% is ordinary combustibles such as cloth, tape and paper sample smears.

RADIATION BAG DISPENSER

A typical dispenser includes 4 rolls of plastic herculite and trash bags weighing approximately 35 lbs. per roll.

SPILL KIT GANG BOX

A typical spill kit gang box consists of approximately 105 lbs of combustible. 65% of the combustible loading is rubber and plastic such as goggles, squeegees, spray bottles, buckets, gloves shoe covers and hose. 35% is ordinary combustibles such as cloth mopheads, liners and decontaminated clothes, wood mop handles and clipboards, paper kay-drys and sample smears.

3.0 ASSUMPTIONS

3.1 Two Design Basis Accidents (e.g., fire and seismic events) do not occur simultaneously. Therefore, degradation of the ability of raceway supports to withstand design basis seismic loads under fire conditions is acceptable (see Ref. 5.3).

3.2 All raceways requiring Thermo-Lag are identified on M2-1700, Rev. CP-1; all Firezone R cables are identified in INDMS (Ref. 5.15).

3.3 All Firezones where Thermo-Lag is installed are identified on M2-1700 (Ref. 5.14).

3.4 All Firezones where Firezone R cable is installed are identified in INDMS (Ref. 5.15).

3.5 Sprinkler systems in the areas evaluated are designed and installed in accordance with NFPA 13 (Ref. 5.16). Field walkdowns conducted in accordance with 2-EAP-016 (Ref. 5.17) provide assurance that this assumption is valid.

3.6 Protruding items (i.e., raceway supports, etc.) directly attached to a raceway requiring Thermo-Lag are protected with 9 inches minimum to 11 inches maximum of Thermo-Lag. This assumption is based on the requirements of the Thermo-Lag installation specification (Ref. 5.5) and inherent quality controls therein.

3.7 The internal temperature of raceway support steel is the same as the ambient temperature. This introduces a safety factor into the evaluation because in actual fire conditions, steel takes a relatively long time for its internal temperature to reach ambient air temperature. Steel has a high thermal conductivity allowing it to transfer heat away from a localized heat source. This property in conjunction with its thermal capacity enables steel to act as a heat sink.

3.8 Combustible loading for a given Firezone adequately represents combustible loading for each room within that Firezone.

3.9 Cable trays, cable tray support materials, conduit, conduit support materials and FZR cable support materials (other than cable tray) are all composed of steel materials which satisfy prevailing CPSES criteria and requirements for safety-related, Seismic Category I applications. References 5.8 through 5.10 provide source documents for traceability to actual steel types and grades for raceways and supports.

Example: For FZR cable free air supports, specification CPES-S-2005 (Ref. 5.9) refers to the "RC" series of details provided in the PESD sheets of drawing S2-0910. Detail RC-2 specifies Unistrut P-2014 one hole clamps (ASTM A-575) mounted to structure with A-36 plate steel and 1/4" diameter HILTI-KWIK bolt.

The critical temperature of 1100°F for all raceway and support materials is therefore acceptable based on review of the applicable reference documents.

3.10 The three Unit 2 Electrical Switchgear Rooms (Fire Zones 2SD9, 2SE16 and 2SE18) containing Thermo-Lagged cables are protected by manually actuated sprinkler systems which provide full spray coverage throughout the respective area. The manual actuation is considered equivalent to automatic suppression in these areas due to complete ionization detection in the area, low combustible loading, and the combustibles in the room being cables which are expected to result in a slow developing fire. Therefore, a Fire will be detected in the incipient stages allowing for actuation of the system well before significant temperatures can be developed.

4.0 METHODOLOGY

4.1 The following data will be compiled into Attachment A and assessed in Section 6 of this evaluation.

A. Determine the Fire Areas, Fire zones and rooms containing Thermo-Lag and/or FZR cable based on the FPIR's for Thermo-Lagged raceways (see definition 2.4) and applicable Design Change Authorizations for FZR cables (Ref. 5.20). Enter this information into columns A, B and C in Attachment A.

B. Determine if the room contains Thermo-Lag and/or FZR cable by entering "T" and/or "R" respectively in column D.

C. Determine if sprinkler coverage is provided for the rooms containing Thermo-Lag or FZR cable by reviewing the Fire Hazards Analysis (FHA) drawings (Ref. 5.21 through 5.25), or the Fire Protection system layout drawings (Ref. 5.26 through 5.39). Enter "yes" or "no" in column E of Attachment A. Follow the response with an "M" when the sprinkler system requires manual actuation (see assumption 3.10).

D. Determine the MPFL (Ref. 5.18 and 5.19) and the actual fire loading, fire duration for time temperature curve E and the types of combustibles (Ref. 5.18 and 5.19). Enter this information into columns F, G, H and I in Attachment A. Also determine the maximum temperature developed for an E curve fire from Attachment C.

E. Determine it the type and arrangement of combustibles and the construction can qualify for the C curve based on Attachment B. If Curve C can be utilized, provide justification in section 6.0 and calculate the fire duration for the Firezones that qualify for the use of Curve C. This is done by dividing the combustible loading of the Fire zone by the maximum heat release rate delivered in Attachment D and multiply the result by 60 minutes. Determine the maximum temperature developed for a C curve fire from Attachment A. In column J of Attachment A, enter "NA" if the C curve does not apply or enter the duration and maximum temperature developed if it does apply.

F. Where Therro-Lag or FZR are installed in rooms which have partial or no suppression system coverage ("No" in column E, Attachment A), the rooms shall be designated as "No Storage" areas (see Def. 2.11) and an "A" shall be entered in column K of Attachment A. Determine if Thermo-Lag or FZR cable is installed in rooms designated as "No Storage" because a deviation exists to justify compliance with 20 foot separation requirements for fire safe shutdown analysis cables and components (Ref. 5.18 and 5.19). Enter "B" in column K for these rooms. If neither "A" or "B" apply, enter "NA" in column K.

4.2 In Section 6.0, evaluate the acceptability of the unprotected steel supports in accordance with the guidance contained in generic letter 86-10 (Ref. 5.4) utilizing the information accumulated with attachment A. The evaluation shall take into consideration combustible loading, automatic suppression, administrative controls and test information.

5.0 DESIGN INPUTS/REFERENCES

5.1 2-ME-0282, Rev. 0, "Unit 2 Fire Safe Shutdown Analysis"

5.2 2-ME-0279, Rev. 0, "Physical Separation Analysis Unit 2 and Unit 2 Cables and Components in Common Areas"

5.3 DBD-ME-020, Rev. 2, "Fire Safe Shutdown Analysis"

5.4 NRC Generic Letter 86-10, Section 3.3.4

5.5 CPES-M-2032, Rev. 0, "Procurement and Installation of Fire Barrier and Fireproofing Materials"

5.6 Underwriters Laboratories "Report on Fire Resistant Cables" File R 109251, Project 84NK2320, dated April 10, 1984.

5.7 STA-729, Rev. 4, "Control of Transient Combustibles, Ignition Sources and Fire Watches"

5.8 CPES-E-2004, Rev. 1, "Electrical Installation"

5.9 CPES-S-2005, Rev. 2, "Electrical Raceway Installation"

5.10 CPES-S-2006, Rev. 1, "Structural Steel"

5.11 CQP-CV-107, Rev. 0, "Application of Fire Barrier and Fireproofing Materials"

5.12 National Fire Protection Association (NFPA) Handbook, 16th Edition, Section 7; 14th Edition, Section 14.

5.13 2-FP-0080, Rev. 0, "Unit 2 MPFL Non-Rated Feature Analysis"

5.14 M2-1700, Rev. 0, "Unit 2 Thermo-Lag and RES Schedule"

5.15 Unit 2 Integrated Nuclear Data Management System (INDEMS), Rev. 3.04.

5.16 DBD-ME-225, Rev. 2, "Fire Suppression System"

5.17 2-EAP-015, Rev. 0, "Engineering Assessment Procedure Fire Protection Features Walkdown"

5.18 LDCR FP-92-002 Dated 3/31/92 to the CPSES Fire Protection Report (Added Unit 2)

5.19 CPSES Unit 1 Fire Protection Report, Rev. 5

5.20 Firezone R Cable DCA's 97609 Rev. 2
97081 Rev. 2
95554 Rev. 1
97610 Rev. 0
97259 Rev. 2
97611 Rev. 0
95975 Rev. 4
99744 Rev. 0

5.21 M2-1920, Sht. 01, CP-1, Fire Hazard Analysis - Unit 2, Containment and Safeguard Buildings Plans at El. 790'-6

5.22 M2-1921, Sht. 01, CP-1, Fire Hazard Analysis - Unit 2, Containment and Safeguard Buildings Plans at El. 808'-0' & 810'-6"

5.23 M2-1922, Sht. 01, CP-1, Fire Hazard Analysis - Unit 2, Containment and Safeguard Buildings Plans at El. 831'-6" & 832'-6"

5.24 M2-1923, Sht. 01, CP-1, Fire Hazard Analysis - Unit 2, Containment and Safeguard Buildings Plans at El. 852'-6" & 860'-0"

5.25 M2-1924, Sht. 01, CP-1, Fire Hazard Analysis - Unit 2, Containment and Safeguard Buildings Plans at El. 873'-6"

5.26 DWG #-0099, R/10, Grinnell Fire Protection Systems, El. 790'-6"

5.27 DWG #-0100, R/8, Grinnell Fire Protection Systems, El. 790'-6"

5.28 DWG #-0101, R/12, Grinnell Fire Protection Systems, El. 810'-6"

5.29 DWG #-0103, R/12, Grinnell Fire Protection Systems, El. 831'-6"

5.30 DWG #-0106, R/10, Grinnell Fire Protection Systems, El. 852'-6"

5.31 DWG #-0106A, R/2, Grinnell Fire Protection Systems, El. 852'-6"

5.32 DWG #-0118, R/8, Grinnell Fire Protection Systems, El. 810'-6"

5.33 DWG #-0130, R/9, Grinnell Fire Protection Systems, El. 831'-6"

5.34 DWG #-0134, R/8, Grinnell Fire Protection Systems, El. 790'-6"

5.35 DWG #-0135, R/7, Grinnell Fire Protection Systems, El. 790'-6"

5.36 DWG #-0146, R/6, Grinnell Fire Protection Systems, El. 790'-6"

5.37 DWG #-0154, R/5, Grinnell Fire Protection Systems, El. 790'-6"

5.38 DWG #-0183, R/5, Grinnell Fire Protection Systems, El. 852'-6"

5.39 DWG #-0184, R/5, Grinnell Fire Protection Systems, El. 852'-6"

6.0 RESULTS

6.1 JUSTIFICATION FOR UTILIZING C-CURVE

The standard time temperature curve is utilized in developing the combustible loading duration. This curve contemplates a severe fire exposure in a masonry walled, wood floor and roof building and a combustible loading of 200,000 BTU/FT^2 to 400,000 BTU/FT^2 (Ref. 5.12). As indicated in attachment A, the combustible loading except in Fire zone 2SB8 is less than 80,000 BTU/FT^2 and in most cases much less. Fire zone 2SB8 has a fire loading of 101,300 BTU/FT^2. All areas being evaluated in this calculation easily qualify for temperature Curve C which contemplates a moderately sever occupancy with well arranged storage, a non combustible building and a fire loading between 100,000 BTU/FT^2 and 200,000 BTU/FT^2 (Ref. 5.12). Utilization of the C-Curve preserves an acceptable safety factor and is justified as follows:

1. Combustibles consist of exposed cables, fire hose in cabinets, Frisker and Anti-C Stations with minor amounts of lube oils, grease and miscellaneous combustibles including small quantities of combustible and flammable liquids in equipment or in containers in designated storage areas.

2. Combustibles are well arranged. Cables which represent the majority fire loading are in trays. The other combustibles are associated with the anti-contamination clothing, frisker stations, the radiation bag dispensers and the spill kit gang boxes. Storage is in boxes, dispensers or in stacks on non-combustible shelves. Minor amounts of other combustibles including some flammable and combustible lube oils, grease and other liquids are either in equipment or stored in containers in designated storage areas.

3. There is no concentrated storage of combustibles as would be the case in a warehouse occupancy.

4. The buildings and areas within the buildings being evaluated are all fire resistive construction.

6.2 Underwriters Laboratories "Report on Fire Resistant Cables" (Ref. 5.6) describes the one hour Fire endurance testing performed for FZR cable. Included in this test were configurations of No. 14 and No. 6 AWG FZR power cables installed in exposed galvanized steel open-ladder type cable trays loaded with 41.5% fill of random lay "fuel loading" cables. Since CPSES utilizes No. 8 AWG FZR cable (Ref. 5.8), the test effectively bounds the cable size installed in the plant. The "Fuel loading" cables consisted of power and control cables representative of those installed at CPSES (Ref. 5.6). The trapeze type supports associated with the tested cable tray configurations, which consisted of 1/2" diameter threaded steel rod with 4 x 3 x 1/2 inch steel angle, were protected with Zonolite Type MK-5 fireproofing material. As described in Section 1.4 of this evaluation, supports associated with FZR cable at CPSES are unprotected. However, the type and construction of the cable trays tested are consistent with cable trays containing FZR cable at CPSES, i.e., galvanized steel open-ladder design. For purposes of this evaluation, the following test report excerpt is relevant:

> "The profuse flaming and smoking of the Fuel loading cables continued throughout the Fire exposure test. At 40 min, it was noticed that the galvanized coating on the cable trays and conduits was oxidized. During the final 20 min of fire exposure, the cable tray siderails bowed inward and several of the cable tray rungs disengaged from the cable tray siderails and allowed the fuel loading cables to deflect downward."

Based on the above test report, the following conclusions can be reasonably drawn to substantiate unprotected support mechanisms at CPSES:

a. The steel supporting elements associated with Thermo-Lagged raceways and FZR cable at CPSES (cable trays, support channel and tube steel, base plates, one hole clamps, etc.) are at least as substantial as the No. 14 and 16 gauge steel comprising the siderails and ladder rungs which started to exhibit loss of structural integrity 40 minutes into the test.

b. The cable tray test configurations with "fuel loading" cable fills of 41.5% conservatively represent a "worst case" challenge to exposed support material integrity. This is based on CPSES design limitations of 30% fill for power cables in tray and 40% for instrumentation and control cable

(Ref. 5.8). The exposure fire utilized in the test was based on the standard temperature curve which is the most severe, and the fuel loading cables experienced fully developed flaming conditions. Additionally, typical plant support configurations would experience less severe exposure conditions due to inherently lower combustible load conditions (more closely represented by the E-119 "C" temperature curve - see Section 6.1) and the heat sink effect of the plant concrete structure.

c. It is not credible to postulate fully developed fire conditions for a period of 40 minutes without either sprinkler system activation or manual response with hose stations which would maintain support steel temperatures below 1100°F. This is based on the provision of fire detection capability in all plant areas with Thermo-Lagged raceways and/or FZR cable.

6.3 SPRINKLER SYSTEM COOLING OF STEEL

The cooling effects of water and more appropriately water in spray form such as would be the case with water discharged from a sprinkler head, has long been recognized (Ref. 5.12, Section 13, Chapter 1). A sprinkler system designed in accordance with NFPA 13 requirements which includes ceiling level suppression and obstruction level coverage (when ceiling sprinklers cannot provide complete coverage due to obstructions) will provide an even distribution of water that will effectively provide coverage for all objects in a protected area (Ref. 5.16).

In addition to the inherently high latent heat of vaporization of water, the dynamics of sprinkler system discharge which promote cooling include rapid air entrainment into the spray which removes heat and effectively knocks down the hot gas layer resulting in rapid temperature reduction at ceiling levels. Therefore, sprinkler system discharge will provide adequate cooling of exposed raceway support elements given a worst case situation involving support steel immersed in the bouyant hot gas layer at the ceiling level.

Sprinkler systems at CPSES optimize coverage to obtain maximum cooling effect from the sprinkler system. They have been designed and installed in accordance with NFPA 13 and system walkdowns have been conducted for verification. Also, the ceiling and obstruction level coverage required by NFPA has been augmented by special application spray nozzles at congested cable tray locations to provide an extra level of protection and cooling in these areas (Ref. 5.26 through 5.39).

An additional feature which helps to optimize the cooling effect of water spray is that the occupancies of the areas where Thermo-Lag and FZR Cables are installed are such that a fire would be slow developing and would not have a high velocity fire plume. As a result the discharged water will be able to penetrate effectively to reach the fire origin.

6.4 RESULTS FOR INDIVIDUAL FIRE ZONES

6.4.1 FIRE ZONE AA 21a

6.4.1.1 General

Firezone AA 21a is located on the 790' - 6" Elevation of the Auxiliary Building. There are 22 rooms in the fire zone, 5 of which contain Unit 2 Thermo-Lag or FZR cable (Rooms X-165, X-172, X-173, X-174 and X-180). Of the 5 rooms only room X-180 has complete automatic sprinkler protection. The combustible loading for the zone is 10,500 BTU/FT^2 and the fire duration utilizing the C-Curve (see 6.1) is 11 minutes with a minimum temperature of 760°F. The MPFL is reduced to 37,300 BTU/FT^2 due to the non sprinklered rooms and the nonsprinklered rooms will be designated as "no storage" (Ref. 5.7).

6.4.1.2 Discussion

Room X-165 is a 911 ft^2 room with a combustible loading consisting of a minor amount of exposed cables, paper and plastic. There is no equipment in the area which contributes significantly to combustible loading. There is no sprinkler protection for the room so it will be designated as a "no storage" room. Ionization detection is provided and manual suppression capability with hose stations and portable extinguishers is provided.

Room X-172 is a 150 ft^2 room with a combustible loading consisting of only a minor amount of cables. There is no equipment in the area which contributes significantly to combustible loading. There is no sprinkler protection for the room so it will be designated as "no storage". Ionization detection is being added to this room via a Design Modification (DM)* Manual suppression capability with hose stations and portable extinguishers is provided.

Room X-173 is a 100 ft^2 room with a combustible loading consisting of a minor amount of exposed cables. There is no equipment in the area which contributes significantly to combustible loading. There is no sprinkler protection for the room so it will be designated as "no storage". Ionization detection is being added to this room via a Design Modification (DM)* Manual suppression capability with hose stations and portable extinguishers is provided.

Room X-174 is a 4694 ft^2 room with a combustible loading consisting of exposed cables, hire hose in cabinets and a radiation bag dispenser. There is no equipment which contributes significantly to the combustible loading. There is no sprinkler protection for the room and it has been designated "no storage" for Unit 1 operation. It will also be designated "no storage" for Unit 2 operation. Ionization detection is provided for the room and manual suppression capability with portable extinguishers and hose stations is provided.

Room X-180 is the 3456 ft^2 main corridor. With a combustible loading consisting of exposed cables, a frisker station, anti-contamination clothing and a spill kit gang box. The corridor has complete automatic sprinkler protection with ceiling level.

* CONFIRMATION REQUIRED FOR DESIGN MODIFICATION TO ADD DETECTION

obstruction level and cable tray coverage. Ionization detection is provided and manual suppression capability with portable extinguishers and hose station is provided.

6.4.1.3 Results

Room X-165, X-172, X-173 and X-174

Thermo-Lag and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is low to very low in these areas. The fire duration is no more than 11 minutes on the C-Curve and the maximum temperature developed is 760°F which is well below the 1100°F critical temperature for steel. Also the arrangement of the combustibles and the lack of congested storage is not conducive to an intense, fast developing fire.

2. There is no sprinkler protection, but the addition of sprinkler protection would not substantially affect the ability of the supports to withstand a design basis fire due to the low severity and duration of a fire in these rooms. Ionization detection is provided throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls for the combustibles in these rooms:

   a. The rooms are designated "no storage"

   b. Additional margin of safety is provided by limiting the MPFL to 37,300 BTU/FT^2

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel was subjected to much higher temperatures for a much longer time than could occur with a fire in these rooms (See Section 6.2).

Room X-180

Thermo-Lag and cable trays which support FZR cables are not required to be protected based on the following:

1. Although the combustible loading in Room X-180 could be as much as 30% to 40% higher than the overall loading for the fire zone, it would still not produce critical temperatures because over half of the combustibles would have to be in the room before a C-Curve fire could reach the critical temperature of steel if allowed to burn freely without suppression being utilized. Also the arrangement and type of combustibles, predominately electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, boxes and on non-combustible shelves, is more conducive to a slow developing or smoldering fire which would be detected early and at relatively low temperatures.

2. There is complete automatic sprinkler protection in the room (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in this room which limits the MPFL to 37,300 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration on exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in Room X-280 would not reach the intensity level of the test fire even if no suppression was utilized and the fire was allowed to burn freely.

6.4.2 FIREZONE AA-21B

6.4.2.1 General

Firezone AA-21B is located on the 790' -6" elevation of the Auxiliary Building. There are 10 rooms in the fire zone, 2 of which contain Unit 2 Thermo-Lag or FZR cable (Rooms X-202 and X-207). Both rooms have complete automatic sprinkler protection. The combustible loading for the zone is 36,200 BTU/ft^2 and the fire duration utilizing temperature Curve C is 39 minutes with a maximum temperature of 1050°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.2.2 Discussion

Room X-202 is a 300 ft^2 room with a combustible loading consisting of a minor amount of exposed cables. There is no equipment in the area which contributes significantly to combustible loading. There is complete automatic sprinkler protection in the room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

Room X-207 is the 9887 ft^2 main corridor area which is 75% of the fire zone area. The combustible loading consists of exposed cable, fire hose, frisker station, anti-contamination clothing and various other minor amounts of ordinary combustibles (cloth, wood, paper, etc.) and plastics. The corridor has complete automatic sprinkler suppression with ceiling level, obstruction level and cable tray coverage. Ionization detection is provided and manual suppression capability with portable extinguishers and hose stations is provided.

6.4.2.3 Results

Thermo-Lag and FZR cable supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, and boxes on non-combustible shelves, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided with hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft$_2$.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in these rooms would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.3 FIRE ZONE AA-21C

6.4.3.1 General

Fire Zone AA-21C is located on the 822'-0" elevation of the Auxiliary Building. There are 2 rooms in this fire zone and only Room X-208 contains Unit 2 Thermo-Lag or FZR cable. There is no sprinkler protection for the room. The combustible loading for the zone is 2800 BTU/ft^2 and the fire duration utilizing the C-Curve is 3 minutes with a maximum temperature of 400°F. The MPFL is reduced to 37,300 BTU/ft^2 due to the non sprinklered rooms and Room X-208 will be designated as "no storage".

6.4.3.2 Discussion

Room X-208 is a 1400 ft^2 room with a combustible loading consisting of a minor amount of exposed cables. There is no equipment in the area which contributes significantly to combustible loading. There is no sprinkler protection for the room so it will be designated as a "no storage" room. Ionization detection is provided throughout and manual suppression capability with hose stations and portable extinguishers is provided.

6.4.3.3 Results

The supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is low in this room. The fire duration is only 4 minutes on the C-Curve and the maximum temperature developed is 400°F which is well below the 1100°F critical temperature for steel. Also the arrangement of the combustibles and the lack of congested storage is not conducive to an intense, fast developing fire.

2. There is no sprinkler protection, but the addition of sprinkler protection would not substantially improve the ability of the supports to witnstand a design basis fire due to the low severity and duration of a fire in this room. Ionization detection is provided throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls for the combustibles in these rooms:

   a. The rooms are designated "no storage"

   b. The MPFL is limited to 37,300 BTU/ft^2

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel was subjected to much higher temperatures for a much longer time than could occur with a fire in this room. Support steel for Thermo-Lagged raceways is more substantial than the steel construction of the cable trays in the test.

6.4.4 FIRE ZONE AA-21D

6.4.4.1 General

Fire Zone AA-21D is located on the 831' -6" elevation of the Auxiliary Building. There are 12 rooms in the fire zone and 3 contain Unit 2 Thermo-Lag or FZR cables (Rooms X-219, X-219A and X-226) which are the corridor areas. Rooms X-219 and X-226 have complete automatic sprinkler protection and room X-219A does not. The combustible loading for the zone is 17,000 BTU/ft^2 and the fire duration utilizing temperature Curve C is 18 minutes with a maximum temperature of 900°F. The MPFL is limited to 37,300 BTU/ft^2 due to room X-219A not being sprinklered.

6.4.4.2 Discussion

Room X-219 is a 936 ft^2 east/west connecting corridor between corridors X-219A and X-226. The combustible loading in this room consists of exposed cable, spill kit gang boxes, radiation bag dispenser, frisker station and some miscellaneous paper and plastic materials. There is complete automatic sprinkler suppression in the room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

Room X-219A is a 2088 ft^2 corridor. The combustible loading in this room is considerably lower than the loading for the remainder of the zone and consists of exposed cables, spill kit gang boxes, fire hose stations, radiation bag dispenser, frisker station and some miscellaneous paper and plastic materials. There is no automatic sprinkler suppression in this room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

Room X-226 is a 3460 ft^2 corridor. The combustible loading in this room is exposed cables, fire hose stations, anti-contamination clothes and miscellaneous minor amounts of ordinary combustibles (plastic and rubber materials). There is complete automatic sprinkler suppression in this room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

6.4.4.3 Results

The Thermo-Lag and FZR cable supports and cable trays which support FZR cables are not required to be protected based on the following:

The combustible loading is such that a C-Curve fire would reach temperatures near the critical temperature of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, and boxes on non combustible shelves is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler suppression in rooms X-219 and X-226 (see Section 1.5). There is no automatic suppression in room X-219A, but due to the reduced combustible loading in this room plus the ionization detection and manual suppression coverage by portable extinguishers and hose stations, the addition of automatic suppression would not significantly add to the ability of these supports to withstand the expected fire in this area.

3. There are administrative controls which limit the MPFL to 37,300 BTU/ft^2. Room X-219A will be designated as "no storage" due to the room not having sprinkler protection.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed in the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also the test was performed accordance with the standard time temperature curve (Curve E) which is more severe than would occur with the combustible loading in these rooms. A fire in these rooms would not reach the intensity level of the test fire even if no suppression was utilized and the fire was allowed to burn freely.

6.4.5 FIRE ZONE AA-21F

6.4.5.1 General

Fire Zone 21F is located on the 852' - 6" elevation of the Auxiliary Building. There are 7 rooms in the fire zone and 1 contains Unit 2 Thermo-Lag or FZR Cables (Room X-241). Room X-241 has complete automatic sprinkler protection. The combustible loading for the zone is 12,900 BUT/ft^2 and the fire duration utilizing temperature Curve C is 14 minutes with a maximum temperature of 875°F. The MPFL is limited to 15,000 BTU/ft^2 due to the 20 foot separation deviation in this area.

6.4.5.2 Discussion

Room X-241 is a 7978 ft^2 corridor area. The combustible loading consists of exposed cables, fire hose stations, lube oil in equipment, anti-contamination clothing, ion exchange resin, frisker station, radiation bag dispenser, spill kit gang box and some miscellaneous minor plastic and paper materials. There is complete automatic sprinkler protection in the room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

6.4.5.3 Results

Thermo-Lag and FZR cable supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would reach temperatures considerably below the critical temperature of steel even if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, mainly electrical cables in trays, ordinary combustibles and plastics well arranged in rolls, dispensers, and boxes and on non-combustible shelves and lube oils and resins in equipment is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler suppression in the room (see Section 1.5). There is ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in the room which limits the MPFL to 15,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed in the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also the test was performed in accordance with the standard temperature curve (Curve E) which is more severe than would occur with the combustible loading in room X-241. A fire in room X-241 would not reach the intensity level of the test fire even if no suppression was utilized and the fire was allowed to burn freely.

6.4.6 FIRE ZONE AA-154

6.4.6.1 General

Fire Zone AA-154 is located on the 778'-0" elevation of the Electrical Controls Building. Room 115E is the only room in the fire zone. This is the Unit 2 Chiller Room. The room has complete automatic suppression. The combustible loading is 22,800 BTU/ft^2 and the fire duration utilizing temperature Curve C is 25 minutes with a maximum temperature of 950°F. The MPFL is limited to 80,000 BTU/ft_2.

6.4.6.2 Discussion

Room X-115B is a 1672 ft^2 room with a combustible loading consisting of exposed cables and lube oil in equipment. The room is subdivided into 3 compartments by a combination of 1 hour rated fire walls and fire protection water curtains. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.6.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and lube oil in equipment is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test fire even if the no suppression was utilized and the fire allowed to burn freely.

6.4.7 FIRE ZONE EA-43

6.4.7.1 General

Fire Zone EA43 is located on the 778-0" elevation of the Electrical Controls Building. Room X-113 is the only room in the fire zone. The room has complete automatic sprinkler suppression. The combustible loading is 15,800 BTU/ft^2 and the fire duration utilizing temperature Curve C is 28 minutes with a maximum temperature of 950°F. The MPFL is limited to 80,000 BUT/ft^2.

6.4.7.2 Discussion

Room X-113 is a 9480 ft^2 room with a combustible loading consisting of exposed cables, lube oil in equipment, fire hose stations and minor amounts of paper and plastic materials. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression is capability provided by portable extinguishers and hose stations.

6.4.7.3 Results

Support associated with raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays, ordinary combustibles and plastics well arranged in rolls and lube oil in equipment is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on F2R cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test fire was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this rooms would not reach the intensity level of the test fire even if no suppression was utilized and the fire allowed to burn freely.

6.4.8 FIRE ZONE EA54

6.4.8.1 General

Fire Zone EA-54 is located on the 792' 0" elevation of the Electrical Control Building. Room X-122 is the only room in the fire zone. The room has complete automatic sprinkler protection. The combustible loading is 13,000 BTU/ft^2 and the fire duration utilizing temperature Curve C is 24 minutes with a maximum temperature of 950°F. The MPFL is limited to 80,000 BUT/ft^2.

6.4.8.2 Discussion

Room X-122 is a 516 ft^2 corridor area outside of the battery rooms. The combustible loading consists of exposed cable and a fire hose cabinet. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.8.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays, is more conductive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test fire even if no suppression was utilized and the fire was allowed to burn freely.

6.4.9 FIRE ZONE 2SA1C

6.4.9.1 General

Fire Zone 2SA1C is located on the 790'-6" elevation of Unit 2 Safeguards. There are 3 rooms in the fire zone and 2 room (2-063 and 2-064) have FZR cable. Room 2-063 has complete automatic sprinkler protection. Room 2-066 has no automatic suppression. The combustible loading is 8400 BTU/ft^2 and the fire duration utilizing temperature Curve C is 9 minutes with a maximum temperature of 750°F. The MPFL is limited to 37,300 BTU/ft^2 due to room 2-064 not having automatic sprinkler protection.

6.4.9.2 Discussion

Room 2-063 is a 922 ft^2 room with a combustible loading consisting of exposed cables. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

Room 2-066 is a 546 ft^2 room with a combustible loading consisting of exposed cables. There is no automatic suppression in the room so it will be designated as a "no storage" room. Ionization detection is provided throughout and manual suppression capability with portable extinguishers and hose stations is provided.

6.4.9.3 Results

Thermo-Lag and FZR cable supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is low in these rooms. The fire duration is only 9 minutes on the C-Curve and the maximum temperature developed is 740°F which is well below the 1100°F critical temperature for steel. Also, the arrangement of the combustibles and the lack of congested storage is not conductive to an intense, fast developing fire.

2. There is automatic sprinkler protection in room 2-063 but none in room 2-066. Addition of sprinkler protection would not substantially improve the ability of the supports to withstand a design basis fire due to the low severity and duration of a fire in this room. Ionization detection is provided throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls for the combustibles in these rooms:

   a. Room 2-066 will be designated "no storage"
   b. The MPFL is limited to 37,300 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel was subjected to much higher temperatures for a much longer time than could occur with a fire in this room.

6.4.10 FIRE ZONE 2SA142

6.4.10.1 General

Fire Zone 2SA142 is located on the 810'-6" elevation of Unit 2 Safeguards. Room 2-077A is the only room in the fire zone. Room 2-077A has complete automatic sprinkler protection. The combustible loading is 11,800 BTU/ft^2 and the fire duration utilizing temperature Curve C is 13 minutes with a maximum temperature of 850°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.10.2 Discussion

Room 2-077A is a 1195 ft^2 room with a combustible loading consisting of exposed cables. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.10.3 Results

Supports associated with Thermo-lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would not reach temperatures near the critical temperatures of steel even if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, electrical cables in trays, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these room which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.11 FIRE ZONE 2SB4

6.4.11.1 General

Fire Zone 2SB4 is located on the 790'-6" elevation of Unit 2 Safeguards. This fire zone consists of 5 rooms, 2 of which have Thermo-Lag or FZR cable (Rooms 2-070 and 2-071). Rooms 2-070 and 2-071 are corridor areas on this elevation. The combustible loading for this fire zone is 26,200 BTU/ft^2 and the fire duration utilizing temperature Curve C is 28 minutes with a maximum temperature of 950°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.11.2 Discussion

Room 2-070 is a 4155 ft^2 corridor area with a combustible loading consisting of exposed cables, 3 fire hose stations, anti-contamination, clothing and frisker stations. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

Room 2-071 is a 610 ft^2 corridor area with a combustible loading consisting of exposed cables and a fire hose station. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.11.3 Results

Thermo-Lag and FZR cable supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would not reach temperatures near the critical temperatures of steel even if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, electrical cables in trays, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these room which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test fire even if no suppression was utilized and the fire was allowed to burn freely.

6.4.12 FIRE ZONE 2SB8

6.4.12.1 General

Fire Zone 2SB8 is located on the 810'-6" elevation of Unit 2 Safeguards. The fire area consists of 3 rooms, 2 of which have Thermo-Lag or FZR cable (2-079 and 2-082). Rooms 2-079 and 2-082 are corridor areas on this elevation. The combustible loading for the zone is 101,300 BUT/ft^2 and the fire duration utilizing temperature Curve C is 109 minutes with a maximum temperature of 950°F. The MPFL is 80,000 BTU/ft^2 so the actual fire loading exceeds the MPFL. This has been justified in the Fire Protection Report (Ref. 5.18) due to provision of ionization detection and automatic sprinkler protection commensurate with the hazards in the area to ensure a postulated fire will not spread out of the area.

6.4.12.2 Discussion

Room 2-079 is a 774 ft^2 corridor area with a combustible loading consisting of exposed cables and a fire hose station. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

Room 2-082 is a 2702 ft^2 corridor area with a combustible loading consisting of exposed cables, fire hose stations, anti-contamination clothing, spill kit gang box, frisker station and radiation bag dispenser. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.12 Results

Thermo-Lag supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire will reach temperatures above the critical temperatures of steel even if allowed to burn freely without suppression being utilized. However, the arrangement and type of combustibles, electrical cables in trays is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). Due to the congestion of cable trays in this area, most of the trays have cable tray suppression as well as ceiling level and obstruction level coverage. There is also ionization detection throughout and manual suppression capability is provided by hose station and portable extinguishers.

3. There are administrative controls on the combustibles in these room which limit the MPFL to 80,000 BTU/ft^2. Since the actual combustible loading exceeds MPFL there can be no additional combustibles brought into area.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.13 [illegible]

6.4.13.1 [illegible]

[illegible] ne 2SB15 is located on the 831'-6" elevation of Unit 2 [illegible]ards. This fire zone consists of 2 rooms, 1 of which has Thermo-Lag or FZR cable (Room 2-094). Room 2-094 is the corridor area on this elevation. The combustible loading for the fire zone is 43,200 BTU/ft^2 and the fire duration utilizing temperature Curve C is 46 minutes with a maximum temperature of 1300°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.13.2 Discussion

Room 2-094 is a 3468 ft^2 corridor area with a combustible loading consisting of exposed cables, fire hose station, spill kit gang box, frisker station, anti-contamination clothing and some miscellaneous ordinary combustibles, rubber and plastics. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.13.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could exceed critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, boxes and on non-combustible shelves, is more conductive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. Although a fire in this room would reach the intensity level of the test fire if no suppression was utilized and the fire burned at the intensity of a C curve, the type and arrangement of combustibles would not result in a fast developing fire and suppression would be utilized before the fire reached the critical temperature.

6.4.14 FIRE ZONE 2SB144

6.4.14.1 General

Fire Zone 2SB144 is located on the 831'-6" elevation of Unit 2 Safeguards. This fire zone consists only of room 2-088. The combustible loading is 7300 BTU/ft^2 and the fire duration utilizing temperature Curve C is 8 minutes with a maximum temperature of 700°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.14.2 Discussion

Room 2-088 is a 1843 ft^2 room with a combustible loading consisting of exposed cables. There is complete automatic suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.14.3 Results

Thermo-Lag supports and cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would be considerably less than the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, electrical cables in trays is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. Although a fire in this room would reach the intensity level of the test fire if no suppression was utilized and the fire burned at the intensity of a C curve, the type and arrangement of combustibles would not result in a fast developing fire and suppression would be utilized before the fire reached the critical temperature.

6.4.15 FIRE ZONE 2SD9

6.4.15.1 General

Fire Zone 2SD9 is located on the 810'-6" elevation of Unit 2 Safeguards. The fire zone consists of 2 rooms, 1 of which has Thermo-Lag (Room 2-083)). The combustible loading is 44,300 BTU/ft^2 and the fire duration utilizing temperature Curve C is 48 minutes with a maximum temperature of 1350°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.15.2 Discussion

Room 2-083 is a 6554 ft^2 electrical equipment room with a combustible loading consisting of exposed cables, fire hose stations and various amounts of ordinary combustibles, rubber and plastics. There is complete manually operated sprinkler suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.15.3 Results

Support associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would exceed temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, boxes and on now combustible shelves, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete manually actuated sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely due to the type and configuration of the combustibles.

6.4.16 FIRE ZONE 2SE16

6.4.16.1 General

Fire Zone 2SE16 is located on the 831'-6" evaluation of Unit 2 safeguards. The fire zone consists of Room 2-096 only. The combustible loading is 31,700 BTU/ft^2 and the fire duration utilizing temperature Curve C is 34 minutes with a maximum temperature of 1000°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.16.2 Discussion

Room 2-0S6 is a 5105 ft^2 electrical equipment room with a combustible loading of exposed cables, and minor amounts of ordinary combustibles, plastics, rubber, grease and small containers of flammable and combustible liquids. There is complete manually operated sprinkler suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.16.3 Results

Thermo-Lag supports are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures near the critical temperatures if steel is allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls dispensers, boxes and on non-combustible shelves, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete manually actuated sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BUT/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had realized a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression utilized and the fire was allowed to burn freely.

6.4.17 FIRE ZONE 2SE18

6.4.17.1 General

Fire Zone 2SE18 is located on the 852-6" evaluation of Unit 2 Safeguards. The Fire Zone consists of 3 rooms, 1 of which has Thermo-Lag (2-103). The combustible loading is 21,000 BTU/ft^2 and the fire duration utilizing temperature Curve C is 23 minutes with a maximum temperature of 900°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.17.2 Discussion

Room 2-103 is a 7259 ft^2 electrical equipment room with a combustible loading consisting of exposed cables, fire hose stations, plastics in equipment and some miscellaneous paper, rubber and plastic materials. There is complete manually operated sprinkler suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hoses stations.

6.4.17.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that C-Curve fire could reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and ordinary combustibles and plastics well arranged in rolls, dispensers, boxes and on non-combustible shelves, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete manually actuated sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.18 FIRE ZONE 2SK17A

6.4.18.1 General

Fire Zone 2SK17A is located on the 852'-6" elevation of Unit 2 Safeguards. The Fire Zone consists of 8 approximately equal sized rooms, 2 of which contain Thermo-Lag (Rooms 2-100B and 2-100F). The combustible loading is 800 BTU/ft^2 and the fire duration utilizing temperature Curve C is 1 minute with the maximum temperature of 300°F. The MPFL is limited to 1800 BTU/ft^2.

6.4.18.2 Discussion

Rooms 2-100B and 2-100F are each approximately 460 ft^2 rooms with a combustible loading consisting of a minor amount of exposed cables and lube oil in a valve in Room 2-100F. There is complete automatic sprinkler suppression for both rooms, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.18.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would be much less than the critical temperatures of steel even if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and a minor amount of lube oil in valves is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 1800 BTU/ft^2. Also the rooms are designated as "no storage" due to a 20 foot separation deviation.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.19 FIRE ZONES 2SK17B AND 17C

6.4.19.1 General

Fire Zones 2SK17B and 17C are located on the 873'-6" and 880'-6" elevation, respectively, of Unit 2 Safeguards. Although they are considered separate fire zones there is no physical separation. Rooms 2-108B and 2-109B, which are the only room in these zones to have Thermo-Lag, are actually the same room physically. The combustible loading for zone 17B is 1800 BTU/ft^2 and the fire duration, utilizing temperature Curve C is 1 minute with a maximum temperature of 400°F. Fire Zone 17C has no combustible loading. Both rooms will be designated as "no storage" due to a deviation for 20' separation requirements. The MPFL is limited to 1800 BTU/ft^2.

6.4.19.2 Discussion

Rooms 2-108B and 2-109B are 460 ft^2 rooms with a combustible loading consisting of a minor amount of exposed cables. There is complete automatic sprinkler suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.19.3 Results

Supports associated with Thermo-Lagged raceways are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would not result in temperatures any where near the critical temperatures of steel even if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly a minor amount of electrical cables is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 1800 BTU/ft^2. Also the rooms are designated as "no storage" due to a 20 foot separation deviation.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in these rooms would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.20 FIRE ZONE 2SL-2K100

6.4.20.1 General

Fire Zone 2SL-2K100 is located on the 852'-6" elevation of Unit 2 Safeguards. Room 2-100 is the only room in this fire zone. The combustible loading is 48,400 BUT/ft^2 and the fire duration utilizing temperature Curve C is 52 minutes with a maximum temperature of 1500°F. The MPFL is limited to 80,000 BTU/ft^2.

6.4.20.2 Discussion

Room 2-100 is a 751 ft^2 room with a combustible loading of exposed cables and a fire hose station. There is complete automatic sprinkler suppression in the room, ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.20.3 Results

Cable trays which support FZR cables are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire could reach temperatures in excess of the critical temperatures of steel if allowed to burn freely without suppression being utilized. The arrangement and type of combustibles, predominantly electrical cables in trays and a minor amount of lube oil in valves, is more conducive to a slow developing or smoldering fire which would be detected early at relatively low temperatures.

2. There is complete automatic sprinkler protection (see Section 1.5). There is also ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 80,000 BTU/ft^2.

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-Curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

6.4.21 FIRE ZONE 2S03

6.4.21.1 General

Fire Zone 2S03 is a stairway which extends from the 773'-0" to the 860'-0" elevations in Unit 2 Safeguards. Each elevation had its own room number. The FZR cable passes through this zone on the 790'-6" elevation (Room-2-074A). The combustible loading is 8000 BTU/ft^2 and the fire duration utilizing temperatures Curve C is 9 minutes with a maximum temperature of 700°F. The MPFL is limited to 37,300 BTU/ft^2 due to Room 2-074A being non-sprinklered.

6.4.21.2 Discussion

Room 2-074A is the stairwell landing on the 790'-6" elevation. There is negligible combustible loading at this location. The combustible loading for the zone consists mainly of a fire hose cabinet at the 773'-0" elevation and exposed cables at the 860'-0" elevation. There is no automatic sprinkler suppression so the room will be designated as "no storage". Ionization detection is provided throughout and manual suppression capability is provided by portable extinguishers and hose stations.

6.4.21.3 Results

FZR cable supports are not required to be protected based on the following:

1. The combustible loading is such that a C-Curve fire would not reach temperatures near the critical temperatures of steel if allowed to burn freely without suppression being utilized. The lack of combustibles in the room, the only combustibles beneath this area being an enclosed hose cabinet and the nearest significant combustibles being located on the 860'0" elevation makes it extremely unlikely that any kind of fire will expose this cable.

2. There is no automatic suppression but the addition of suppression would not improve on the ability of the supports to withstand the type of fire expected in the room due in the very low combustible loading. There is ionization detection throughout and manual suppression capability is provided by hose stations and portable extinguishers.

3. There are administrative controls on the combustibles in these rooms which limit the MPFL to 37,300 BTU/ft^2 and the room will be designated as "no storage".

4. The fire test conducted on FZR cable did not have deterioration of exposed cable tray steel until the steel had been exposed to the test fire for over 40 minutes and had reached a temperature of over 1600°F. Also, the test was performed in accordance with the standard temperature curve (E-curve) which is more severe than would occur with the combustible loading. A fire in this room would not reach the intensity level of the test even if no suppression was utilized and the fire was allowed to burn freely.

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RACEWAY SUPPORT ANALYSIS MATRIX

FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 3.8) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 3.8) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (ASSUMP 3.8) (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
AA	21a	X-165	T	NO	37,300	10,500	8/1150	EXP. CABLE, FIRE HOSE, ANTI-C CLOTHING FRISKER STA., RAD. BAG DISP., PAPER, PLASTIC, VINYL (PLASTIC SPILL KIT GANG BOX	11/760	A	ACCEPT.
		X-172	T	NO						A	ACCEPT.
		X-173	T	NO						A	ACCEPT
		X-174	R&T	NO						A	ACCEPT
		X-180	R&T	YES						N/A	ACCEPT
AA	21b	X-202	T	YES	80,000	36,200	27/1550	EXP. CABLE, FIRE HOSE, FRISKER & ANTI-C STA., AND MISC. ORD. COMB & PLASTICS	39/1050	N/A	ACCEPT.
		X-207	R&T	YES						N/A	ACCEPT.
AA	21C	X-208	T	NO	37,300	2,800	2/700	EXPOSED CABLE	3/400	A	ACCEPT.
AA	21d	X-219	T	YES	37,300	17,000	13/1350	EXP. CABLE, FIRE HOSE, ANTI-C & FRISKER STA., SPILL KIT GANG BOX, RAD. BAG DISP. AND MISC ORD. COMB & PLASTIC	18/900	N/A	ACCEPT.
		X-219A	T	NO						A	ACCEPT.
		X-226	R&T	YES						N/A	ACCEPT.

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 38) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 38) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
AA	21f	X241	R & T	YES	15,000	12,900	10/1250	EXP. CABLES, LUBE OIL, FIRE HOSE, ANTI-C & FRISKER STA ION EXCHG RESIN, SPILL KIT GANG BOX & MISC. ORD COMB & PLASTICS	14/875	N/A	ACCEPT.
AA	154	X115D	T	YES	89,000	22,800	17/1475	EXPOSED CABLE & LUBE OIL	25/950	N/A	ACCEPT.
EA	43	X113	T	YES	80,000	15,800	12/1350	EXP. CABLES, LUBE OIL, HOSE STA PLUS MINOR AMTS OF ORD. COMB & PLASTICS	28/950	N/A	ACCEPT
EA	54	X122	T	YES	80,000	13,000	10/1250	EXP. CABLES FIRE HOSE STA.	24/950	N/A	ACCEPT
2SA	1C	2-063	R	YES	37300	8400	6/1000	EXP. CABLE	9/740	N/A	ACCEPT
		2-066	R	NO						A	ACCEPT

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 38) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 38) (BTU/FT²) (G)	FIRE DUR / MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR / MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
AA	21f	X241	R&T	YES	15,000	12,900	10/1250	EXP. CABLES, LUBE OIL, FIRE HOSE, ANTI-C & FRISKOSE STA. IONEXCHG RESIN, SPILL KIT, GARB BOX & MISC. ORD. COMB & PLASTICS	14/875	N/A	ACCEPT.
AA	154	X115D	T	YES	80,000	22,800	17/1475	EXPOSED CABLE & LUBE OIL	25/950	N/A	ACCEPT.
EA	43	X113	T	YES	80,000	15,800	12/1350	EXP. CABLES, LUBE OIL, HOSE STA PLUS NUMBER UNITS OF ORD COMB & PLASTICS	28/950	N/A	ACCEPT
EA	54	X122	T	YES	80,000	13,000	10/1250	EXP. CABLES FIRE HOSE STA.	24/950	N/A	ACCEPT
2SA	1C	2-063	R	YES	37300	8400	6/1000	EXP. CABLE	9/740	N/A	ACCEPT
		2-066	R	NO						A	ACCEPT

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 38) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 38) BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SA	142	2-077A	T	YES	80,000	11,800	9/1225	EXP. CABLE	13/850	N/A	ACCEPT.
2SB	4	2-070	R&T	YES	80,000	26,200	20/1475	EXP. CABLE, FIRE HOSE, ANTI-C CLOTHING, FRISKER STA.	28/950	N/A	ACCEPT
		2-071	R&T	YES						N/A	ACCEPT
2SB	8	2-079	T	YES	80,000	101,300	76/1750	EXP. CABLE, FIREHOSE, ANTI-C & FRISKER STA. SPILL KIT GANG BOX, VINYL, TRASH, & MISC PLASTIC & RUBBER	109/1850	N/A	ACCEPT.
		2-082	R&T	YES						N/A	ACCEPT.
2SB	15	2-094	T	YES	80,000	43,200	32/1580	EXP. CABLE, FIRE HOSE, ANTI-C & FRISKER STA., SPILL KIT GANG BOX, AND MINOR AMOUNT OF ORD COMB, PLASTIC, RUBBER AND OIL.	46/1300	NA	ACCEPT

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 38 (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 38 (BTU/FT²) (G)	FIRE DUR. / MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR. / MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SB	144	2-088	R&T	YES	80,000	7300	6/1000	EXP. CABLE	8/700	NA	ACCEPT.
2SD	9	2-083	T	YES-M	80,000	44,300	33/1600	EXP. CABLE, FIRE HOSE & VARIOUS AMTS OF ORD COMB., RUBBER, PLASTIC & FLAM/COMB LIQ.	48/1350	NA	ACCEPT
2SE	16	2-096	T	YES-M	80,000	31,700	24/1500	EXP. CABLE, FIRE HOSE, RUBBER, PAPER & PLASTIC WITH MINOR AMOUNTS OF ORD. COMB., COMB. FLAM. LIQ & LUB.	34/1000	N/A	ACCEPT
2SE	18	2-103	T	YES-M	80,000	21,000	16/1400	EXP. CABLE, FIRE HOSE, RUBBER, PAPER, PLASTIC, TRASH BARRELS & EPOXY	23/900	N/A	ACCEPT.

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 3.8) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP 3.8) (BTU/FT²) (G)	FIRE DUR. / MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR. / MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT. / UNACCEPT. (L)
2SK	17A	2-100B	T	YES	1800	800	1/300	EXP. CABLE, LUBE OIL	1/300	B	ACCEPT
		2-100F	T	YES						B	ACCEPT
2SK	17B	2-108B	T	YES	1800	1800	1/300	EXP. COMB & LUBE OIL	2/400	B	ACCEPT
2SK	17C	2-109B	T	YES	1800	0	0/0	NONE	0/0	B	ACCEPT
2SL	SK100	2-100	R	YES	80,000	48,400	.6/1600	EXP. CABLE, FIRE HOSE	52/1500	N/A	ACCEPT
2SO	3	2-074A	R	NO	37,300	8000	6/1000	EXP CABLE, FIRE HOSE, FRISKER STA	9/700	A	ACCEPT

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ATTACHMENT A

RACEWAY SUPPORT ANALYSIS MATRIX

FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 3.8) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 3.8) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SA	142	2-077A	T	YES	80,000	11,800	9/1225	EXP. CABLE	13/850	N/A	ACCEPT.
2SB	4	2-070	R&T	YES	80,000	26,200	20/1475	EXP. CABLE, FIRE HOSE, ANTI-C CLOTHING, FRISKER STA.	28/950	N/A	ACCEPT
		2-071	R&T	YES						N/A	ACCEPT
2SB	8	2-079	T	YES	80,000	101,300	76/1750	EXP. CABLE, FIREHOSE, ANTI-C & FRISKER STA. SPILL KIT GANG BOX, VINYL, TRASH, & MISC PLASTIC & RUBBER	109/1850	N/A	ACCEPT.
		2-082	R&T	YES						N/A	ACCEPT.
2SB	15	2-094	T	YES	80,000	43,200	32/1580	EXP. CABLE, FIRE HOSE, ANTI-C & FRISKER STA., SPILL KIT GANG BOX, AND MINOR AMOUNT OF ORD. COMB. PLASTIC, RUBBER AND OIL.	46/1300	NA	ACCEPT.

ATTACHMENT A

RACEWAY SUPPORT ANALYSIS MATRIX

FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 38) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 38) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SA	142	2-077A	T	YES	80,000	11,800	9/1225	EXP. CABLE	13/850	N/A	ACCEPT.
2SB	4	2-070	R&T	YES	80,000	26,200	20/1475	EXP. CABLE, FIRE HOSE, ANTI-C CLOTHING, FRISKER STA.	28/950	N/A	ACCEPT
		2-071	R&T	YES						N/A	ACCEPT
2SB	8	2-079	T	YES	80,000	101,300	76/1750	EXP. CABLE, FIREHOSE, ANTI-C & FRISKER STA. SPILL KIT, GANG BOX, VINYL, TRASH, & MISC PLASTIC & RUBBER	109/1850	N/A	ACCEPT.
		2-082	R&T	YES						N/A	ACCEPT.
2SB	15	2-094	T	YES	80,000	43,200	32/1580	EXP. CABLE, FIRE HOSE, ANTI-C & FRISKER STA., SPILL KIT GANG BOX, AND MINOR AMOUNT OF ORD. COMB., PLASTIC, RUBBER AND OIL.	46/1300	NA	ACCEPT

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ATTACHMENT A

RACEWAY SUPPORT ANALYSIS MATRIX

FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MPFL (ASSUMP 3.8) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 3.8) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SB	144	2-088	R&T	YES	80,000	7300	6/1000	EXP. CABLE	8/700	NA	ACCEPT.
2SD	9	2-083	T	YES-M	80,000	44,300	33/1600	EXP. CABLE, FIRE HOSE & VARIOUS AMTS OF ORD. COMB., RUBBER, PLASTIC & FLAM/COMB LIQ.	48/1350	NA	ACCEPT.
2SE	16	2-096	T	YES-M	80,000	31,700	24/1500	EXP. CABLE, FIRE HOSE, RUBBER, PAPER & PLASTIC WITH MINOR AMOUNTS OF ORD. COMB., COMB/ FLAM. LIQ & LUB.	34/1000	N/A	ACCEPT
2SE	18	2-103	T	YES-M	80,000	21,000	16/1400	EXP. CABLE, FIRE HOSE, RUBBER PAPER, PLASTIC TRASH BARRELS & EPOXY	23/900	N/A	ACCEPT.

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ATTACHMENT A

RACEWAY SUPPORT ANALYSIS MATRIX

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FIRE AREA (A)	FIRE ZONE (B)	ROOM (C)	T-LAG / FZR (D)	A.S. COVG. (E)	MFFL (ASSUMP 3B) (BTU/FT²) (F)	ACTUAL FIRE LOAD (ASSUMP. 3B) (BTU/FT²) (G)	FIRE DUR./ MAX. TEMP. E-CURVE (MIN/°F) (H)	TYPES OF COMBUSTIBLES (I)	FIRE DUR./ MAX TEMP. C-CURVE (MIN./°F) (J)	ADMIN CONTR. (K)	RESULTS: ACCEPT./ UNACCEPT. (L)
2SK	17A	2-100B	T	YES	1800	800	1/300	EXP. CABLE, LUBE OIL	1/300	B	ACCEPT
		2-100F	T	YES						B	ACCEPT
2SK	17B	2-108B	T	YES	1800	1800	1/300	EXP. COMB & LUBE OIL	2/400	B	ACCEPT
2SK	17C	2-109B	T	YES	1800	0	0/0	NONE	0/0	B	ACCEPT
2SL	SK100	2-100	R	YES	80,000	48,400	36/1600	EXP. CABLE, FIRE HOSE	52/1500	N/A	ACCEPT
2SO	3	2-014A	R	NO	37,300	8000	6/1000	EXP. CABLE, FIRE HOSE, FRISKER STA.	9/700	A	ACCEPT

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ATTACHMENT B

Fire Severity Expected by Occupancy

Temperature Curve A (Slight)

Well-arranged office, metal furniture, noncombustible building.
Welding areas containing slight combustibles.
Noncombustible power house.
Noncombustible buildings, slight amount of combustible occupancy.

Temperature Curve B (Moderate)

Cotton and waste paper storage (baled) and well-arranged, noncombustible building.
Paper-making processes, noncombustible building.
Noncombustible institutional buildings with combustible occupancy.

Temperature Curve C (Moderately Severe)

Well-arranged combustible storage, e.g., wooden patterns, noncombustible buildings.
Machine shop having noncombustible floors.

Temperature Curve D (Severe)

Manufacturing areas, combustible products, noncombustible building.
Congested combustible storage areas, noncombustible building.

Temperature Curve E (Standard Fire Exposure—Severe)

Flammable liquids.
Woodworking areas.
Office, combustible furniture and buildings.
Paper working, printing, etc.
Furniture manufacturing and finishing.
Machine shop having combustible floors.

NOTE: THIS FIGURE IS A REPRODUCTION FROM PAGE 7-112, NFPA HANDBOOK, 16TH EDITION. (REF. 5.1)

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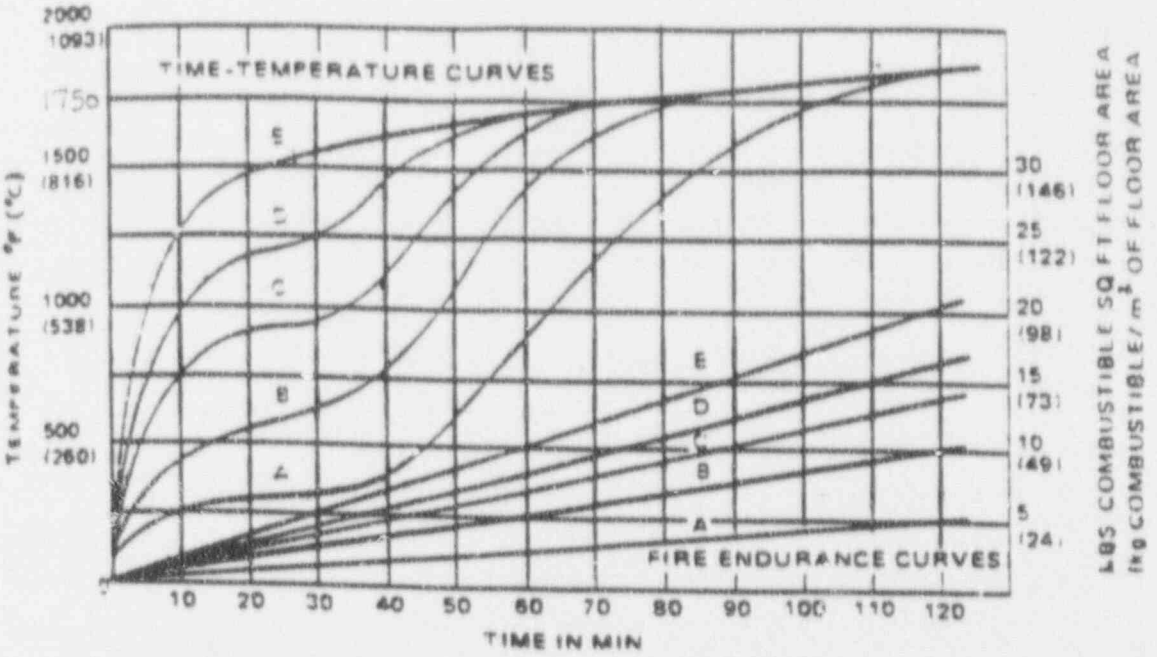
ATTACHMENT C



Possible classification of building contents for fire severity and duration. The straight lines indicate the length of fire endurance based upon amounts of combustibles involved. The curved lines indicate the severity expected for the various occupancies. (See ATT. B)

NOTE: THIS FIGURE IS A REPRODUCTION FROM PAGE 7-113, NFPA HANDBOOK, 16TH EDITION. (REF. 5.1)

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ATTACHMENT D

DERIVATION OF THE MAXIMUM HEAT RELEASE RATE

IN ORDER TO DETERMINE HOW LONG IT WILL TAKE FOR A FIRE BURNING IN ACCORDANCE WITH A PARTICULAR TIME-TEMPERATURE CURVE (SEE ATTACHMENT C) TO CONSUME THE COMBUSTIBLE LOADING FOR A PARTICULAR FIRE ZONE (FIRE DURATION ON ATTACHMENT A), A BURN RATE OR MAXIMUM HEAT RELEASE RATE MUST BE DEVELOPED.

THE FOLLOWING FORMULA IS UTILIZED:

$Mx = (De)(hc)$ WHERE:

M = MAXIMUM HEAT RELEASE (BTU)/FT^2/HR

x = TIME-TEMPERATURE CURVE (SEE ATTACH.C)

De = EQUIVALENT DENSITY BURN RATE OF COMBUSTIBLES AS COMPARED TO WOOD (LB/FT^2/HR). THIS IS THE INTERSECTION POINT OF THE APPROPRIATE FIRE ENDURANCE CURVE (SEE ATTACHMENT C) AND ONE(1) HOUR.*

hc = HEAT OF COMBUSTION OF WOOD (BTU/LB) (NFPA HANDBOOK, 16TH EDITION, PG 7-111)

* THE FIRE ENDURANCE CURVE IS LINEAR WITH RESPECT TO TIME. THEREFORE, THE USE OF THE DENSITY BURN RATE TO DETERMINE FIRE DURATION OTHER THAN ONE(1) HOUR IS CORRECT.

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NOTE: ONLY TIME-TEMPERATURE CURVES E AND C ARE USED.

C-CURVE:

$M_C = (7\ LB/FT^2/HR)\ (8000\ BTU/LB)$

$= 56{,}000\ BTU/FT^2/HR$

E-CURVE:

$M_e = (10\ LB/FT^2/HR)\ (8000\ BTU/LB)$

$= 80{,}000\ BTU/FT^2/HR$