Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1126-1974** **Building:** Auxiliary **Fire Area:** A-07

Description: Boron Injection Tank & Pump Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1341	N/A
Member Type:	Beam	N/A
Member Size:	18 X 45	N/A
Comments:	Additional attachments in close proximity, beam temp acceptable.	Column is embedded, columns considered bounded no review required.

NUREG-1805 FDT Input Data

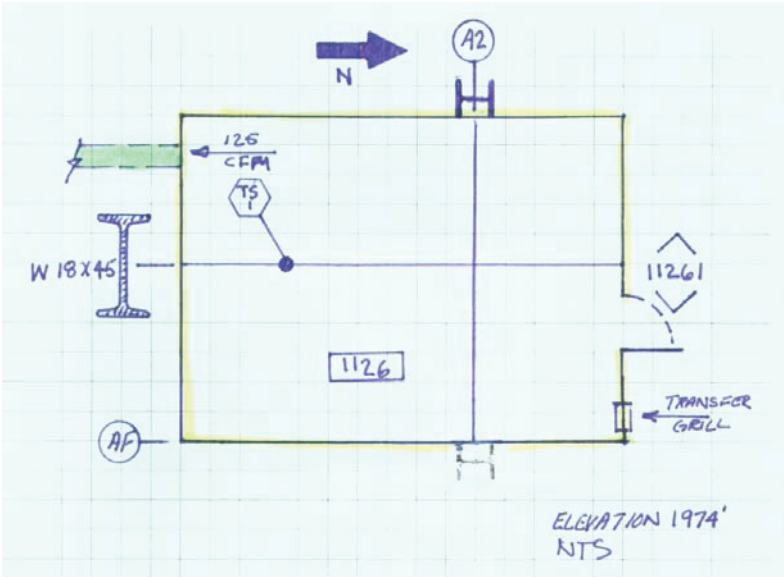
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 125, Open Grille Exht: 125
Compartment Width (ft):	17	**Vent Description:**	Open Grille
Compartment Length (ft):	16		
Compartment Height (ft):	25	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	200
Hot Gas Layer Temperature @ 180 minutes (F):	**1067.67**

Room Sketch:

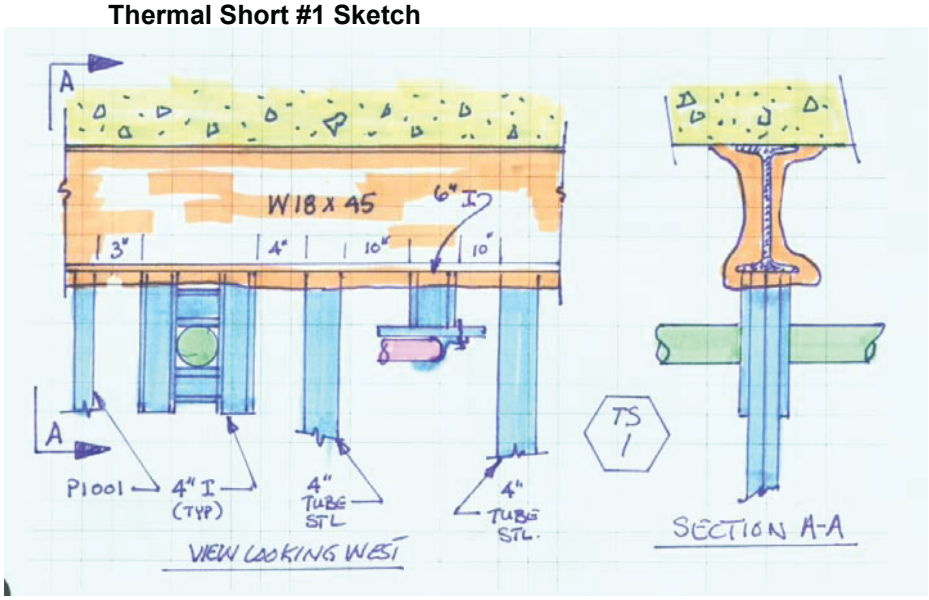


Structural Steel Fireproofing Data

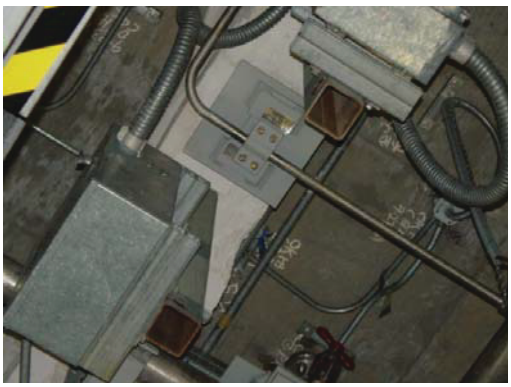
Appendix G3D

1126-1974

Thermal Short #1 Sketch



Thermal Short #1 Photo 1



Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1311-2000** **Building:** Auxiliary **Fire Area:** A-08

Description: Sampling Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1421	N/A
Member Type:	Beam	N/A
Member Size:	24 X 76	N/A
Comments:	Orientation reduces 1 ea 4" I area. Beam temp. acceptable.	No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW): 650

Compartment Width (ft): 18

Compartment Length (ft): 16

Compartment Height (ft): 25

Barrier Type: Concrete

Forced Ventilation Rate (cfm): Supply: 100
Exht: 100

Vent Description:

Temp not in USAR Table 3.11, used adjacent rooms that are similar

Initial Room Temp. (F): 104

Barrier Thickness (in): 24

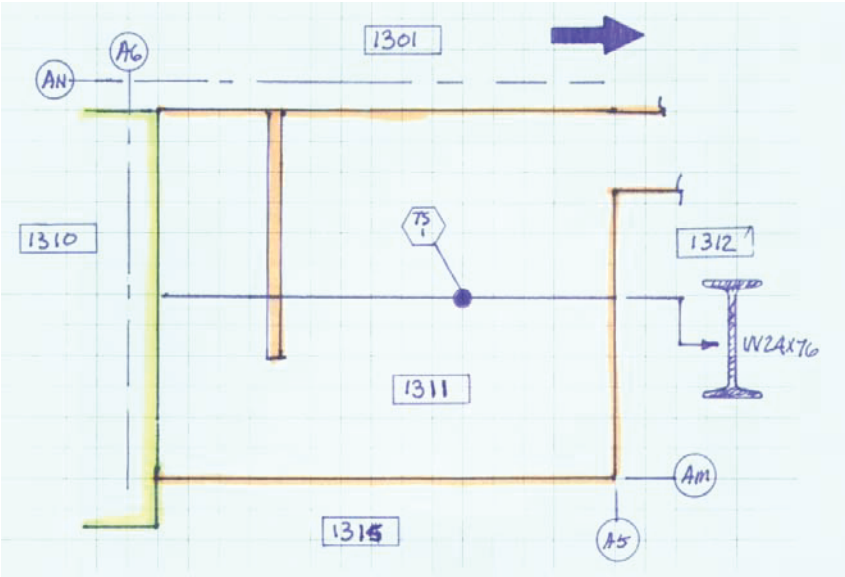
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent. FDT: 200

Hot Gas Layer Temperature @ 180 minutes (F): **1036.29**

Room Sketch:

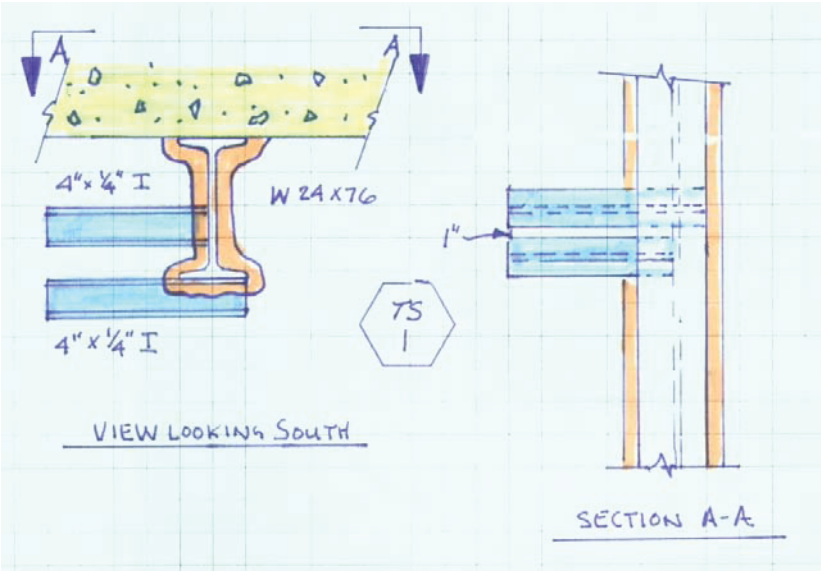


Structural Steel Fireproofing Data

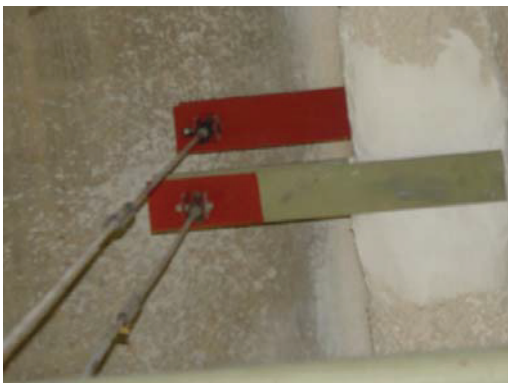
Appendix G3D

1311-2000

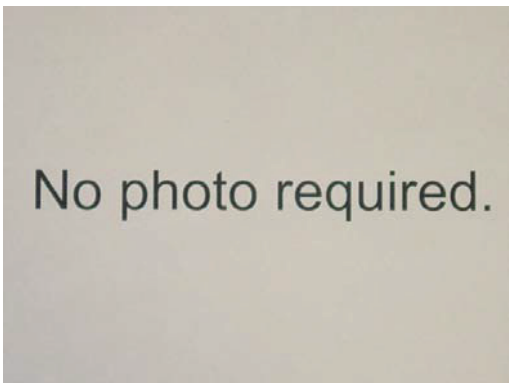
Thermal Short #1 Sketch



Thermal Short #1 Photo 1



Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1325-2000** **Building:** Auxiliary **Fire Area:** A-13

Description: Aux Feedwater Pump Rm B

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	N/A
Member Type:	Beam	N/A
Member Size:	30 X 99	N/A
Comments:	Beam temp. acceptable.	Columns (2) encapsulated in concrete, no issues w/columns, considered bound by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW): 650

Compartment Width (ft): 22

Compartment Length (ft): 14

Compartment Height (ft): 24

Barrier Type: Concrete

Forced Ventilation Rate (cfm): Supply: 100 Exht: 100

Vent Description:

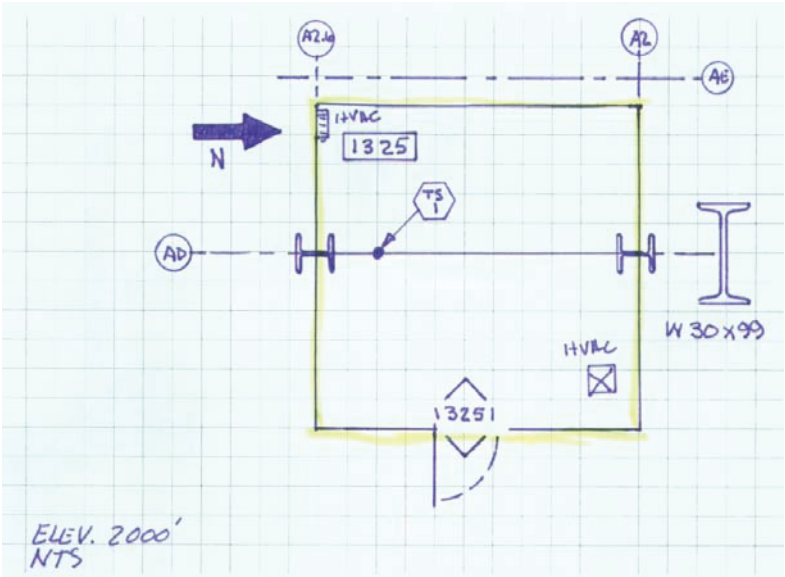
Initial Room Temp. (F): 104

Barrier Thickness (in): 12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	200
Hot Gas Layer Temperature @ 180 minutes (F):	**1012.05**

Room Sketch:

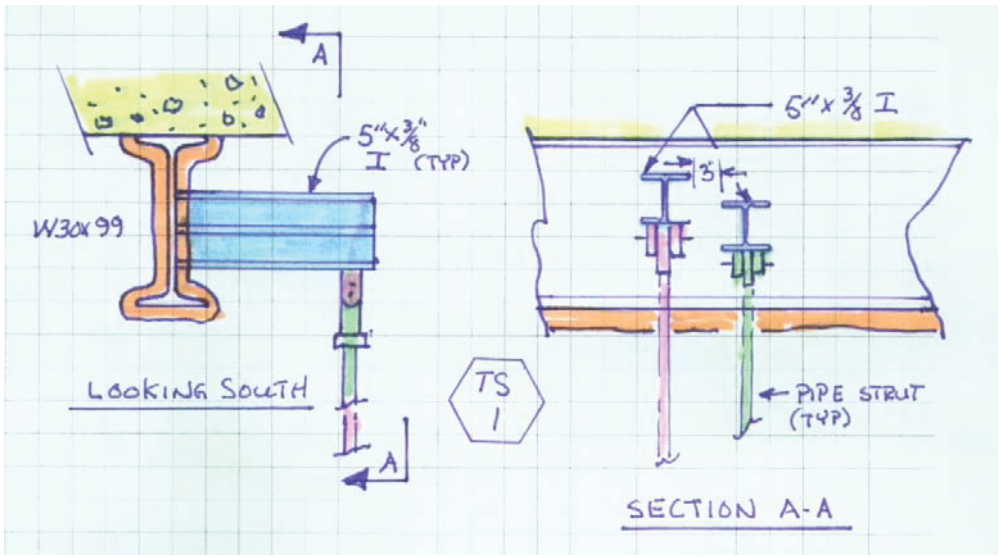


Structural Steel Fireproofing Data

Appendix G3D

1325-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1326-2000** **Building:** Auxiliary **Fire Area:** A-14

Description: Aux Feedwater Pump Rm A

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	N/A
Member Type:	Beam	N/A
Member Size:	24 X 76	N/A
Comments:		Column encapsulated in concrete, no issues w/column, considered bounded by testing.

NUREG-1805 FDT Input Data

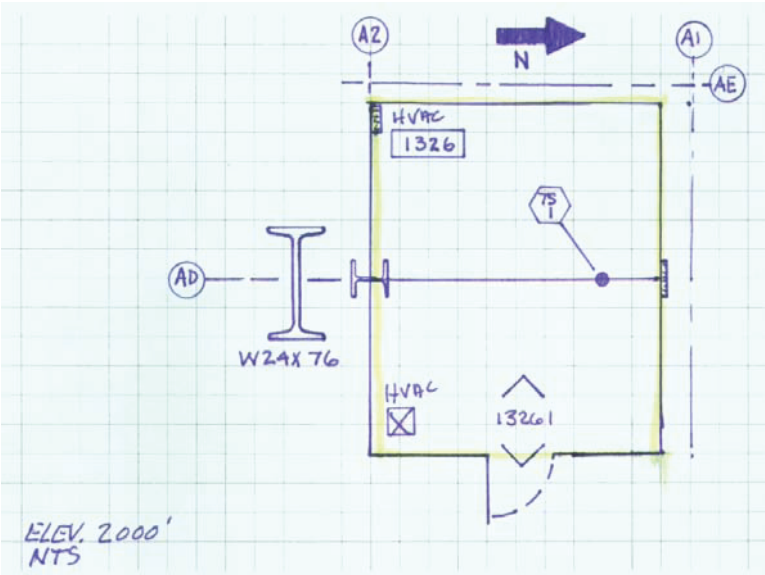
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 100 Exht: 100
Compartment Width (ft):	22	**Vent Description:**	
Compartment Length (ft):	12.25		
Compartment Height (ft):	24	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	200
Hot Gas Layer Temperature @ 180 minutes (F):	**1072.29**

Room Sketch:

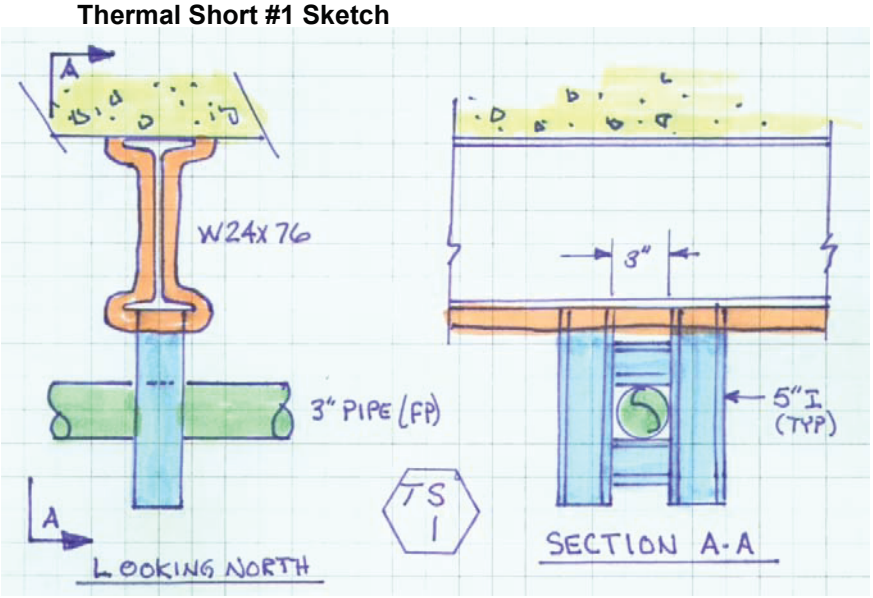


Structural Steel Fireproofing Data

Appendix G3D

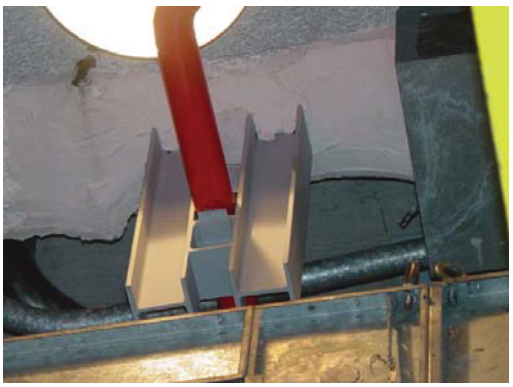
1326-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1331-2000** **Building:** Auxiliary **Fire Area:** A-15

Description: Aux Feedwater Pump Rm C

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	C-1S1001
Member Type:	Column	Beam
Member Size:	14 X 184	18 X 60
Comments:		Additional attachments in close proximity.

NUREG-1805 FDT Input Data

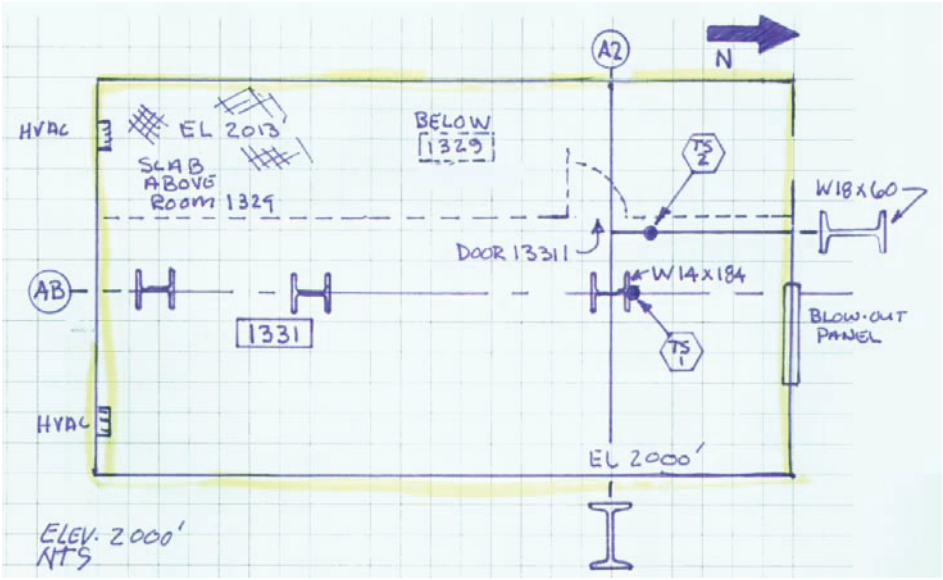
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 1400 Exht: 1400
Compartment Width (ft):	22.5	**Vent Description:**	
Compartment Length (ft):	27.75		
Compartment Height (ft):	24	**Initial Room Temp. (F):**	115
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	245.29
Hot Gas Layer Temperature @ 180 minutes (F):	**764.51**

Room Sketch:

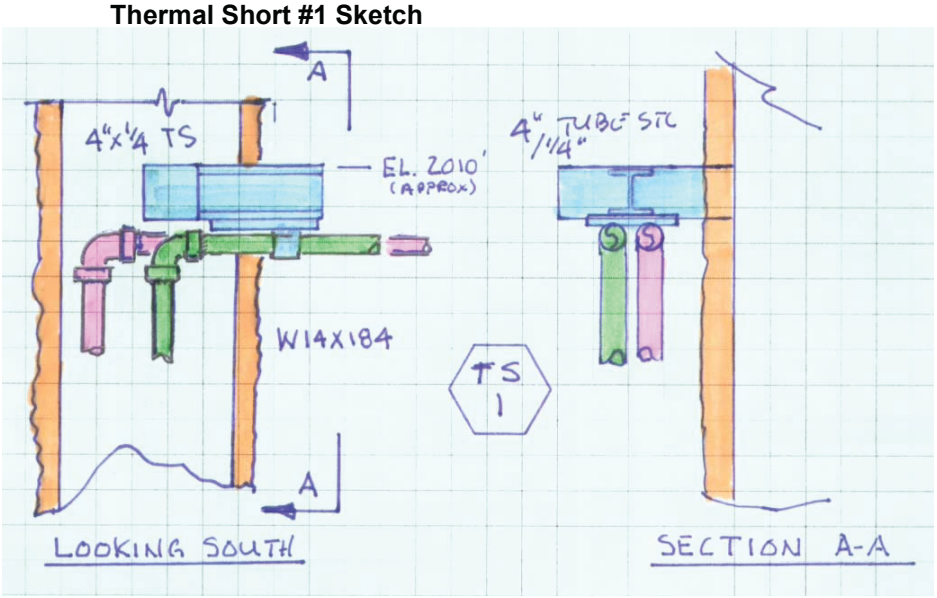


Structural Steel Fireproofing Data

Appendix G3D

1331-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

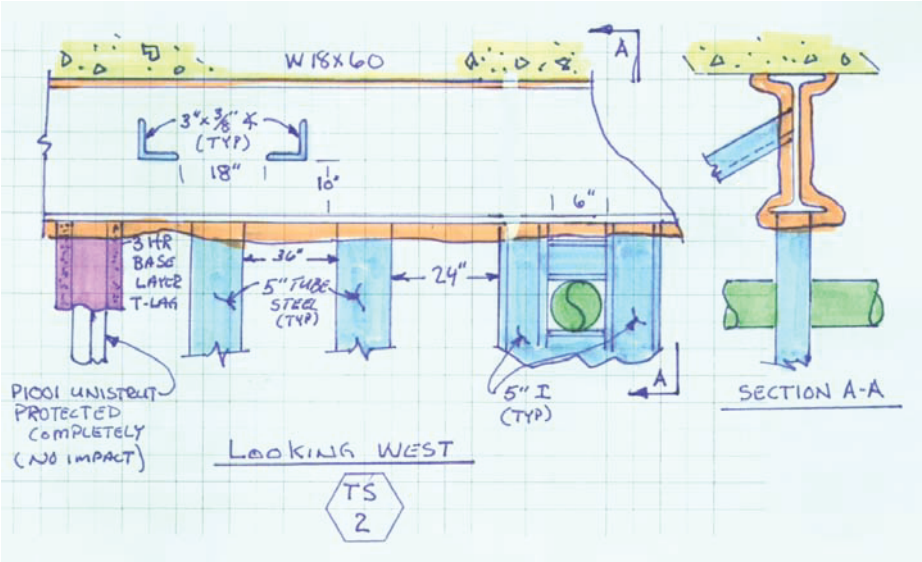
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

1331-2000

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1501-2047** **Building:** Auxiliary **Fire Area:** A-21

Description: Control Rm A/C & Filtration Units B

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1621	C-0S1002
Member Type:	Beam	Column
Member Size:	18 X 45	14 X 193
Comments:	Orientation of one tube causes 40 square inches of unprotected steel.	Orientation of one tube causes 40 square inches of unprotected steel.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW): 650

Compartment Width (ft): 53.5

Compartment Length (ft): 37.5

Compartment Height (ft): 25.25

Barrier Type: Concrete

Forced Ventilation Rate (cfm): Supply: 400 Exht: 0

Vent Description:

Initial Room Temp. (F): 104

Barrier Thickness (in): 12

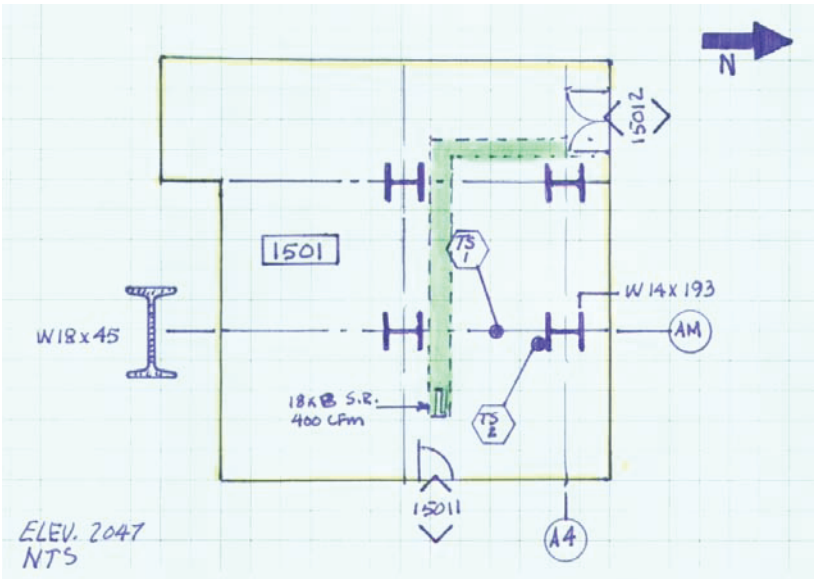
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent. FDT: 267.09

Hot Gas Layer Temperature @ 180 minutes (F): **487.20**

Room Sketch:

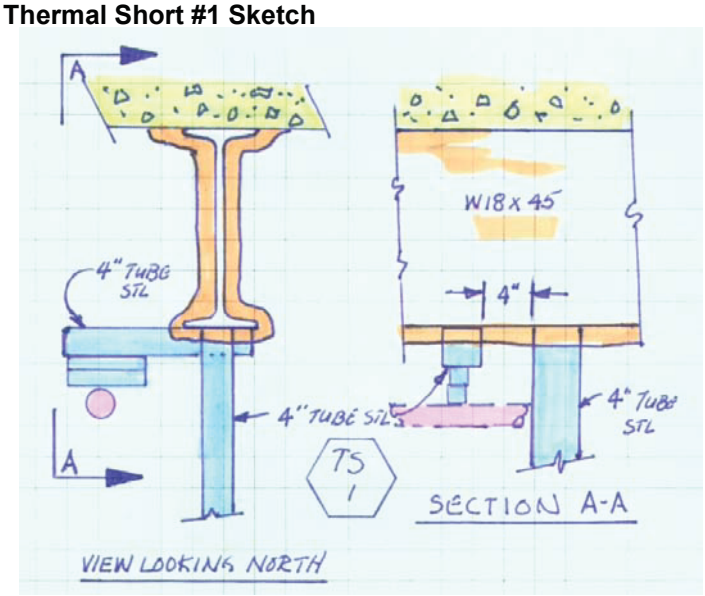


Structural Steel Fireproofing Data

Appendix G3D

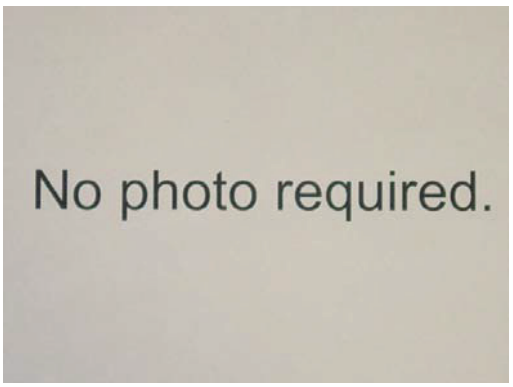
1501-2047

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

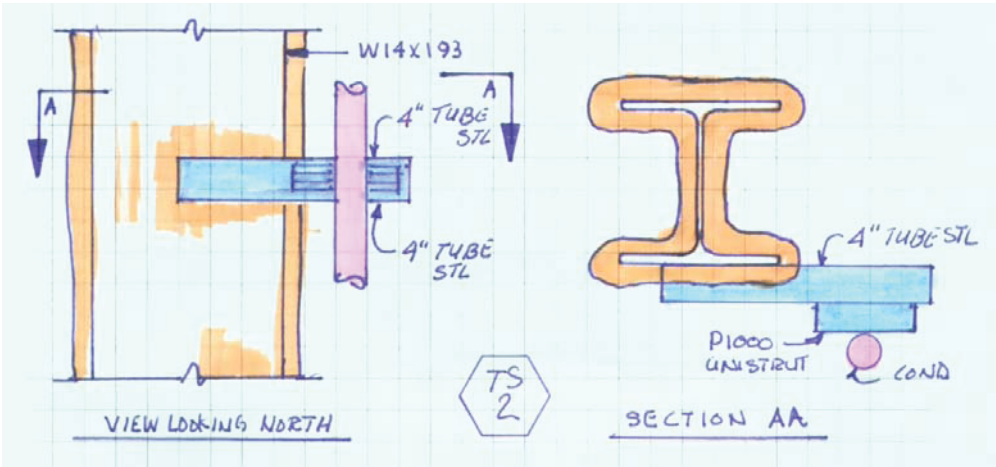


Structural Steel Fireproofing Data

Appendix G3D

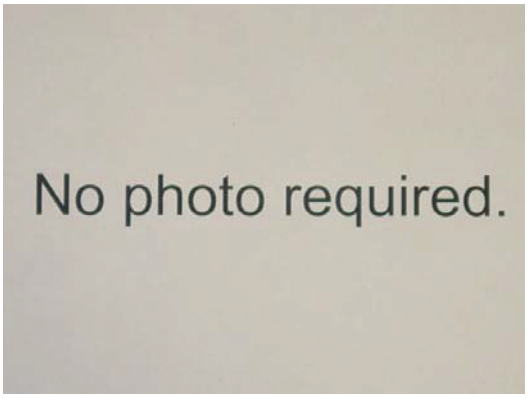
1501-2047

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1512-2047** **Building:** Auxiliary **Fire Area:** A-22

Description: Control Rm A/C & Filtration Units A

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1621	C-0S1002
Member Type:	Beam	Column
Member Size:	27 X 84	14 X 184
Comments:	Additional attachments in close proximity orientation of 1 ea. 4" tube causes 40 SQ IN.	

NUREG-1805 FDT Input Data

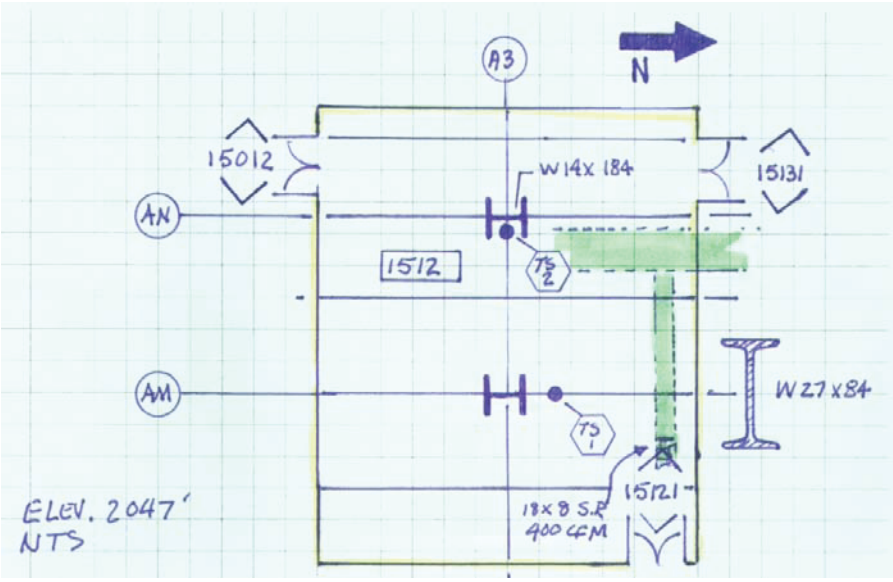
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 400 Exht: 0
Compartment Width (ft):	53.5	**Vent Description:**	
Compartment Length (ft):	40		
Compartment Height (ft):	25.25	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	264.44
Hot Gas Layer Temperature @ 180 minutes (F):	474.87

Room Sketch:

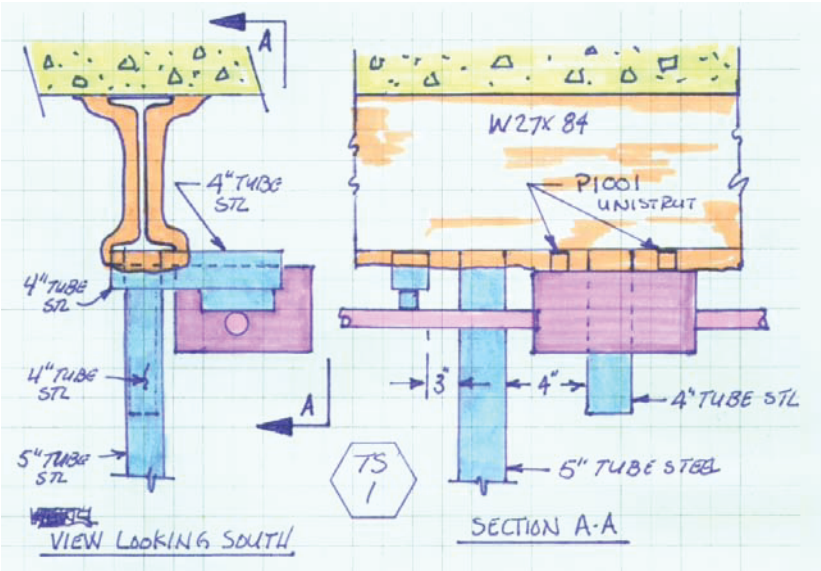


Structural Steel Fireproofing Data

Appendix G3D

1512-2047

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

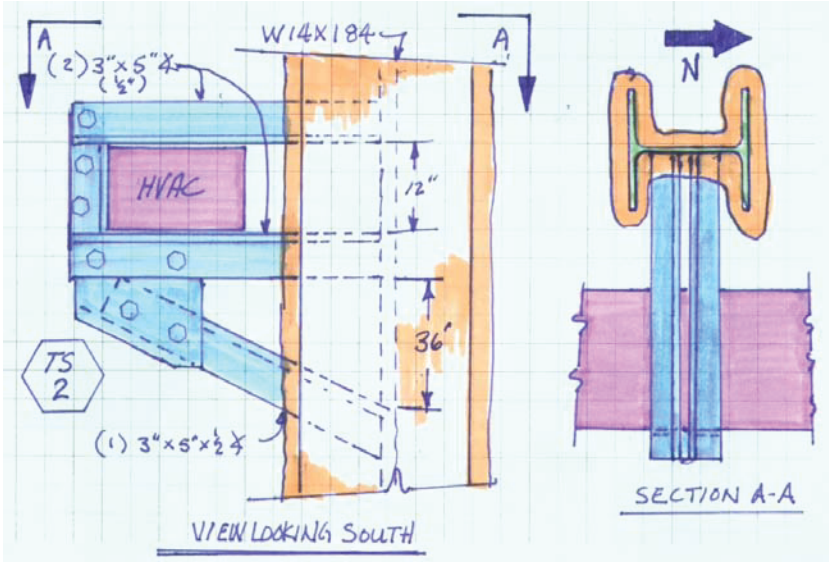
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

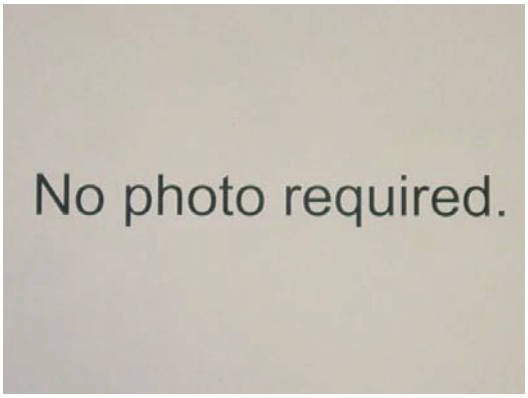
1512-2047

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1323-2000** **Building:** Auxiliary **Fire Area:** A-24

Description: Pipe Penetration Rm A

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1441	C-1S1001
Member Type:	Beam	Column
Member Size:	33 X 118	14 X 314
Comments:		Additional attachments in close proximity (2 Items 43 sq. in.).

NUREG-1805 FDT Input Data

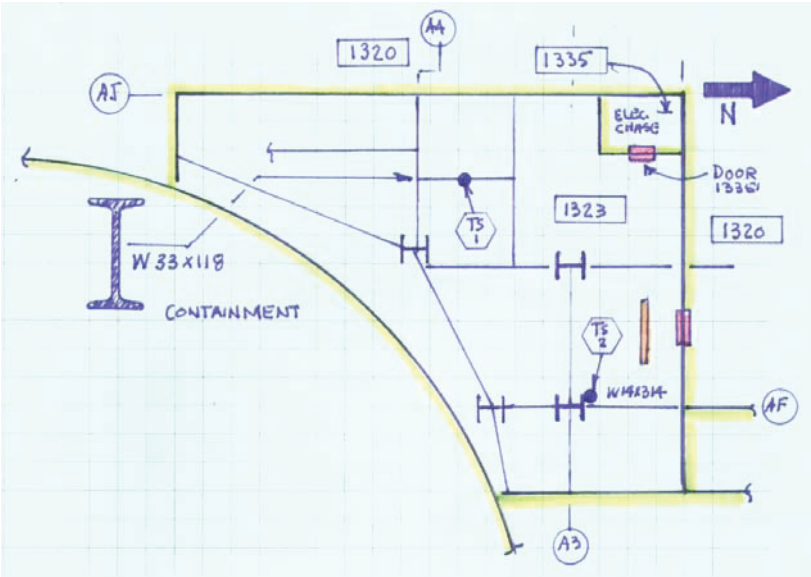
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 200 Plus Transfer Grille = 250
Compartment Width (ft):	49	**Vent Description:**	
Compartment Length (ft):	33.5		
Compartment Height (ft):	25	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	307.82
Hot Gas Layer Temperature @ 180 minutes (F):	**563.90**

Room Sketch:

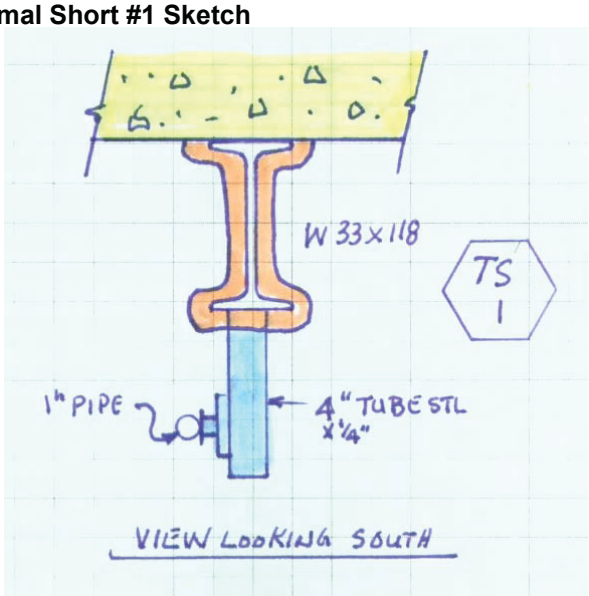


Structural Steel Fireproofing Data

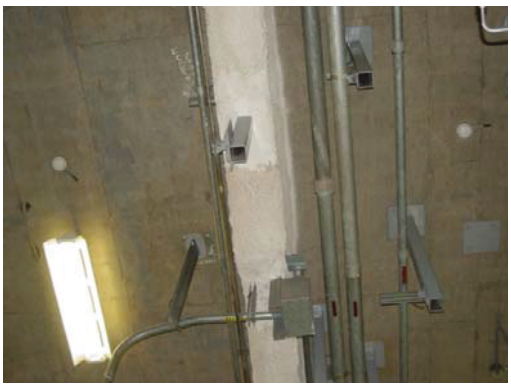
Appendix G3D

1323-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1



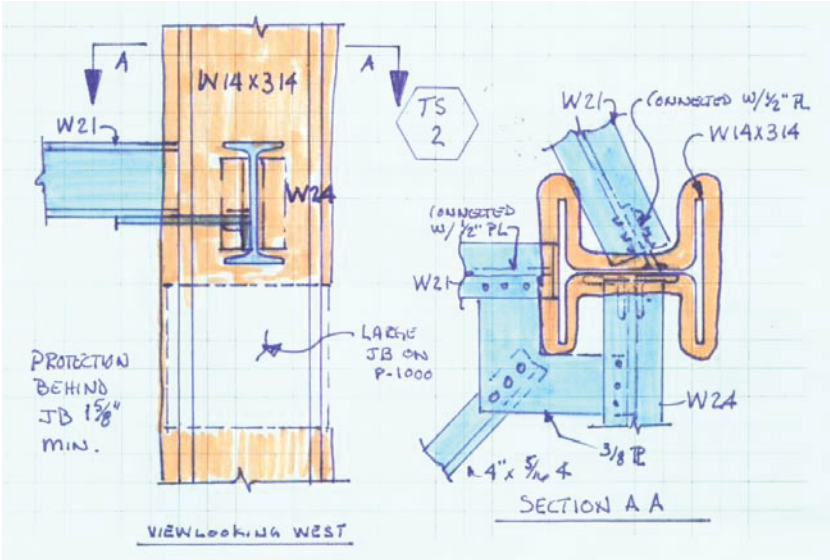
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

1323-2000

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1322-2000** **Building:** Auxiliary **Fire Area:** A-25

Description: Pipe Penetration Rm B

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S1431	C-1S1001
Member Type:	Beam	Column
Member Size:	33 X 118	14 X 264
Comments:		Additional attachments in close proximity.

NUREG-1805 FDT Input Data

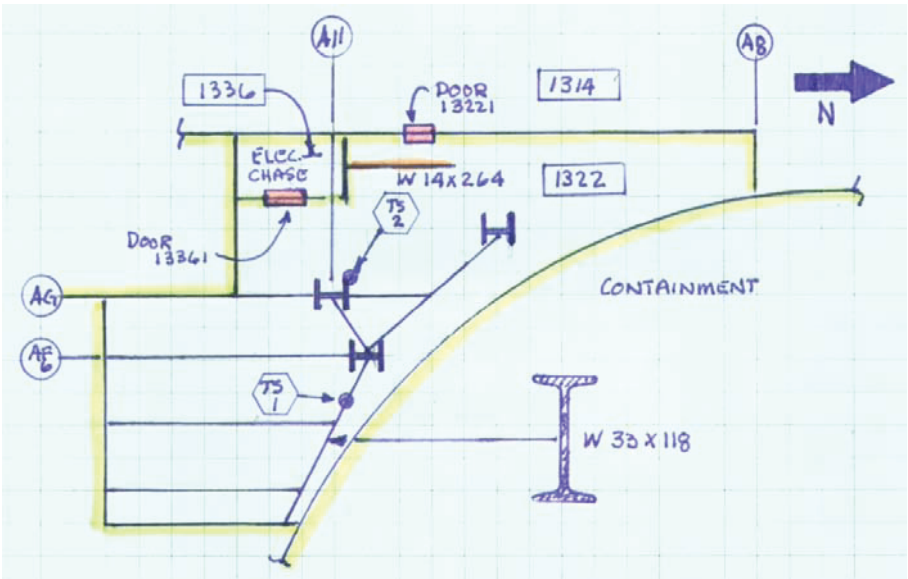
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 200 Plus Transfer Grille = 250
Compartment Width (ft):	49	**Vent Description:**	
Compartment Length (ft):	33.5		
Compartment Height (ft):	25	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	307.82
Hot Gas Layer Temperature @ 180 minutes (F):	**563.90**

Room Sketch:

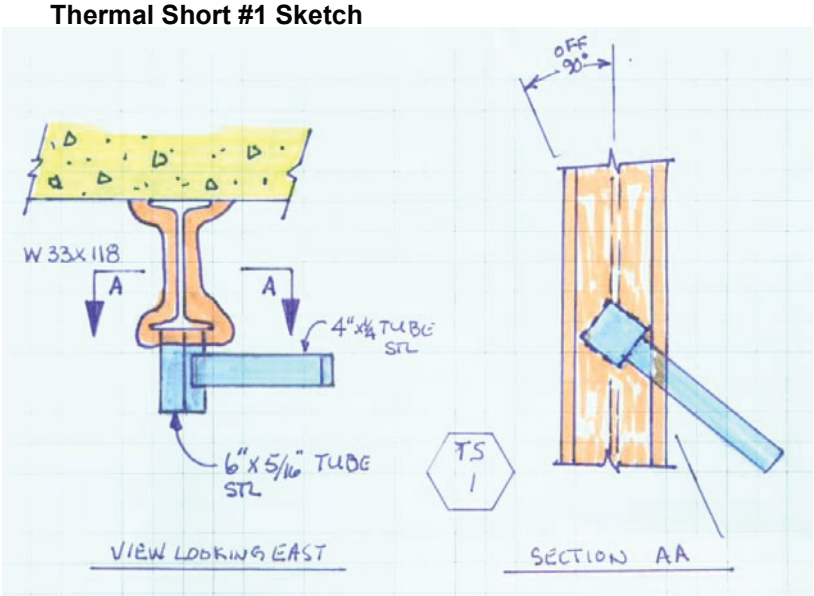


Structural Steel Fireproofing Data

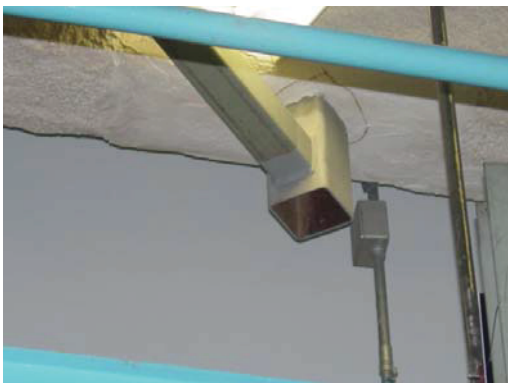
Appendix G3D

1322-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1



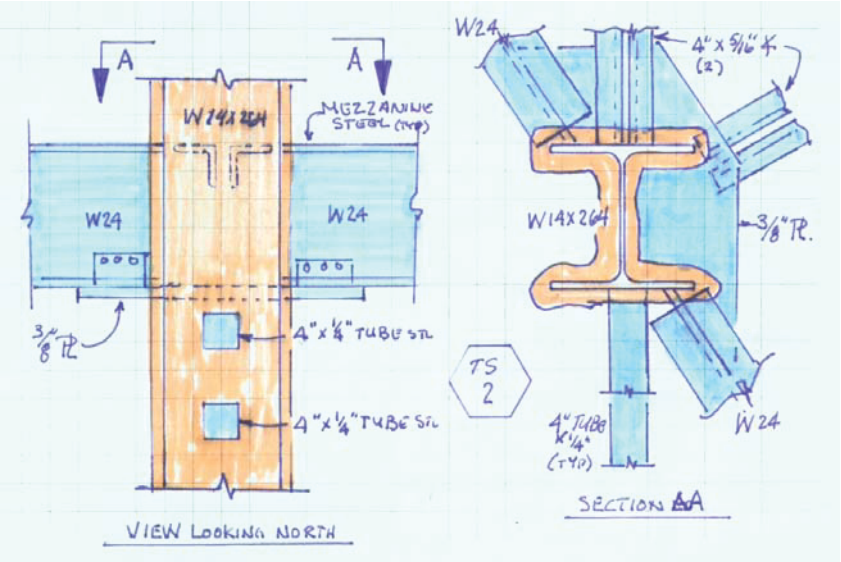
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

1322-2000

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **1405-2026** **Building:** Auxiliary **Fire Area:** A-26

Description: Chemical Storage Area

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1511	N/A
Member Type:	Beam	N/A
Member Size:	21 X 62	N/A
Comments:		Columns embedded in concrete, no exposed surfaces.

NUREG-1805 FDT Input Data

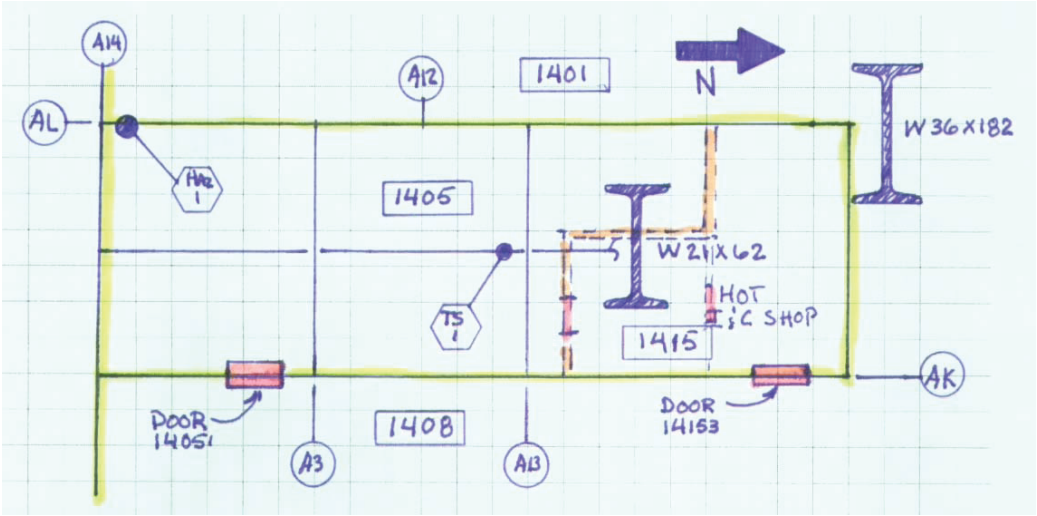
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 900, Open Grille Exht: 900
Compartment Width (ft):	16.5	**Vent Description:**	Temp. not in USAR Table 3.11, used adjacent room temperatures
Compartment Length (ft):	36.75		
Compartment Height (ft):	20	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	275.16
Hot Gas Layer Temperature @ 180 minutes (F):	**844.46**

Room Sketch:

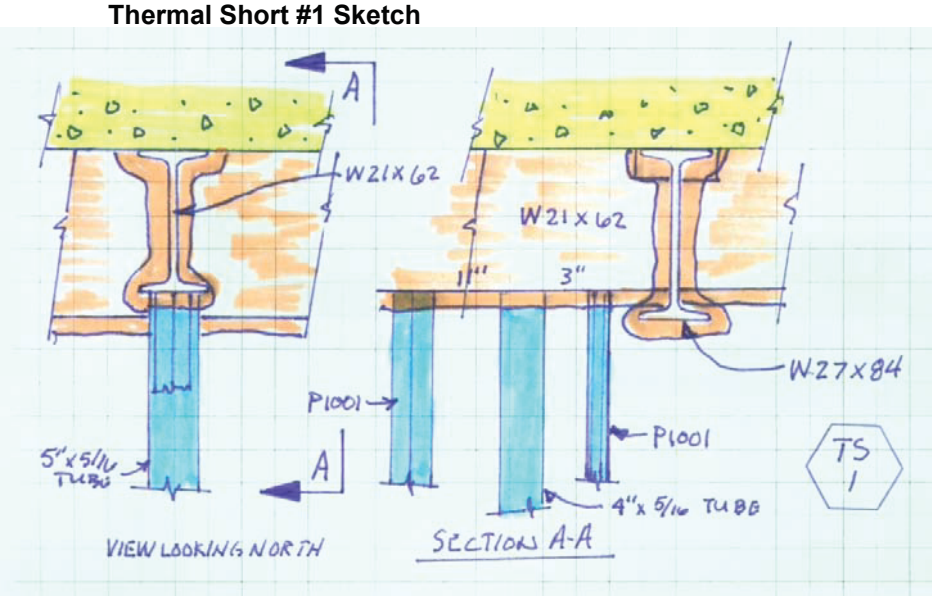


Structural Steel Fireproofing Data

Appendix G3D

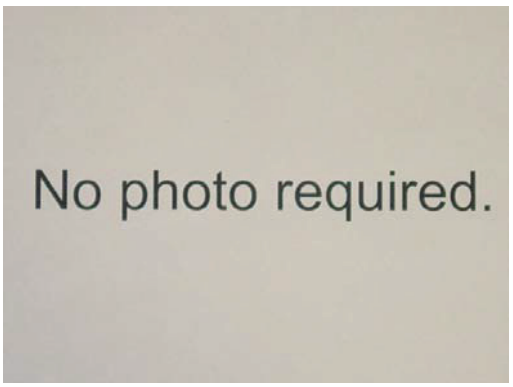
1405-2026

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **3101-1974** **Building:** Control **Fire Area:** C-01

Description: Pipe Space & Tank Area and Duct Chase on all levels of the Co

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3211	N/A
Member Type:	Beam	Column
Member Size:	12 X 27	N/R
Comments:	Additional attachments in close proximity.	Columns have no thermal shorts except Unistrut.

NUREG-1805 FDT Input Data

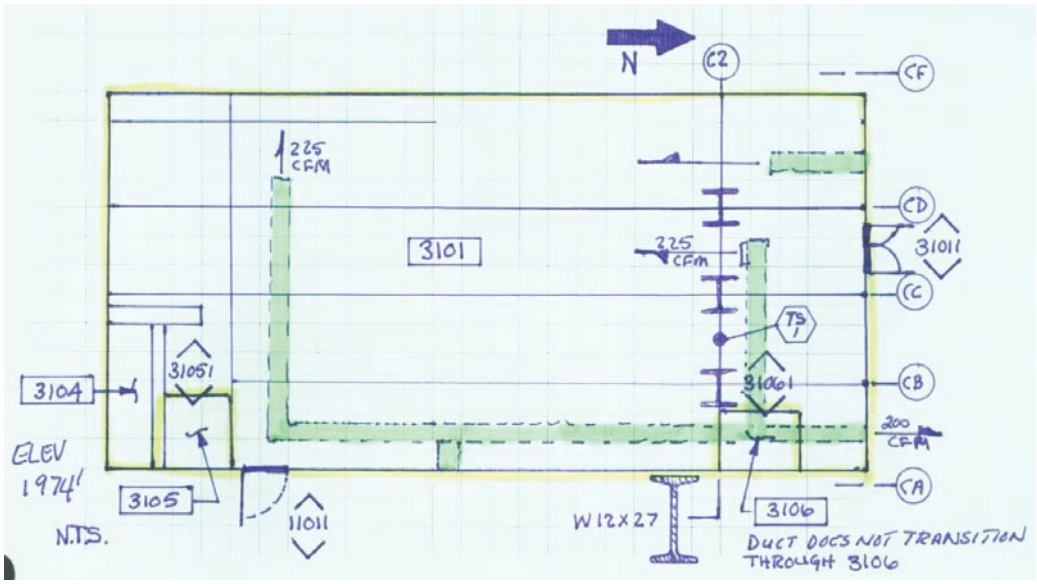
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 550 Exht: 700
Compartment Width (ft):	65.5	**Vent Description:**	
Compartment Length (ft):	99		
Compartment Height (ft):	9	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	36

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	210.80
Hot Gas Layer Temperature @ 180 minutes (F):	**330.99**

Room Sketch:

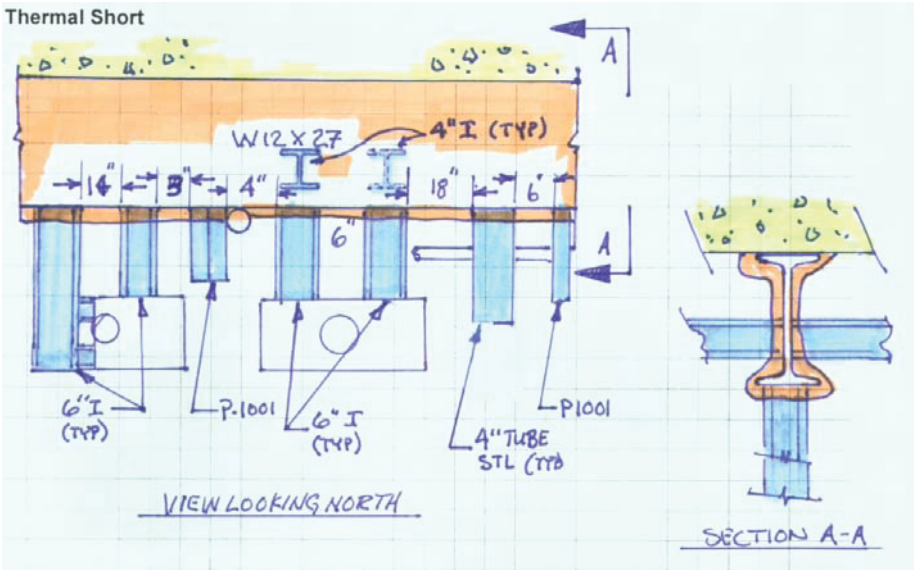


Structural Steel Fireproofing Data

Appendix G3D

3101-1974

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **0NAC-1984** **Building:** Control **Fire Area:** C-05

Description: Area Above Suspended Ceiling

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3311	N/A
Member Type:	Beam	Column
Member Size:	27 X 94	N/R
Comments:	Additional 3" angle and 2-4" I in close proximity.	Columns below drop ceiling are incased within CMU wall, and above drop ceiling there are no attachments.

NUREG-1805 FDT Input Data

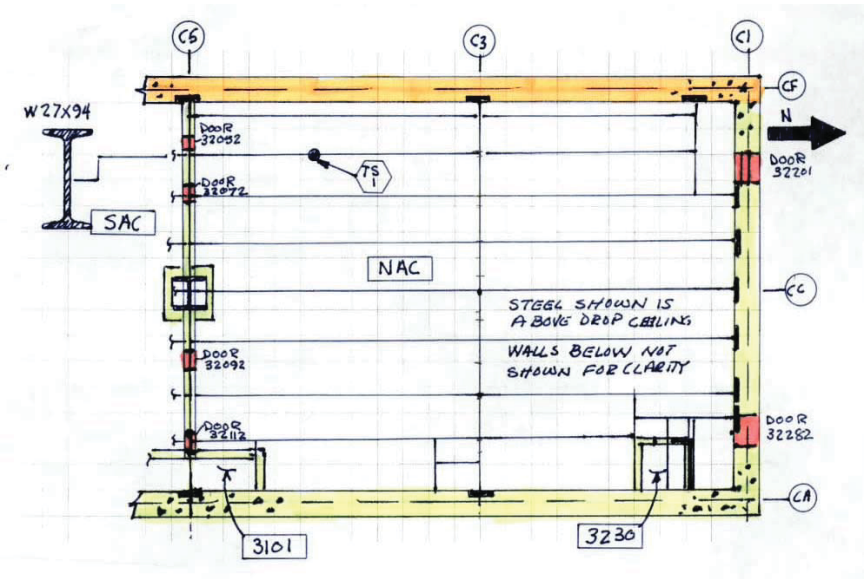
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 4925 Exht: 4350
Compartment Width (ft):	65.5	**Vent Description:**	Temp not in USAR Table 3.11, temp used is based on other similar rooms within the Control Building
Compartment Length (ft):	54.25		
Compartment Height (ft):	15	**Initial Room Temp. (F):**	90
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	30
Compartment Starting Temp. for Closed Room No Vent. FDT:	200.83
Hot Gas Layer Temperature @ 180 minutes (F):	**362.91**

Room Sketch:

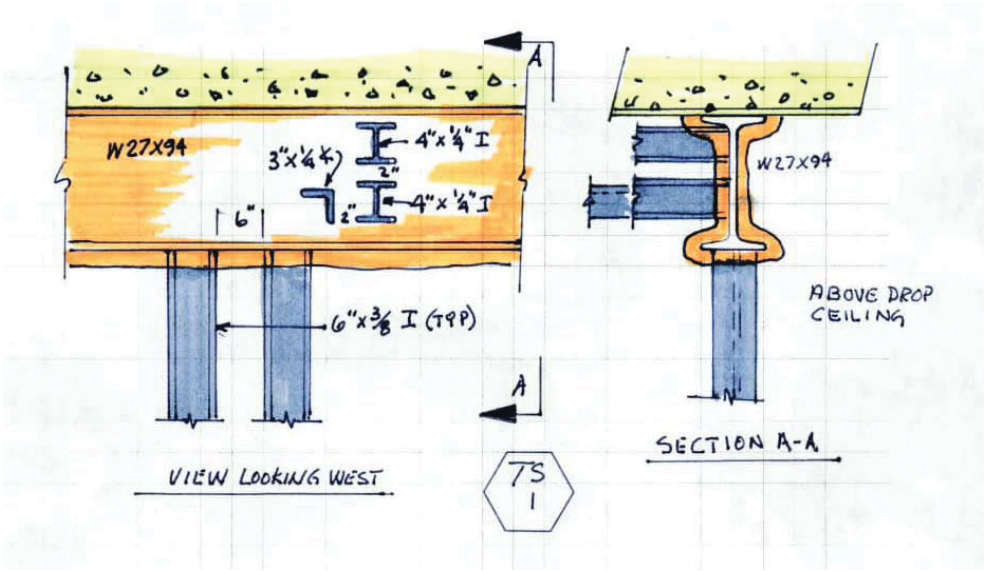


Structural Steel Fireproofing Data

Appendix G3D

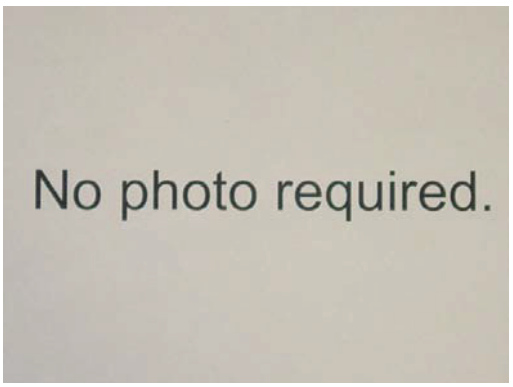
0NAC-1984

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **0SAC-1984** **Building:** Control **Fire Area:** C-06

Description: Area Above Suspended Ceiling

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3311	N/A
Member Type:	Beam	Column
Member Size:	27 X 94	N/R
Comments:	None.	Columns below drop ceiling are incased within CMU wall, and above drop ceiling there are no attachments.

NUREG-1805 FDT Input Data

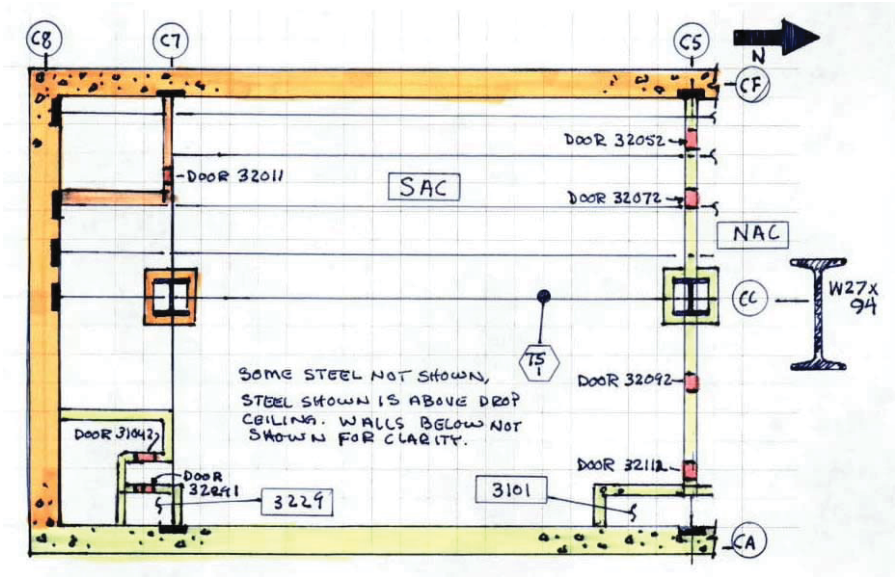
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 3275 Exht: 2950
Compartment Width (ft):	65.5	**Vent Description:**	Temp not in USAR Table 3.11, temp used is based on other similar rooms within the Control Building.
Compartment Length (ft):	31.25		
Compartment Height (ft):	15	**Initial Room Temp. (F):**	90
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	10
Compartment Starting Temp. for Closed Room No Vent. FDT:	212.74
Hot Gas Layer Temperature @ 180 minutes (F):	**477.18**

Room Sketch:

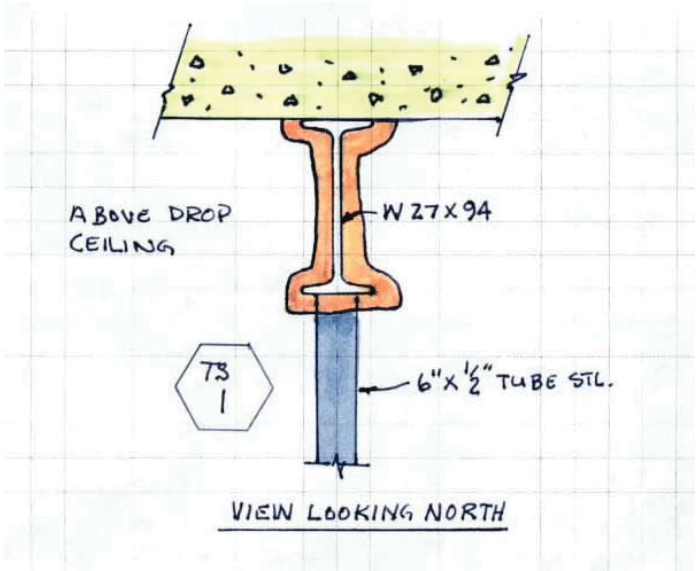


Structural Steel Fireproofing Data

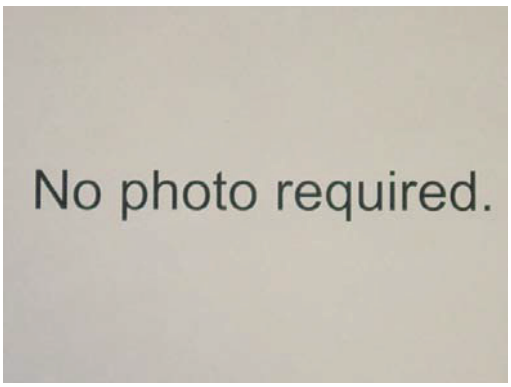
Appendix G3D

0SAC-1984

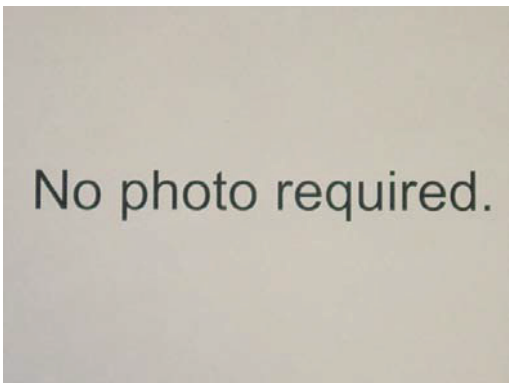
Thermal Short #1 Sketch



Thermal Short #1 Photo 1



Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **3415-2016** **Building:** Control **Fire Area:** C-13

Description: Access Ctrl & Elec Equip A/C Units No. 1

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 68	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

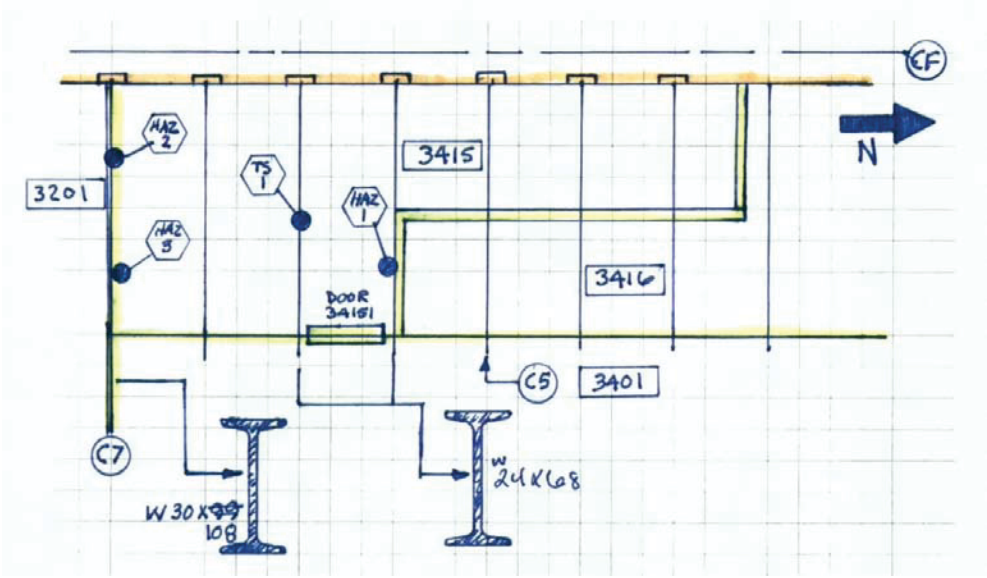
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 750 Exht: 750
Compartment Width (ft):	13	**Vent Description:**	
Compartment Length (ft):	53.5		
Compartment Height (ft):	15.25	**Initial Room Temp. (F):**	90
Barrier Type:	Block	**Barrier Thickness (in):**	8

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	200
Hot Gas Layer Temperature @ 180 minutes (F):	**1062.38**

Room Sketch:

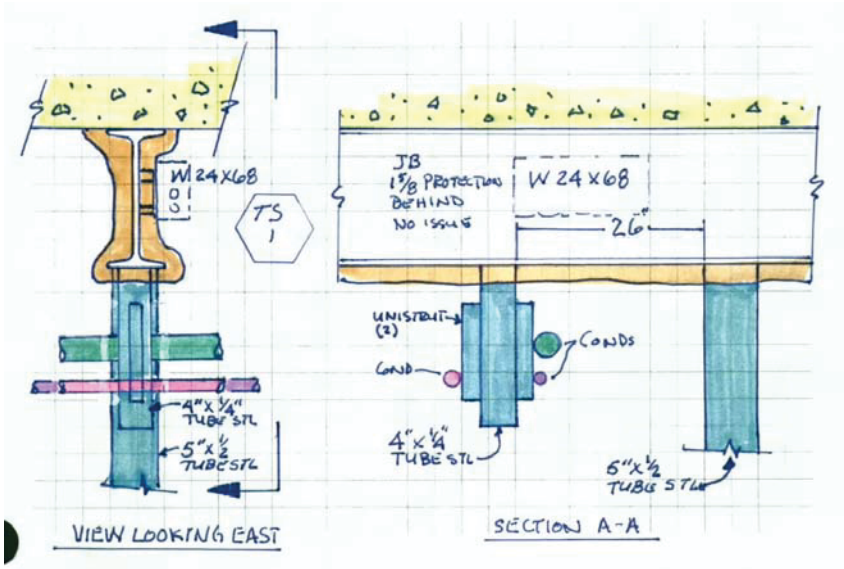


Structural Steel Fireproofing Data

Appendix G3D

3415-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **3416-2016** **Building:** Control **Fire Area:** C-14

Description: Access Ctrl & Elec Equip A/C Units No. 2

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 68	N/A
Comments:	Additional attachments in close proximity (3" x 1/4" angles).	No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW): 650

Compartment Width (ft): 13

Compartment Length (ft): 63.5

Compartment Height (ft): 15.25

Barrier Type: Block

Forced Ventilation Rate (cfm): Supply: 750 Exht: 750

Vent Description:

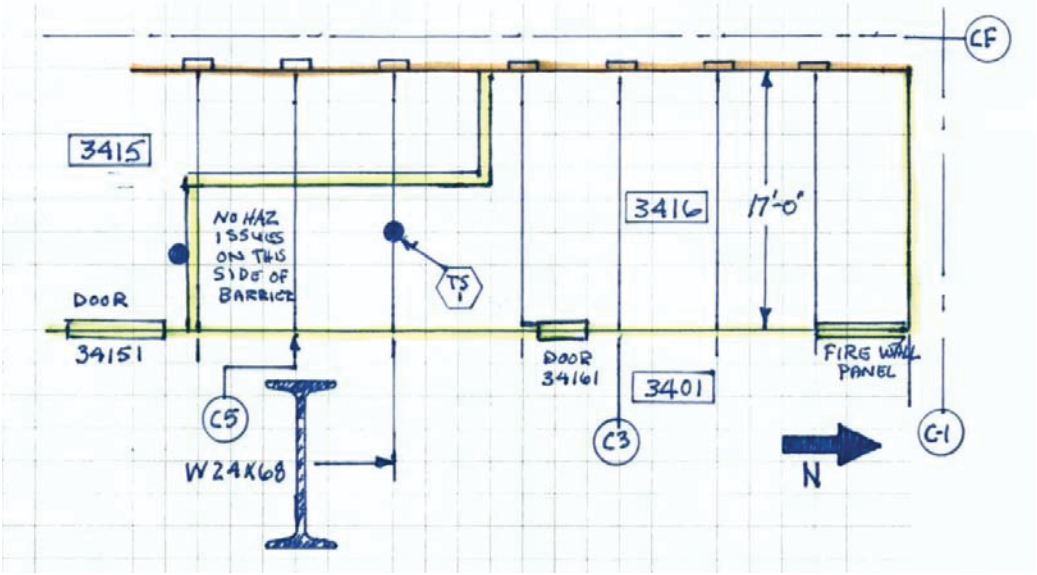
Initial Room Temp. (F): 90

Barrier Thickness (in): 8

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	200
Hot Gas Layer Temperature @ 180 minutes (F):	939.95

Room Sketch:

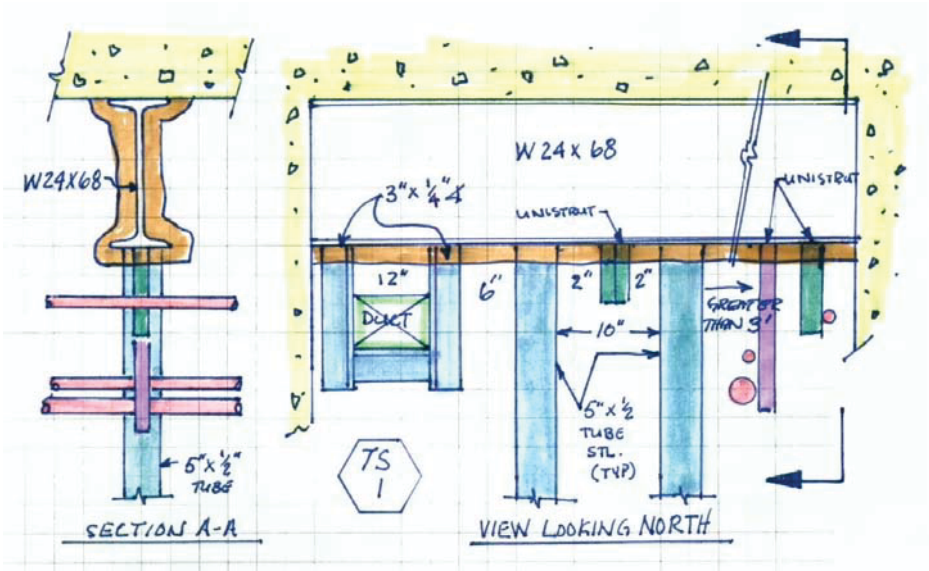


Structural Steel Fireproofing Data

Appendix G3D

3416-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **3501-2032** **Building:** Control **Fire Area:** C-21

Description: Lower Cable Spreading Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3611	C-0S3001
Member Type:	Beam	Column
Member Size:	30 X 108	14 X 342
Comments:	Additional attachment in close proximity (6" X 5/16 I).	

NUREG-1805 FDT Input Data

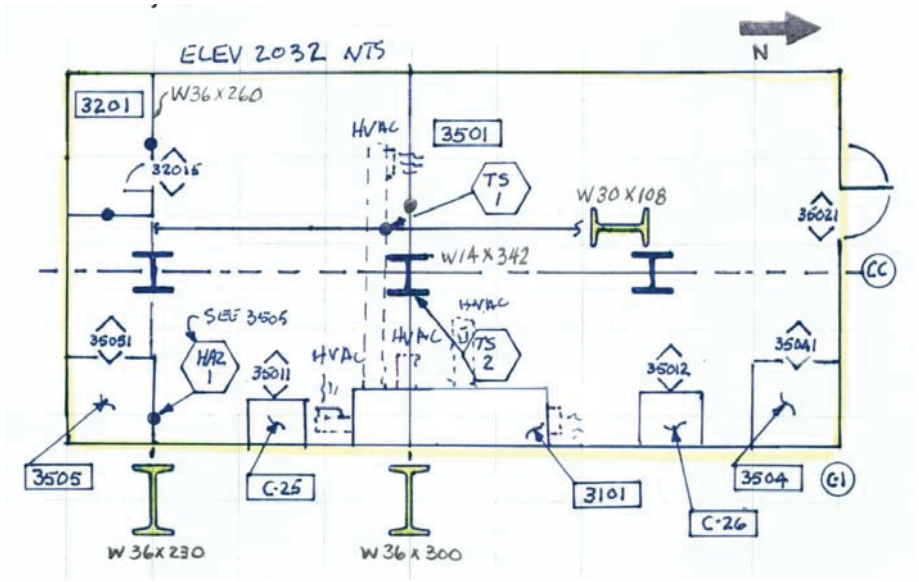
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 500 Exht: 500
Compartment Width (ft):	65.5	**Vent Description:**	
Compartment Length (ft):	99		
Compartment Height (ft):	14.75	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	219.78
Hot Gas Layer Temperature @ 180 minutes (F):	**326.12**

Room Sketch:

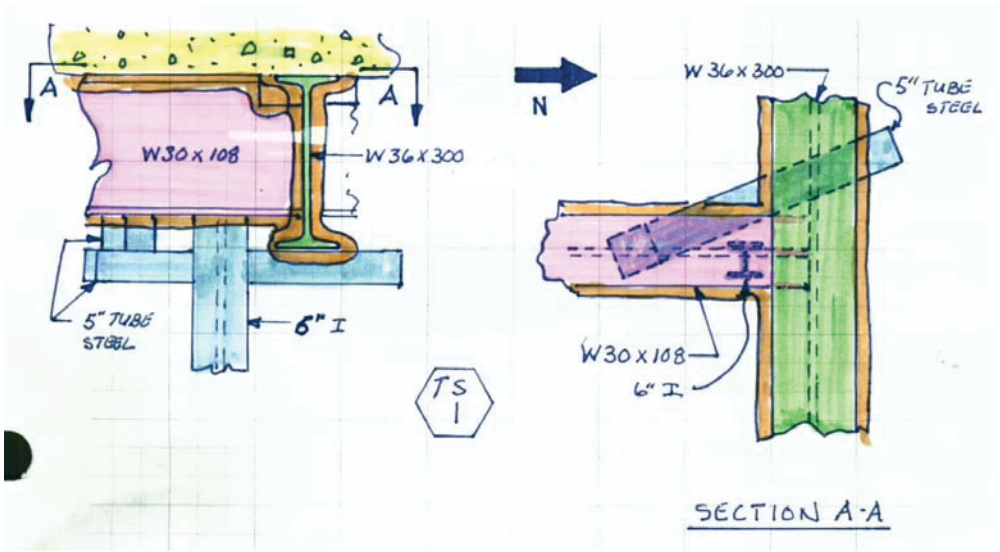


Structural Steel Fireproofing Data

Appendix G3D

3501-2032

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

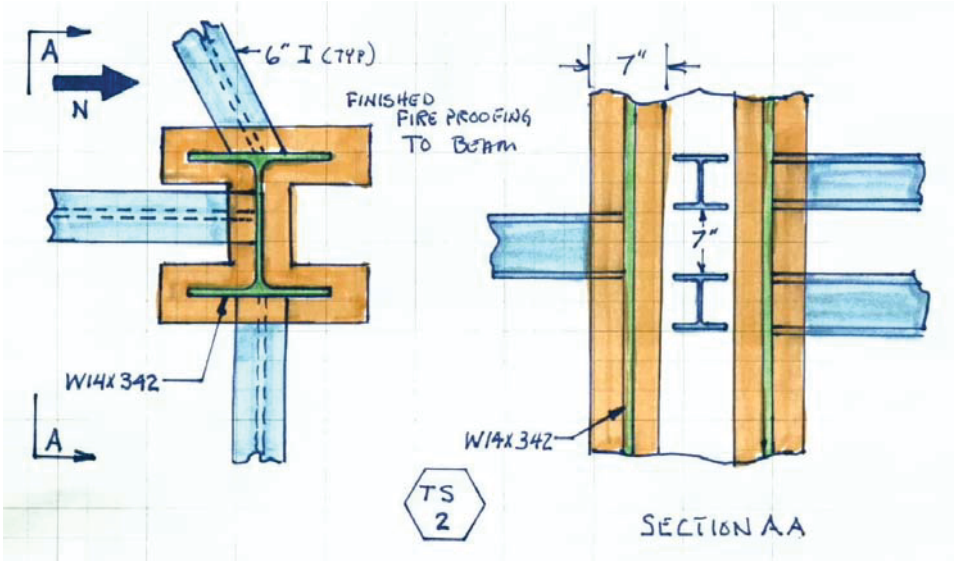
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

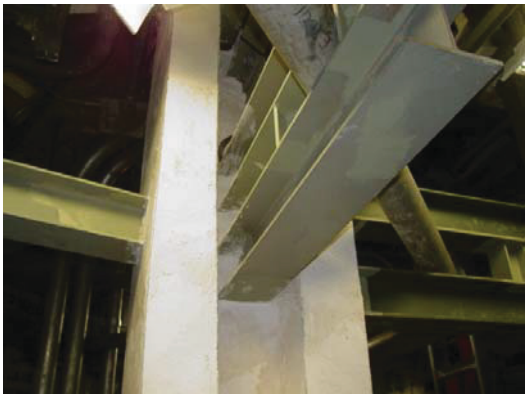
3501-2032

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **3801-2073** **Building:** Control **Fire Area:** C-22

Description: Upper Cable Spreading Room

	Thermal Short #1 (TS1) Data	**Thermal Short #2 (TS2) Data**
Drawing:	C-1S3811	N/R
Member Type:	Beam	Column
Member Size:	33 X 118	N/R
Comments:	Orientation cause large area of unprotected steel. Columns only have Unistrut, acceptable.	Unistrut only attached to columns.

NUREG-1805 FDT Input Data

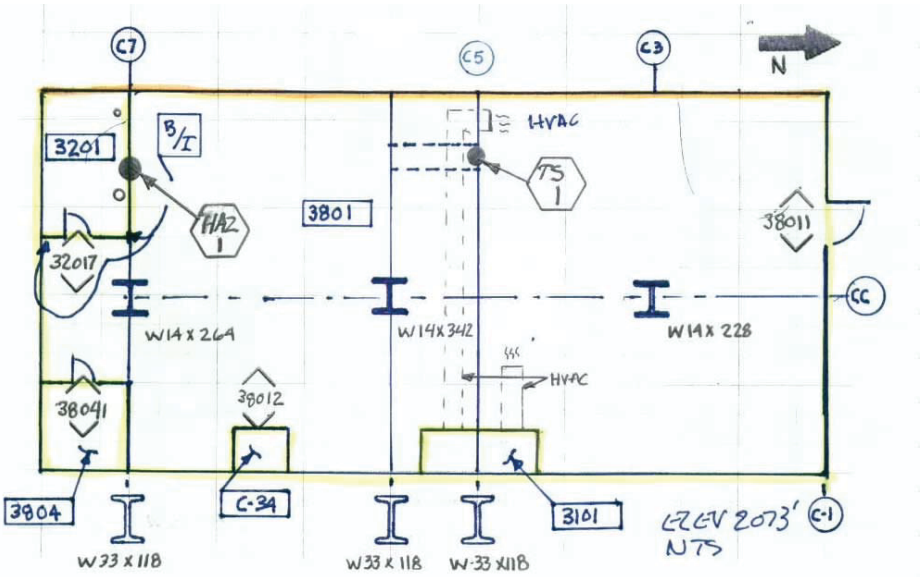
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 3450 Exht: 3020
Compartment Width (ft):	65.5	**Vent Description:**	
Compartment Length (ft):	99		
Compartment Height (ft):	11.75	**Initial Room Temp. (F):**	104
Barrier Type:	Concrete	**Barrier Thickness (in):**	24

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	15
Compartment Starting Temp. for Closed Room No Vent. FDT:	200.00
Hot Gas Layer Temperature @ 180 minutes (F):	**308.20**

Room Sketch:

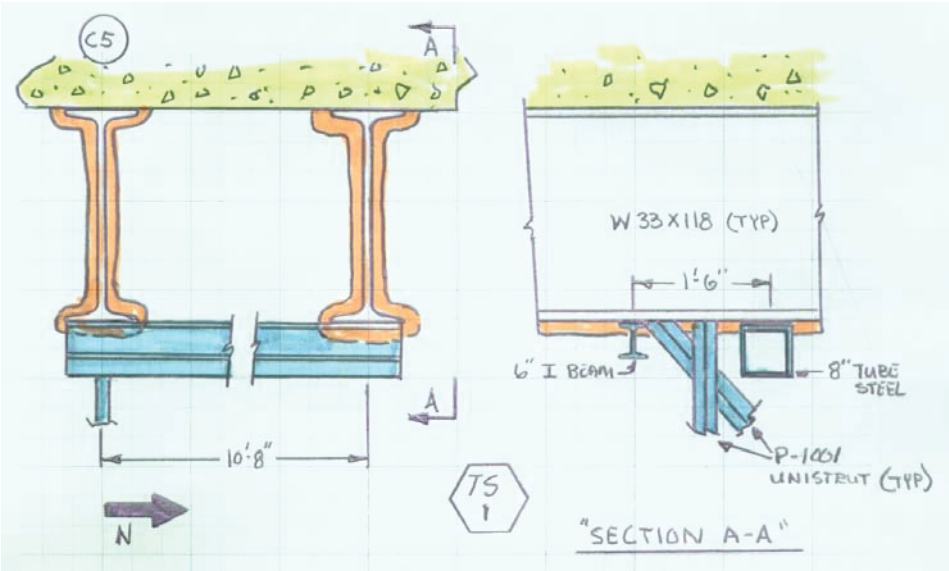


Structural Steel Fireproofing Data

Appendix G3D

3801-2073

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **6104-2000** **Building:** Fuel **Fire Area:** F-02

Description: Fuel Pool Cooling Heat Exch Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C0S6211	N/A
Member Type:	Beam	N/A
Member Size:	24 X 55	N/A
Comments:	Additional thermal shorts in close proximity.	No columns.

NUREG-1805 FDT Input Data

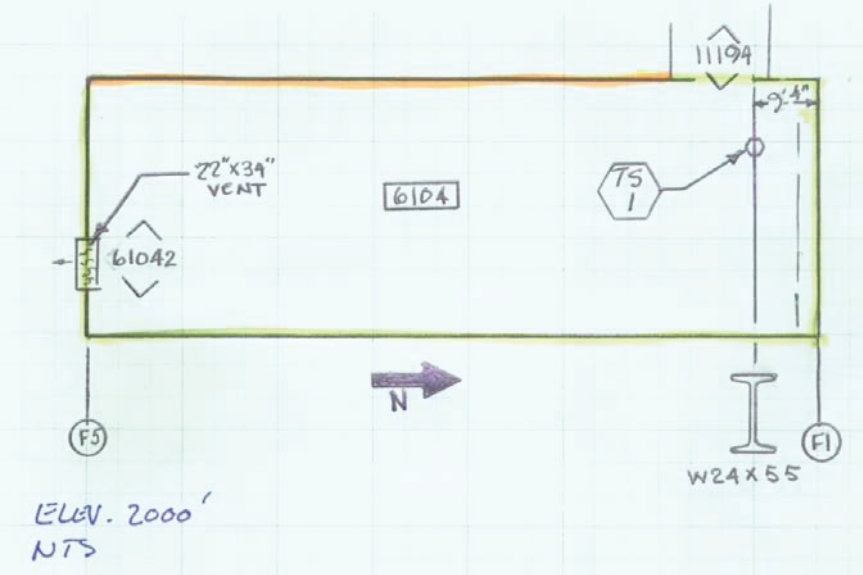
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 1300 Exht: 1300
Compartment Width (ft):	15.25	**Vent Description:**	Open Grille
Compartment Length (ft):	80		
Compartment Height (ft):	25	**Initial Room Temp. (F):**	122
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	238.05
Hot Gas Layer Temperature @ 180 minutes (F):	**501.86**

Room Sketch:

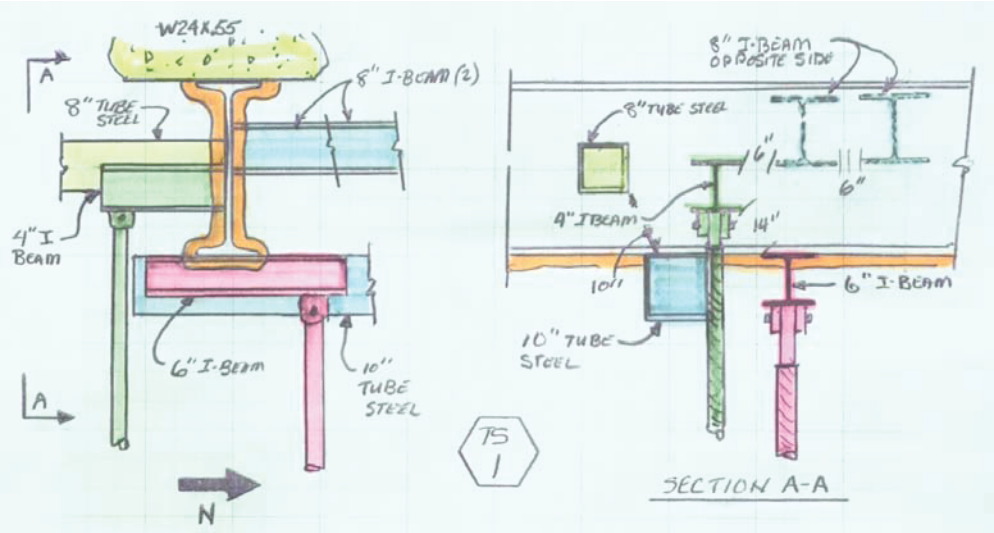


Structural Steel Fireproofing Data

Appendix G3D

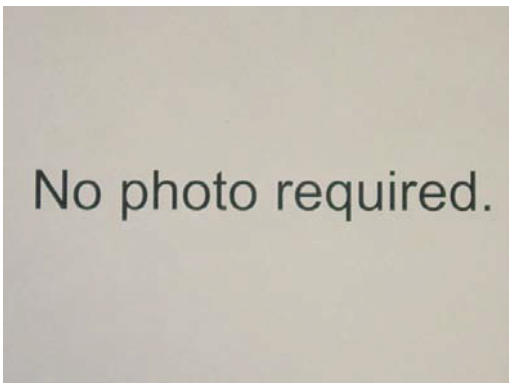
6104-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **6105-2000** **Building:** Fuel **Fire Area:** F-03

Description: Fuel Pool Cooling Heat Exch Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C0S6211	N/A
Member Type:	Beam	N/A
Member Size:	24 X 55	N/A
Comments:	6" pipe.	No columns.

NUREG-1805 FDT Input Data

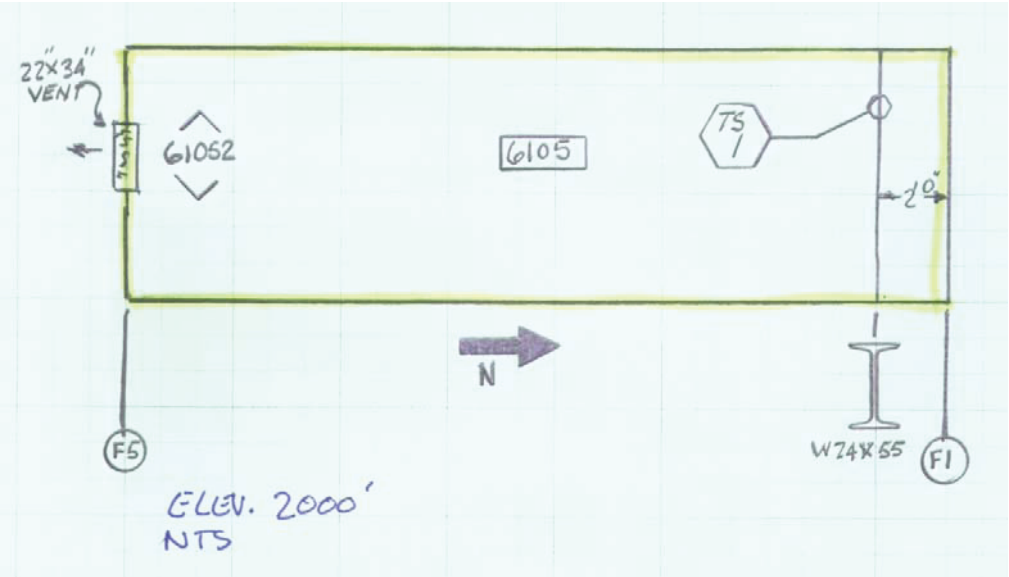
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 1300 Exht: 1300
Compartment Width (ft):	15.25	**Vent Description:**	Open Grille
Compartment Length (ft):	80		
Compartment Height (ft):	25	**Initial Room Temp. (F):**	122
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	238.05
Hot Gas Layer Temperature @ 180 minutes (F):	**501.86**

Room Sketch:

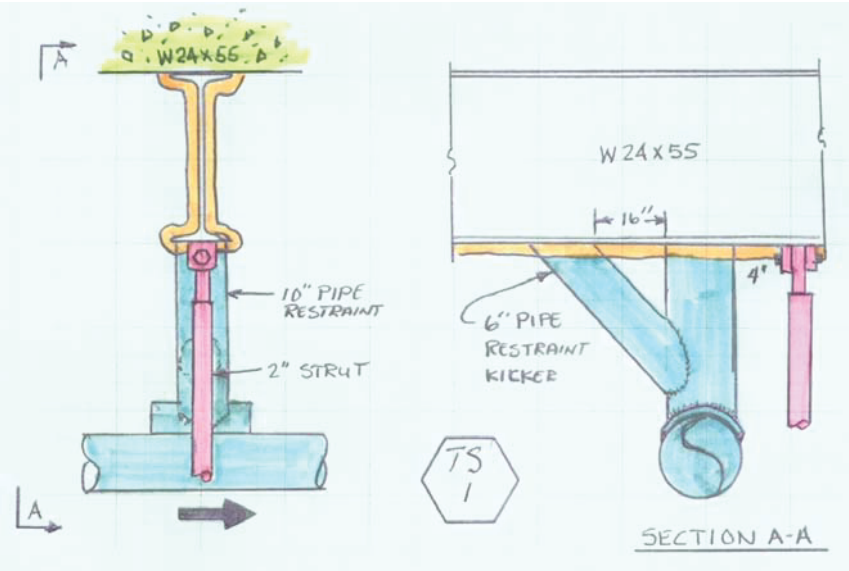


Structural Steel Fireproofing Data

Appendix G3D

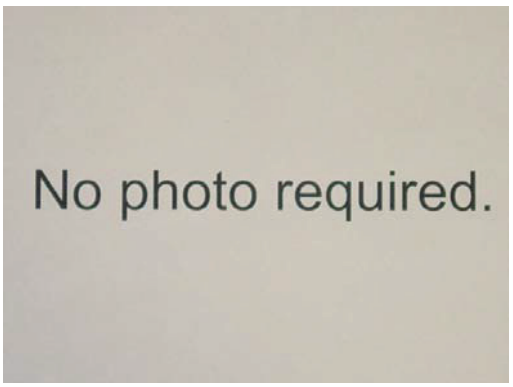
6105-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **6202-2026** **Building:** Fuel **Fire Area:** F-05

Description: Electrical Equipment Room

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C1S6311	N/A
Member Type:	Beam	N/A
Member Size:	36 X 135	N/A
Comments:	Additional attachments in close proximity.	No columns.

NUREG-1805 FDT Input Data

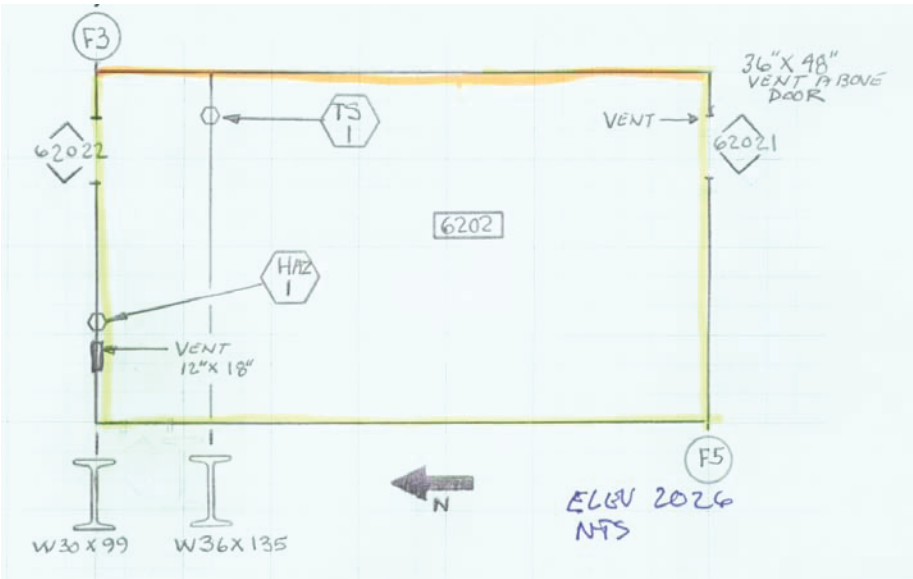
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 10800 Exht: 10800
Compartment Width (ft):	30.5	**Vent Description:**	Open Grille
Compartment Length (ft):	39		
Compartment Height (ft):	20.5	**Initial Room Temp. (F):**	110
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	10
Compartment Starting Temp. for Closed Room No Vent. FDT:	200.76
Hot Gas Layer Temperature @ 180 minutes (F):	**556.31**

Room Sketch:

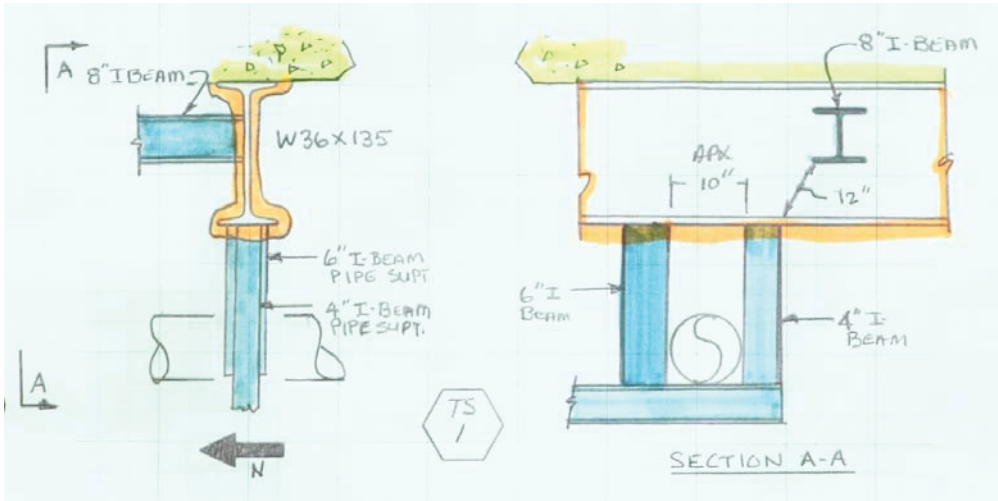


Structural Steel Fireproofing Data

Appendix G3D

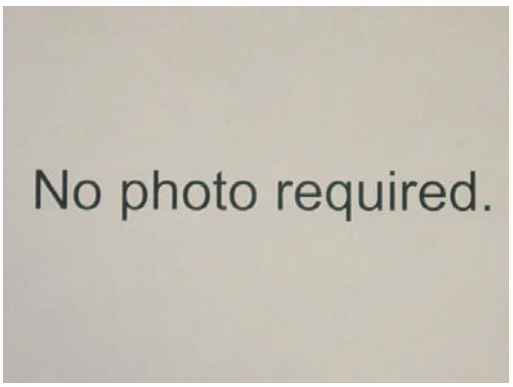
6202-2026

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **6304-2047** **Building:** Fuel **Fire Area:** F-06

Description: Exhaust Filter Absorber Room A

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C1S6411	N/A
Member Type:	Beam	N/A
Member Size:	16 X 36	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

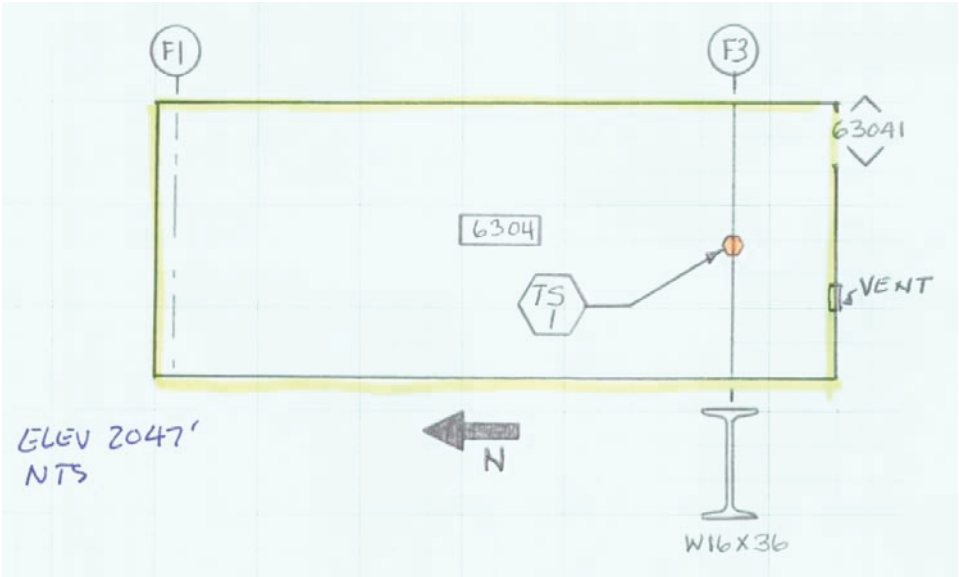
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 300 Exht: 300
Compartment Width (ft):	13.5	**Vent Description:**	Open Grille
Compartment Length (ft):	49.5		
Compartment Height (ft):	16.5	**Initial Room Temp. (F):**	110
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	363.95
Hot Gas Layer Temperature @ 180 minutes (F):	**921.91**

Room Sketch:

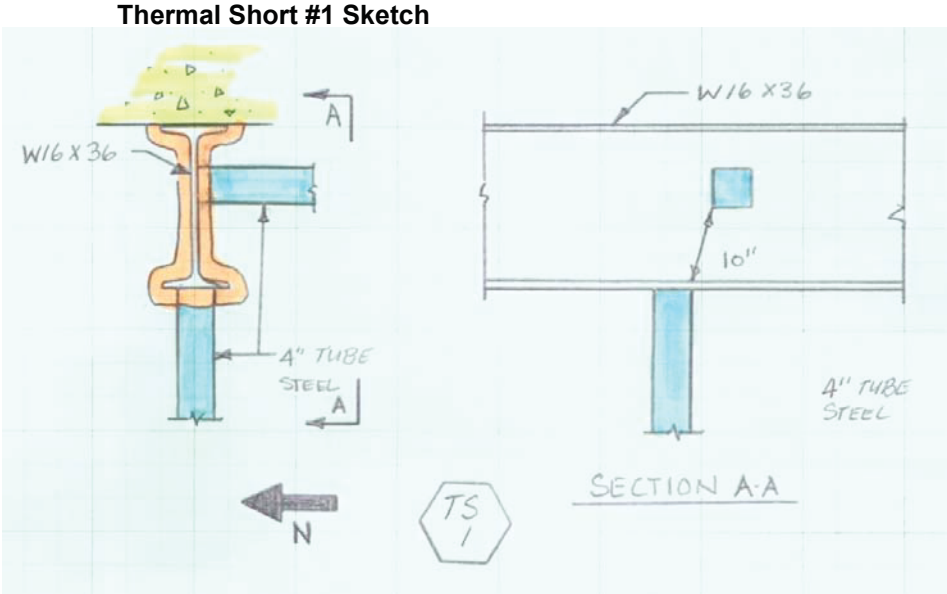


Structural Steel Fireproofing Data

Appendix G3D

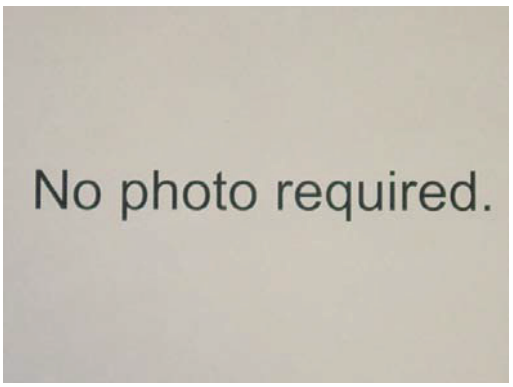
6304-2047

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G3D

Room-Elevation: **6303-2047** **Building:** Fuel **Fire Area:** F-07

Description: Exhaust Filter Absorber Room B

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C1S6411	N/A
Member Type:	Beam	N/A
Member Size:	16 X 36	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

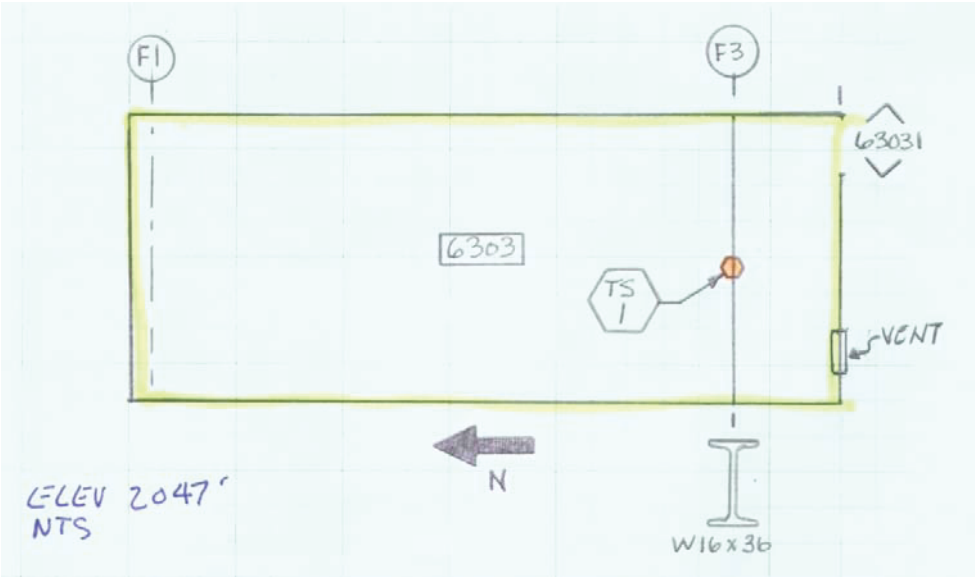
NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Heat Release Rate (kW):	650	**Forced Ventilation Rate (cfm):**	Supply: 300 Exht: 300
Compartment Width (ft):	13.5	**Vent Description:**	Open Grille
Compartment Length (ft):	49.5		
Compartment Height (ft):	16.5	**Initial Room Temp. (F):**	110
Barrier Type:	Concrete	**Barrier Thickness (in):**	12

NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min):	1
Compartment Starting Temp. for Closed Room No Vent. FDT:	363.95
Hot Gas Layer Temperature @ 180 minutes (F):	**921.91**

Room Sketch:

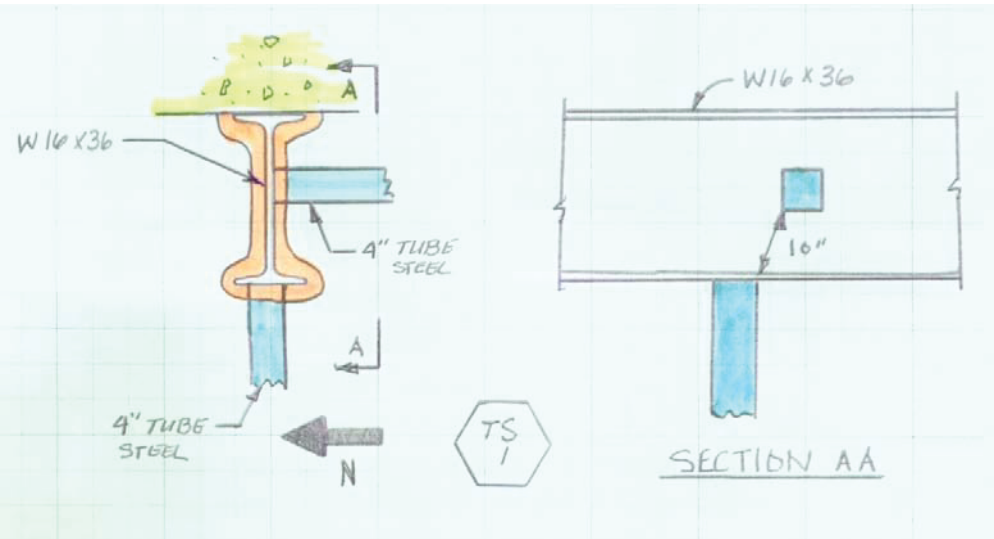


Structural Steel Fireproofing Data

Appendix G3D

6303-2047

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

WOLF CREEK
NUCLEAR OPERATING CORPORATION

M-663-00017A

Attachment G4

Fire Protection Evaluation For Structural Steel Fireproofing With Unprotected Thermal Shorts in Closed Rooms with a Credible Fire and No Ventilation or Forced Ventilation

Rev. No.	Prepared By	Date	Reviewed By	Date
W03	Wayne S. Crisp	6/20/07	Jeff Dates	06/20/07

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7.0 Evaluation 8

8.0 Conclusions 12

Appendix G4A, NUREG-1805 FDT Example -
Closed Room No Ventilation …….. (2 Total Pages)

Appendix G4B, NUREG-1805 FDT Example –
Closed Room Forced Ventilation ……. (4 Total Pages)

Appendix G4C, Thermal Short and Room Data Sheets
Closed Room No Ventilation …… (13 Total Pages)

Appendix G4D, Thermal Short and Room Data Sheets
Closed Room Forced Ventilation …… (19 Total Pages)

Revision Log

Revision	Reason for Revision
W03	Original Issue

1.0 Purpose

1.1 The purpose of this document is to evaluate the acceptability of protected structural steel with unprotected steel attachments (thermal shorts) that are welded to the building steel. This evaluation was conducted in accordance with the guidance of NRC Generic Letter 86-10 and Regulatory Guide 1.189.

2.0 Scope

2.1 This evaluation is applicable to the Rooms identified in Table II.

3.0 References

3.1 NRC Generic Letter 86-10, Implementation of Fire Protection Requirements, dated April 24, 1986

3.2 10 CFR 50 Appendix R, Fire Protection Program For Nuclear Power Facilities Operating Prior To January 1, 1979

3.3 NRC Inspection Manual 0609, Appendix F, Fire Protection Significant Determination Process, dated 02/28/05.

3.4 NUREG/CR-6850, Fire PRA Methodology for Nuclear Power Facilities, published 09/2005

3.5 NUREG-1805, Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program, published 12/2004

3.6 NUREG-1824, Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications

3.7 Regulatory Guide 1.189, Fire Protection For Operating Nuclear Power Plants, April 2001

3.8 ASTM E-119, Standard Test Methods for Fire Tests of Building Construction and Materials

3.9 UL N-711, (A-126-00001), Fire Test Report Of Loaded Restrained Beams Protected By Cementitious Mixture, Dated August 11, 1976

3.10 UL N-712, (A-126-00002), Fire Test Report Of Loaded Restrained Beams Protected By Cementitious Mixture, Dated May 13, 1977

3.11 A-126, Technical Specification For Cementitious Fireproofing Of Structural Steel For The Standardized Nuclear Unit Power Plant Unit (SNUPPS)

3.12 PIR 2002-2287, Structural Steel Fireproofing With Unprotected Attachments

3.13 FP-M-012, Rev 0, Structural Steel Fireproofing Thermal Shorts and Omissions Evaluation

3.14 CNT-MC-600, Rev. 2, Fireproofing of Structural Steel

3.15 Drawing A-1801, Rev. 10, Architectural Fire Delineation Floor Plan EL 1974'-0"

3.16 Updated Safety Analysis Report (USAR) Section 9.5.1.2.2.3.c, Rev. 15 and Table 9.5A-1 Sheet 27, Rev. 4

3.17 AN-94-041, WCGS IPEEE Project IPEEE Fire Ignition Frequencies

4.0 Assumptions

4.1 It is assumed that fireproofing material used to protect building steel is applied to a thickness as required by CNT-MC-600. This is an acceptable assumption based on a review of the Quality Control documentation maintained during initial fireproofing installation activities and subsequent inspections during ongoing plant repairs witnessed by Fire Protection personnel.

5.0 Assessment of Condition to Design Requirements

5.1 Requirements

USAR Section 9.5.1.2.2.3.c , identifies that the notes contained on Figure 9.5.1-2 [Drawing A-1801] define the structural steel fireproofing requirements. The structural steel of all of the ceilings of the fire areas is fireproofed with 3-hour protection with the exception that no fireproofing is provided on the underside of the fuel building roof.

USAR Table 9.5A-1 Sheet 27 (Rev. 4), that structural steel supporting the Control and Auxiliary Building roofs is protected with [3-hour] rated fireproofing.

Table I identifies the ASTM E-119 temperature limitations for structural steel protected with fireproofing.

TABLE I
ASTM E-119 Temperature Limitations for 3-Hour Fire Exposure

Structural Member Type	Maximum Single Point Temperature (°F)	Maximum Average Temperature (°F)
Beam	1300°(F)	1100°(F)
Column	1200°(F)	1000°(F)

5.2 Assessment

At Wolf Creek, fireproofing material is generally applied over exposed surfaces of structural members with the exception of thermal shorts and intervening items. Underwriters Laboratories (UL) has tested several different size members utilizing both Albi Duraspray and Monokote Z-146 coatings to 3-hour ASTM E-119 fire exposures. The testing for beams and columns, utilized W8 x 28 steel shapes incorporating two protection methods; contour and boxed. However, testing of both techniques did not incorporate thermal short attachments. Therefore, the affect of heat flux into plant structural steel with unprotected

thermal shorts is not directly bounded by fire testing. FP-M-012 revealed that unprotected thermal shorts, larger than Unistrut, contribute to single point temperatures that in some cases exceed the ASTM E-119 acceptance criteria, assuming a 3-hour fire exposure. Typically, average temperatures satisfied the ASTM E-119 acceptance criteria.

Refer to Table II for the specific rooms that are addressed by this evaluation.

TABLE II

Thermal Shorts in Closed Rooms with Credible Fire and No Ventilation or Forced Ventilation

Fire Area	Room	Building	Elev.	Description:	Table III Group	Table III ASTM E-119 Rating
A-3	1407	Auxiliary	2026-0	Boric Acid Batching Tank Area	1	Beam: About 2-Hours See Note 3
A-29	1304	Auxiliary	2013-6	Aux Feedwater Pipe Chase	1 & 4	Beam: 1.8 Hours, Attachment size is smaller than analyzed, See Note 2
	1327	Auxiliary	2000-0	Feedwater Pump Valve Compartment No. 2	1 & 4	Beam: 1.8 Hours, Attachment size is smaller than analyzed, See Note 2
A-30	1305	Auxiliary	2013-6	Aux Feedwater Pipe Chase	1	Beam: About 2-Hours
					3	Column: About 1-Hour, Attachment size is smaller than analyzed
	1328	Auxiliary	2000-0	Feedwater Pump Valve Compartment No. 3	1	Beam: About 2-Hours
A-33	1329	Auxiliary	2000-0	Vestibule	1	Beam: About 2-Hours
C-15	3403	Control	2016-0	Non-Vital Swgr & Xfmr Rm No. 1	1	Beam: About 2-Hours See Note 3 Below
	3404	Control	2016-0	Switchboard Rm No. 4	1	Beam: About 2-Hours, See Note 3
	3405	Control	2016-0	Battery Rm No. 4	1	Beam: About 2-Hours, See Note 3
					2	Column: Nearly 3-Hours, See Note 2
	3410	Control	2016-0	Switchboard Rm No. 2	1	Beam: About 2-Hours See Note 3
	3411	Control	2016-0	Battery Rm No. 2	1	Beam: About 2-Hours
C-16	3407	Control	2016-0	Battery Rm No. 1	1	Beam: About 2-Hours
	3408	Control	2016-0	Switchboard Rm No. 1	1	Beam: About 2-Hours
					2	Column: Nearly 3-Hours, See Note 2
	3409	Control	2016-0	Non-Vital Swgr & Xfmr Rm No. 2	1 & 4	Beam: 1.8 Hours, Attachment size is smaller than analyzed, See Notes 2 & 3
	3413	Control	2016-0	Battery Rm No. 3	1	Beam: About 2-Hours
	3414	Control	2016-0	Switchboard Rm No. 3	1	Beam: About 2-Hours

Table II Notes:

1. Category 1 (H member) as been conservatively assigned to this beam attachment configuration due to the lack of analysis of a W shape configuration welded to the bottom beam flange. It should be noted that W shapes thermally perform significantly better than H shapes due to the larger exposed area of the H shape.

2. Hot spot forms in Web area around thermal short. Structural considerations could show this element performs its intended design function for three-hours. This Note is a direct excerpt from Calculation FP-M-012.

3. Refer to Attachment G5 for the Heat Affected Zone (HAZ) review where steel is an integral element of the fire barrier assembly.

6.0 Methodology

As discussed in Section 12.2.2 of M-663-00017A, Section 4.2.2 of Regulatory Guide 1.189 identifies that structural steel is not required to be protected to the fire resistance rating of the barrier [typically 3-hours], provided analysis demonstrates that the steel temperature reached during fire exposure does not result in structural failure of the steel. Considering the results of FP-M-012, where an ASTM E-119 3-hour fire was modeled to assess thermal insult presented by unprotected attachments connected to protected steel, the Reg. Guide 1.189 approach allowance is utilized to address impact of unprotected thermal short attachments larger than Unistrut.

Walkdowns were conducted on a room-by-room basis utilizing structural steel drawings and a best effort visual inspection to determine the worse case thermal short configuration for columns, beams and where structural steel serves as an Appendix R fire boundary. For the purpose of this evaluation, all unprotected thermal shorts greater than Unistrut were reviewed and considered relevant to determine worse case scenario. FP-M-012 demonstrated that thermal short attachments equivalent to Unistrut did not present a thermal conductive path that would challenge structural steel integrity, assuming an ASTM E-119 fire exposure.

See section 12.2.3 of M-663-00017A for further discussion regarding the overall fireproofing assessment methodology utilized in the identification process for selecting the worse case thermal short configuration.

Each worse case thermal short configuration was then compared to the configurations identified in Table III, from FP-M-012, which were modeled assuming an ASTM E-119 3-hour fire exposure. The fire resistance rating of the Table III configuration that provided the closest match to the worse case configuration was utilized to infer an approximate fire resistance rating, again assuming an ASTM E-119 3-hour fire exposure. This comparison information is captured in Table II. In all cases the structural steel for the rooms satisfied at least a 1-hour rating, and in several cases nearly a 3-hour rating. Additionally, many unprotected attachment members were smaller than that analyzed in FP-M-012, and therefore the beam or column being evaluated is expected to perform better than that indicated.

In effort to assess structural steel performance considering representative plant configurations and hazards, the NUREG-1805 Fire Dynamics Tools (FDT) were utilized to determine the maximum hot gas layer temperature anticipated within the rooms

considering simple fire heat release rates provided in Appendix F of NRC Inspection Manual 0609.

TABLE III

Thermal Short Configurations Analyzed in FP-M-012

Thermal Short Configuration	Summary Of Thermal Short Configuration	ASTM E119 Fire Resistance Rating	Findings
1	Typical H-Shape thermal short on a moderate size beam	About two-hours	Large segment of flange exceeds peak temperature criterion.
2	Multiple W-Shape thermal shorts on a large size column	Nearly three-hours	Hot spot formation on the web. Structural considerations could show this element performs function for three-hours.
3	Large H Shape thermal short on a large size column	About one-hour	Large segment of entire cross-section exceeds peak temperature criterion.
4	Typical W-Shape thermal short on a moderate size beam	1.8-hours	Hot spot forms in web area around thermal short, Structural considerations could show this element performs function for three-hours.
5	Small thermal short (Unistrut) on a moderate size beam	Over three-hours	Provides indications of Unistrut impact on temperature field in structural steel. These thermal shorts have little impact on primary structural element steel temperature.
6	Small thermal short (Unistrut) on a moderate size beam. Thermal Insulation on beam within the Unistrut is missing.	Over three-hours	Provides indications of Unistrut impact on temperature field in structural steel. This is the most severe type of Unistrut thermal short.

7.0 Evaluation

Each Room identified in Table II was reviewed and evaluated to determine if building structural members with unprotected steel attachments larger than Unistrut would affect the steel integrity in the event of fire. It was determined by utilizing NUREG-1805 Fire Dynamics Tools that these rooms would not develop a hot gas layer that would influence the existing building steel, and existing building steel protection configurations are acceptable to maintain building integrity.

Each Table II room is either a closed room with no ventilation or a closed room with forced ventilation. A closed room with no ventilation is consistent with the application of NUREG-1805 FDT “02.3_temperature_cc_rev1.xls” (Version 1805.1), as it addresses modeling closed compartments with natural ventilation associated only with compartment leakage. This is an acceptable approach, as rooms of concern will have limited natural ventilation leakage occurring predominantly around allowed door gaps. Therefore, this FDT was utilized to assess room hot gas layer temperature development

for closed rooms containing no ventilation. An example of the FDT is provided in Appendix G4A.

Where rooms were closed, with the exception of forced air ventilation openings, it was recognized that these rooms would effectively become a closed room once HVAC fire damper closure was achieved. HVAC fire dampers are closed by one of the following means:

- Automatically close by the fire alarm system, following smoke detection activation, for dampers provided with an electro-thermal link (ETL).
- Close by the melting of a fusible link with a temperature rating of 165 °F.

Rooms with ETL controlled fire dampers were considered closed rooms with no forced ventilation, since room forced ventilation flow would be eliminated by fire alarm system activation, which would occur early in the fire development stage. Therefore, closed rooms with forced ventilation controlled by ETL fire dampers also utilize NUREG-1805 FDT “02.3_temperature_cc_rev1.xls” (Version 1805.1).

Where fusible link fire dampers provide room ventilation isolation, it was recognized that forced ventilation would continue for the room until the compartment temperature reached the activation point of the fire damper fusible link. Therefore, each of these rooms was first treated as compartment with forced ventilation until room hot gas layer temperature exceeded 200°F. NUREG-1805 FDT “02.2_Temperature_FV.xls” (Version 1805.0), was utilized for this application. An example of the FDT is provided in Appendix G4B. At the point that the hot gas layer temperature exceeded 200 °F, effectively creating a closed room with no ventilation following fire damper closure, relevant data from the Closed Room - Forced Ventilation FDT was extracted and utilized as input within the previously discussed FDT, for a closed room with no forced ventilation. When the duration for reaching 200°F was less than 1 minute, 200°F was utilized as the input temperature for the Closed Room - Forced Ventilation FDT.

Data collection necessary for FDT input is provided in the individual room data sheets documented in Appendices G4C and G4D. Appendix G4C contains data for closed rooms with no ventilation, while G4D is for closed rooms with forced ventilation. Input information necessary for each FDT utilized is as follows:

Closed Room – No Ventilation
NUREG –1805 FDT "02.3_temperature_cc_rev1.xls" (Version 1805.1)

- Compartment width (ft)
- Compartment length (ft)
- Compartment height (ft)
- Barrier type (concrete or concrete block)
- Barrier thickness (in)
- Ambient air temperature (°F)
- Fire Heat Release Rate (kW)
- Time when Closed Room – Forced Ventilation FDT exceeds 200°F (min) *****
- Compartment starting temperature for Closed Room – No Ventilation FDT (°F) *****

*Data input from Closed Room – Forced Ventilation FDT

Closed Room – Forced Ventilation
NUREG-1805 FDT "02.2_Temperature_FV.xls" (Version 1805.0)

- Compartment width (ft)
- Compartment length (ft)
- Compartment height (ft)
- Barrier type (concrete or concrete block)
- Barrier thickness (in)
- Forced Ventilation Rate (cfm)
- Ambient air temperature (°F)
- Fire Heat Release Rate (kW)

Initially, a fire with a constant 650 kW heat release rate (HRR) was utilized for the Table II rooms. This HRR was chosen considering the guidance of Appendix F to NRC Inspection Manual 0609. Table IV, extracted from the Inspection Manual, reveals that a 650 kW HRR is based on a large electrical fire that reflects a high confidence limit (98th percentile) fire severity. This fire severity envelops large electrical fires, transient combustible fires, and 90% of very large fire sources. This HRR exceeds the credible fire severity for each room of concern. It was initially chosen in effort to eliminate the need for a detailed quantitative review of room contents. When utilizing a 650 kW HRR for each of the Table II rooms, the gas layer modeled did develop temperatures that exceeded the Table I maximum average exposure temperatures limitations for beams and/or columns.

To further evaluate and assess the Table II rooms, a room by room walk down along with a comparison to the IEEE ignition source frequency calculation AN-94-041 was conducted in effort to reasonably develop a credible scenario heat release rate, considering room combustible loading, equipment, and the associated fire hazard.

NRC Inspection Manual 0609, Appendix F was utilized to aid in the process of mapping the general fire scenario characterization to a for each room evaluated. Table IV was

used to bin predefined fire characteristics for each room considering AN-94-041 and walkdown data. Each room was binned to either a 200 kW or 70 kW HRR fire based on an assessment of room contents in relation to Table IV information. Specifically, a 200 kW fire envelops small electrical, engine/heater, and transient combustible fires, while a 70 kW fire envelopes 90% of both engine/heater and transient combustible fires. The credible heat release rates determined for each room are identified in the Appendix G4C and G4D room data sheets.

In all cases, specific room area input into the FDT using a credible HRR yielded hot gas layer results at a 180-minute duration that were less than the ASTM E-119 average temperature limitations identified in Table I. Refer, to the Appendix G4C and G4D room data sheets for specific results. During ASTM E-119 fire testing, temperatures are recorded on the steel surface underneath the fireproofing protective coating in effort to assess fireproofing effectiveness when subjected to approximate 1925 °F fire exposure for a 3-hour duration. Considering that the FDT calculated room hot gas layer temperature was less than the Table I ASTM E-119 average temperature limitations, it is reasonable to conclude that unprotected thermal short attachments will not present a thermal failure mode to the structural steel, since the room will not attain temperatures during the postulated fire event that would challenge steel structural integrity.

TABLE IV

Generic Fire Bins[1]

Mapping of General Fire Scenario Characterization Type Bins to Fire Intensity Characteristics						
Fire Size Bins	**Generic Fire Type Bins with Simple Predefined Characteristics**					
	Small Electrical Fire	**Large Electrical Fire**	**Indoor Oil-Filled Transformers**	**Very Large Fire Sources**	**Engines and Heaters**	**Solid and Transient Combustibles**
70 kW	75th Percentile Fire				75th Percentile Fire	75th Percentile Fire
200 kW	98th Percentile Fire	75th Percentile Fire			98th Percentile Fire	98th Percentile Fire
650 kW		98th Percentile Fire	75th Percentile Fire	75th Percentile Fire		
2 MW			98th Percentile Fire			
10 MW				98th Percentile Fire		

Table IV Note:

1. Information extracted from NRC Inspection Manual 0609, Appendix F, Table 2.3.1.

8.0 Post Fire Safe Shutdown Impact

There is no impact to post-fire safe shutdown (PFSSD) capability, as the evaluation demonstrates that postulated fire event room temperate will not result in detrimental impact to structural steel integrity.

Refer to Attachment G5 for the Heat Affected Zone (HAZ) review where steel is an integral element of the fire barrier assembly.

9.0 Conclusions

This evaluation demonstrates that unprotected thermal shorts, attached to structural steel within the Table II rooms, does not result in a detrimental impact to structural steel integrity. Utilization of NUREG-1805 FDTs revealed that hot gas layer temperatures for each of the Table II rooms did not exceed the ASTM E-119 maximum average exposure temperature for beam or column limitation in the associated room. Therefore, the protected structural steel configurations within these rooms are acceptable for the intended service, and will not degrade the affected fire barrier or structural integrity of the building steel, or affect redundant PFSSD capability.

Based on the above discussion, it is reasonable to conclude that the existing fireproofing on the structural steel with unprotected attachments will satisfy regulatory expectations and commitments as well as WCNOC Fire Protection Program requirements, to prevent building steel failure as a result of fire exposure.

CHAPTER 2. PREDICTING HOT GAS LAYER TEMPERATURE IN A ROOM FIRE WITH DOOR CLOSED

Version 1805.1

The following calculations estimate the hot gas layer temperature in enclosure fire with door closed.
This method assume that compartment has sufficient leaks to prevent pressure buildup, but the leakages are ignored.
Parameters in YELLOW CELLS are Entered by the User.
Parameters in GREEN CELLS are Automatically Selected from the DROP DOWN MENU for the Material Selected.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s).
The chapter in the NUREG should be read before an analysis is made.

INPUT PARAMETERS

COMPARTMENT INFORMATION

Compartment Width (w_c)	15.00	ft	4.57 m
Compartment Length (l_c)	15.00	ft	4.57 m
Compartment Height (h_c)	15.00	ft	4.57 m
Interior Lining Thickness (δ)	12.00	in	0.3048 m
Ambient Air Temperature (T_a)	77.00	°F	25.00 °C
			298.00 K

AMBIENT CONDITIONS

Specific Heat of Air (c_p)	1.00	kJ/kg-K	
Ambient Air Density (ρ_a)	1.18	kg/m^3	
Volume of the Compartment (V)	3375.00	ft^3	95.57 m^3
Mass of the Gas in the Compartment (m = V x ρ_a)	113.21	kg	

Note: Air density will automatically correct with Ambient Air Temperature (T_a) Input

THERMAL PROPERTIES OF COMPARTMENT ENCLOSING SURFACES

Interior Lining Thermal Inertia ($k\rho c$)	2.9	(kW/m^2-K)^2-sec
Interior Lining Thermal Conductivity (k)	0.0016	kW/m-K
Interior Lining Specific Heat (c)	0.75	kJ/kg-K
Interior Lining Density (ρ)	2400	kg/m^3

THERMAL PROPERTIES FOR COMMON INTERIOR LINING MATERIALS

Material	$k\rho c$ (kW/m^2-K)^2-sec	k (kW/m-K)	c (kJ/kg-K)	ρ (kg/m^3)
Aluminum (pure)	500	0.206	0.895	2710
Steel (0.5% Carbon)	197	0.054	0.465	7850
Concrete	2.9	0.0016	0.75	2400
Brick	1.7	0.0008	0.8	2600
Glass, Plate	1.6	0.00076	0.8	2710
Brick/Concrete Block	1.2	0.00073	0.84	1900
Gypsum Board	0.18	0.00017	1.1	960
Plywood	0.16	0.00012	2.5	540
Fiber Insulation Board	0.16	0.00053	1.25	240
Chipboard	0.15	0.00015	1.25	800
Aerated Concrete	0.12	0.00026	0.96	500
Plasterboard	0.12	0.00016	0.84	950
Calcium Silicate Board	0.098	0.00013	1.12	700
Alumina Silicate Block	0.036	0.00014	1.0	260
Glass Fiber Insulation	0.0018	0.000037	0.8	60
Expanded Polystyrene	0.001	0.000034	1.5	20
User Specified Value	Enter Value	Enter Value	Enter Value	Enter Value

Reference: *Klote, J., J. Milke, Principles of Smoke Management*, 2002, Page 270.

Select Material
Concrete
Scroll to desired material then Click on selection

FIRE SPECIFICATIONS

Fire Heat Release Rate (Q)	500.00	kW
Time after Ignition	120	sec

Calculate

METHOD OF BEYLER

Reference: *SFPE Handbook of Fire Protection Engineering, 3rd Edition, 2002, Page 3-180.*

$\Delta T_g = (2 K_2 / K_1^2) (K_1 \sqrt{t} - 1 + e^{(-K_1 \sqrt{t})})$

Where $\Delta T_g = T_g - T_a$ = upper layer gas temperature rise above ambient (K)
T_a = ambient air temperature (K)
Parameter $K_1 = 2 (0.4\sqrt{k\rho c}) A_T / mc_p$
Parameter $K_2 = Q / m c_p$
$k\rho c$ = interior construction thermal inertia (kW/m^2-K)^2-sec
m = mass of gas in the compartment (kg)
c_p = specific heat of air (kJ/kg-K)
A_T = total area of the compartment enclosing surface boundaries (m^2)
Q = heat release rate of the fire (kW)
t = exposure time (sec)

Calculation for Parameter K_1

$K_1 = 2 (0.4\sqrt{k\rho c}) A_T / mc$

Where
$k\rho c$ = interior construction thermal inertia (kW/m^2-K)^2-sec
A_T = total area of the compartment enclosing surface boundaries (m^2)
m = mass of gas in the compartment (kg)

Area of Compartment Enclosing Surface Boundaries

$A_T = [2(w_c \times l_c) + 2(h_c \times w_c) + 2(h_c \times l_c)]$

Where A_T = total area of the compartment enclosing surface boundaries (m^2)
w_c = compartment width (m)

l_c = compartment length (m)
h_c = compartment height (m)

A_T = **125.42** m^2
K_1 = **1.51** kW/m^2-K

Calculation for Parameter K_2

K_2 = $Q / m\ c_p$

Where
Q = heat release rate of the fire (kW)
m = mass of gas in the compartment (kg)
c_p = specific heat of air (kJ/kg-K)

K_2 = **4.42**

Compartment Hot Gas Layer Temperature, Compartment Door Closed

$\Delta T_g = (2 K_2 / K_1^2) (K_1 \sqrt{t} - 1 + e^{(-K_1 \sqrt{t})})$

$\Delta T_g = T_g - T_a$ = **60.23**

T_g = **358.23** K

T_g =	**85.23 °C**	**185.42 °F**	**Answer**

NOTE

The above calculations are based on principles developed in the SFPE Handbook of Fire Protection Engineering, 3rd Edition, 2002.
Calculations are based on certain assumptions and have inherent limitations. The results of such calculation may or may not have reasonable predictive capabilities for a given situation, and should only be interpreted by an informed user. Although each calculation in the spreadsheet has been verified with the results of hand calculation, there is no absolute guarantee of the accuracy of these calculations.
Any questions, comments, concerns, and suggestions, or to report an error(s) in the spreadsheet, please send an email to nxi@nrc.gov or mxs3@nrc.gov.

Prepared by: Date Organization

Checked by: Date Organization

Additional Information

Revision Log	Description of Revision	Date
1805.0	Original issue with final text.	January 2005
1805.1	Corrected calculation for Parameter K_1. Added area of compartment enclosing surface boundaries (A_T) in Parameter K1.	September 2005

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Fire Protection Engineering and Special Projects Section

CHAPTER 2. PREDICTING HOT GAS LAYER TEMPERATURE IN A ROOM FIRE WITH FORCED VENTILATION

COMPARTMENT WITH THERMALLY THICK/THIN BOUNDARIES

Version 1805.0

The following calculations estimate the hot gas layer temperature and smoke layer height in enclosure fire.
Parameters in YELLOW CELLS are Entered by the User.
Parameters in GREEN CELLS are Automatically Selected from the DROP DOWN MENU for the Material Selected.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s).
The chapter in the NUREG should be read before an analysis is made.

INPUT PARAMETERS

COMPARTMENT INFORMATION

Compartment Width (w_c)	16.50	ft	5.03 m
Compartment Length (l_c)	36.50	ft	11.13 m
Compartment Height (h_c)	20.00	ft	6.10 m
Interior Lining Thickness (δ)	12.00	in	0.3048 m

AMBIENT CONDITIONS

Ambient Air Temperature (T_a)	104.00	°F	40.00 °C 313.00 K
Specific Heat of Air (c_p)	1.00	kJ/kg-K	
Ambient Air Density (ρ_a)	1.13	kg/m^3	

THERMAL PROPERTIES OF COMPARTMENT ENCLOSING SURFACES

Interior Lining Thermal Inertia ($k\rho c$)	2.9	(kW/m^2-K)^2-sec
Interior Lining Thermal Conductivity (k)	0.0016	kW/m-K
Interior Lining Specific Heat (c)	0.75	kJ/kg-K
Interior Lining Density (ρ)	2400	kg/m^3

Note: Air density will automatically correct with Ambient Air Temperature (T_a) Input

THERMAL PROPERTIES FOR COMMON INTERIOR LINING MATERIALS

Material	$k\rho c$ (kW/m^2-K)^2-sec	k (kW/m-K)	c (kJ/kg-K)	ρ (kg/m^3)
Aluminum (pure)	500	0.206	0.895	2710
Steel (0.5% Carbon)	197	0.054	0.465	7850
Concrete	2.9	0.0016	0.75	2400
Brick	1.7	0.0008	0.8	2600
Glass, Plate	1.6	0.00076	0.8	2710
Brick/Concrete Block	1.2	0.00073	0.84	1900
Gypsum Board	0.18	0.00017	1.1	960
Plywood	0.16	0.00012	2.5	540
Fiber Insulation Board	0.16	0.00053	1.25	240
Chipboard	0.15	0.00015	1.25	800
Aerated Concrete	0.12	0.00026	0.96	500
Plasterboard	0.12	0.00016	0.84	950
Calcium Silicate Board	0.098	0.00013	1.12	700
Alumina Silicate Block	0.036	0.00014	1	260
Glass Fiber Insulation	0.0018	0.000037	0.8	60
Expanded Polystyrene	0.001	0.000034	1.5	20
User Specified Value	Enter Value	Enter Value	Enter Value	Enter Value

Select Material
Concrete
Scroll to desired material then Click on selection

Reference: *Klote, J., J. Milke, Principles of Smoke Management, 2002 Page 270.*

COMPARTMENT MASS VENTILATION FLOW RATE

Forced Ventilation Flow Rate (m)	100.00	cfm	0.047 m^3/sec 0.053 kg/sec

FIRE SPECIFICATIONS

Fire Heat Release Rate (Q)	70.00	kW

Calculate

METHOD OF FOOTE, PAGNI, AND ALVARES (FPA)

Reference: *SFPE Handbook of Fire Protection Engineering*, 3rd Edition, 2002, Page 3-177.

$$\Delta T_g/T_a = 0.63(Q/mc_pT_a)^{0.72}(h_kA_T/mc_p)^{-0.36}$$

Where
$\Delta T_g = T_g - T_a$ = upper layer gas temperature rise above ambient (K)
T_a = ambient air temperature (K)
Q = heat release rate of the fire (kW)
m = compartment mass ventilation flow rate (kg/sec)
c_p = specific heat of air (kJ/kg-K)
h_k = convective heat transfer coefficient (kW/m^2-K)
A_T = total area of the compartment enclosing surface boundaries (m^2)

Thermal Penetration Time Calculation

$$t_p = (\rho c_p/k)(\delta/2)^2$$

Where
t_p = thermal penetration time (sec)
ρ = interior construction density (kg/m^3)
c_p = interior construction heat capacity (kJ/kg-K)
k = interior construction thermal conductivity (kW/m-K)
δ = interior construction thickness (m)

t_p = **26128.98** sec

Heat Transfer Coefficient Calculation

h_k = $\sqrt{(k\rho c/t)}$ for $t < t_p$ or (k/δ) for $t > t_p$

Where h_k = heat transfer coefficient (kW/m^2-K)

$k\rho c$ = interior construction thermal inertia (kW/m^2-K)^2-sec

(a thermal property of material responsible for the rate of temperature rise)

t = time after ignition (sec)

See table below for results

Area of Compartment Enclosing Surface Boundaries

A_T = $2 (w_c \times l_c) + 2 (h_c \times w_c) + 2 (h_c \times l_c)$

Where A_T = total area of the compartment enclosing surface boundaries (m^2)

w_c = compartment width (m)

l_c = compartment length (m)

h_c = compartment height (m)

A_v = area of ventilation opening (m^2)

A_T = **308.86** m^2

Compartment Hot Gas Layer Temperature With Forced Ventilation

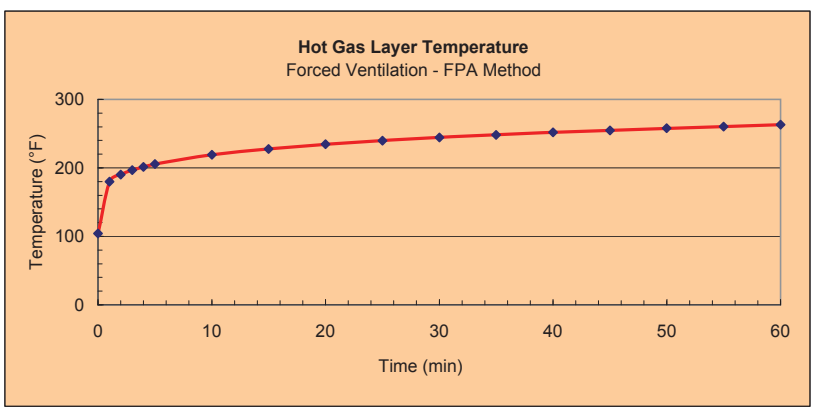
$\Delta T_g/T_a = 0.63(Q/mc_pT_0)^{0.72}(h_kA_T/mc_p)^{-0.36}$

ΔT_g = $T_g - T_a$

T_g = $\Delta T_g + T_a$

Results

Time After Ignition (t) (min)	(sec)	h_k (kW/m^2-K)	$\Delta T_g/T_0$	ΔT_g (K)	T_g (K)	T_g (°C)	T_g (°F)
0	0	-	-	-	313.00	40.00	104.00
1	60	0.22	0.13	42.24	355.24	82.24	180.02
2	120	0.16	0.15	47.85	360.85	87.85	190.13
3	180	0.13	0.16	51.47	364.47	91.47	196.65
4	240	0.11	0.17	54.21	367.21	94.21	201.57
5	300	0.10	0.18	56.43	369.43	96.43	205.57
10	600	0.07	0.20	63.93	376.93	103.93	219.07
15	900	0.06	0.22	68.77	381.77	108.77	227.78
20	1200	0.05	0.23	72.42	385.42	112.42	234.36
25	1500	0.04	0.24	75.39	388.39	115.39	239.70
30	1800	0.04	0.25	77.90	390.90	117.90	244.23
35	2100	0.04	0.26	80.10	393.10	120.10	248.17
40	2400	0.03	0.26	82.05	395.05	122.05	251.68
45	2700	0.03	0.27	83.80	396.80	123.80	254.85
50	3000	0.03	0.27	85.41	398.41	125.41	257.73
55	3300	0.03	0.28	86.89	399.89	126.89	260.39
60	3600	0.03	0.28	88.26	401.26	128.26	262.86



METHOD OF DEAL AND BEYLER

Reference: *SFPE Handbook of Fire Protection Engineering* , 3rd Edition, 2002, Page 3-178.

Heat Transfer Coefficient Calculation

h_k = $0.4 \sqrt{(k\rho c / t)}$ for $t < t_p$

Where h_k = heat transfer coefficient (kW/m^2-K)

$k\rho c$ = interior construction thermal inertia (kW/m^2-K)^2-sec

(a thermal property of material responsible for the rate of temperature rise)

δ = thickness of interior lining (m)

h_k = **0.088** kW/m^2-K

Area of Compartment Enclosing Surface Boundaries

A_T = $2(w_c \times l_c) + 2(h_c \times w_c) + 2(h_c \times l_c)$

A_T = **308.86** m^2

Compartment Hot Gas Layer Temperature With Forced Ventilation

$\Delta T_g = Q / (m\, c_p + h_k A_T)$

Where $\Delta T_g = T_g - T_a$ = upper layer gas temperature rise above ambient (K)

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T_a = ambient air temperature (K)

Q = heat release rate of the fire (kW)

m = compartment mass ventilation flow rate (kg/sec)

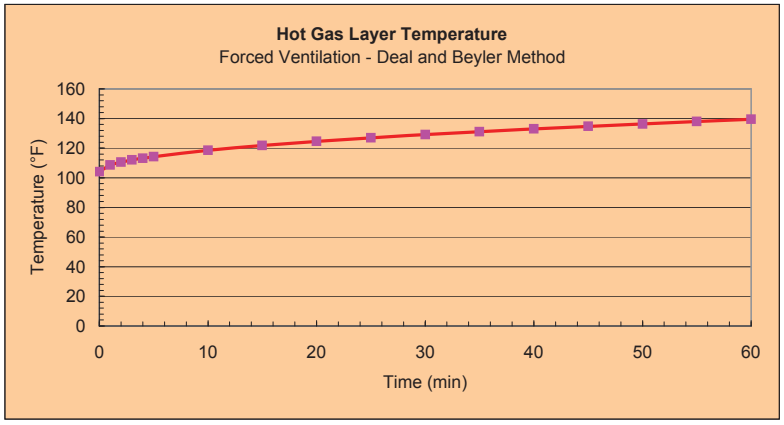
c_p = specific heat of air (kJ/Kg-K)

h_k = convective heat transfer coefficient (kW/m^2-K)

A_T = total area of the compartment enclosing surface boundaries (m^2)

Results

Time After Ignition (t) (min)	(sec)	h_k (kW/m^2-K)	ΔT_g (K)	T_g (K)	T_g (°C)	T_g (°F)
0	0	-	-	313.00	40.00	104.00
1	60	0.09	2.57	315.57	42.57	108.63
2	120	0.06	3.63	316.63	43.63	110.54
3	180	0.05	4.45	317.45	44.45	112.01
4	240	0.04	5.13	318.13	45.13	113.24
5	300	0.04	5.74	318.74	45.74	114.33
10	600	0.03	8.10	321.10	48.10	118.58
15	900	0.02	9.91	322.91	49.91	121.83
20	1200	0.02	11.43	324.43	51.43	124.57
25	1500	0.02	12.76	325.76	52.76	126.97
30	1800	0.02	13.97	326.97	53.97	129.14
35	2100	0.01	15.07	328.07	55.07	131.13
40	2400	0.01	16.10	329.10	56.10	132.98
45	2700	0.01	17.06	330.06	57.06	134.72
50	3000	0.01	17.97	330.97	57.97	136.35
55	3300	0.01	18.84	331.84	58.84	137.91
60	3600	0.01	19.66	332.66	59.66	139.40



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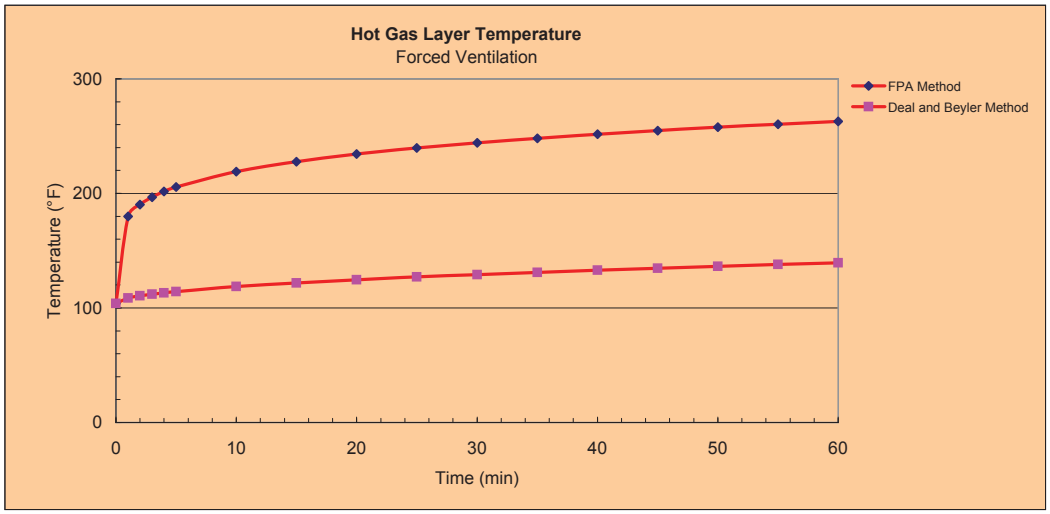

NOTE

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Calculations are based on certain assumptions and have inherent limitations. The results of such calculations may or may not have reasonable predictive capabilities for a given situation, and should only be interpreted by an informed user.
Although each calculation in the spreadsheet has been verified with the results of hand calculation, there is no absolute guarantee of the accuracy of these calculations.
Any questions, comments, concerns, and suggestions, or to report an error(s) in the spreadsheet, please send an email to nxi@nrc.gov or mxs3@nrc.gov.

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Division of Systems Safety and Analysis
Plant Systems Branch
Fire Protection Engineering and Special Projects Section

Prepared by: Date Organization

Checked by: Date Organization

Additional Information

Revision Log	Description of Revision	Date
1805.0	Original issue with final text.	January 2005

Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3403-2016** **Building:** Control **Fire Area:** C-15

Description: Non-Vital Swgr & Xfmr Rm No. 1

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	C-0S3001
Member Type:	Beam	Column
Member Size:	14 X 30	14 X 370
Comments:		No thermal shorts, column is bounded by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

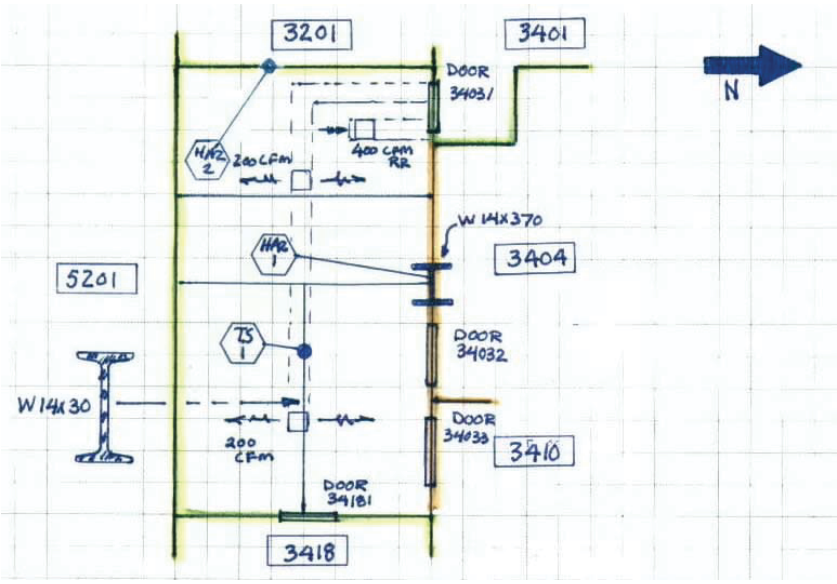
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimal, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 1.82E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	12.5
Compartment Length (ft):	30
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **534.27**

Room Sketch:

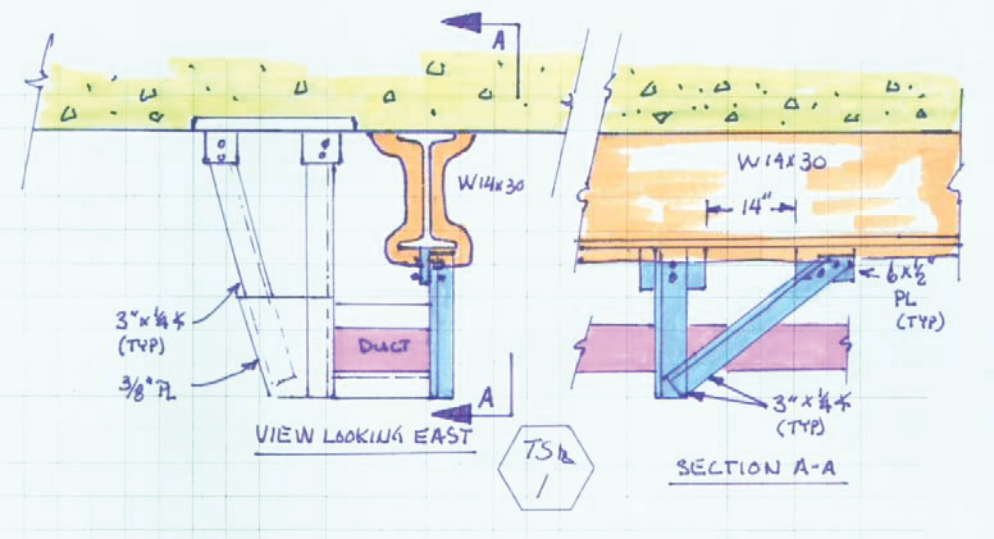


Structural Steel Fireproofing Data

Appendix G4C

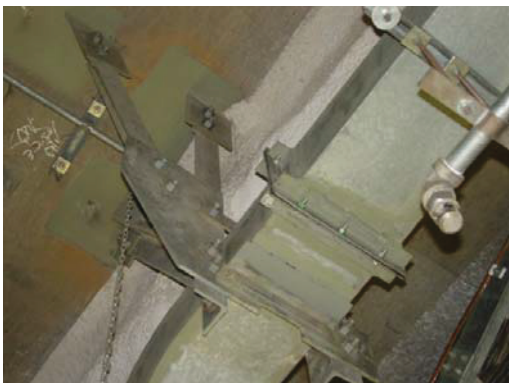
3403-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3404-2016** **Building:** Control **Fire Area:** C-15

Description: Switchboard Rm No. 4

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	C-0S3001
Member Type:	Beam	Column
Member Size:	24 X 76	14 X 370
Comments:		Column has no thermal shorts, considered bounded by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

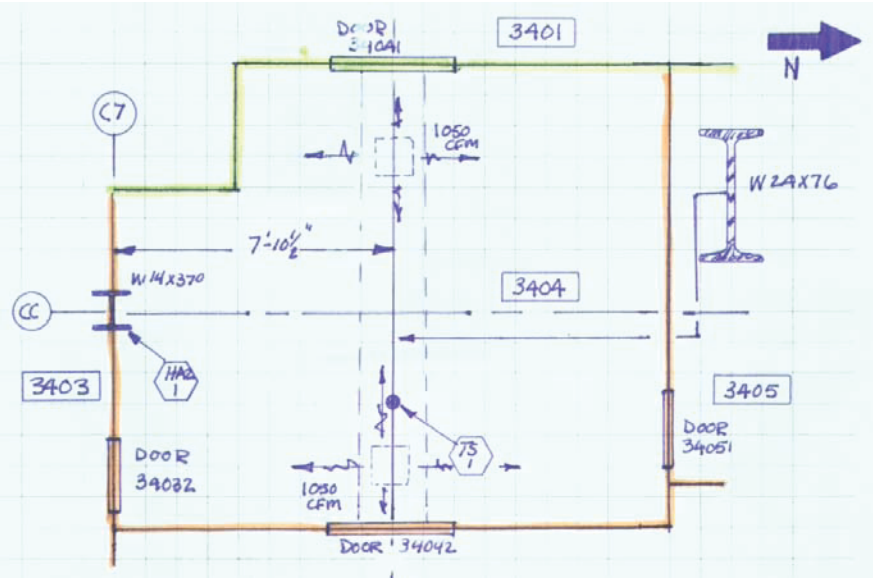
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimum, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 2.00E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	22.5
Compartment Length (ft):	17
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **551.23**

Room Sketch:

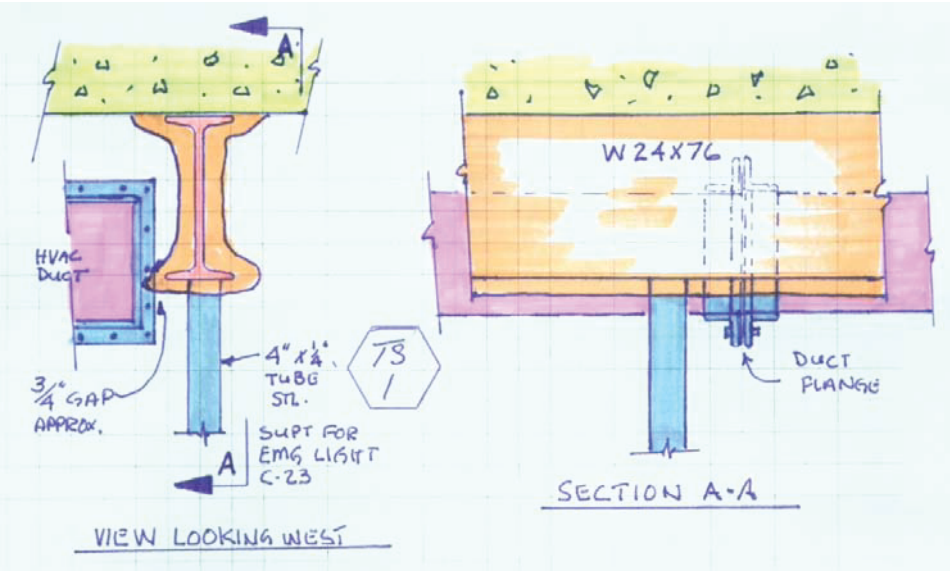


Structural Steel Fireproofing Data

Appendix G4C

3404-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3410-2016** **Building:** Control **Fire Area:** C-15

Description: Switchboard Rm No. 2

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 76	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

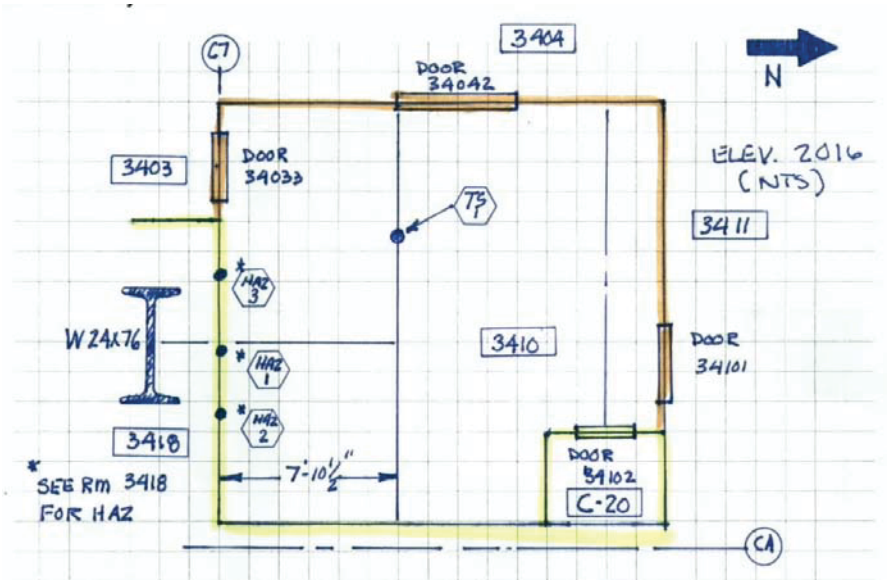
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimum, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 1.93E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	19
Compartment Length (ft):	18
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **591.41**

Room Sketch:

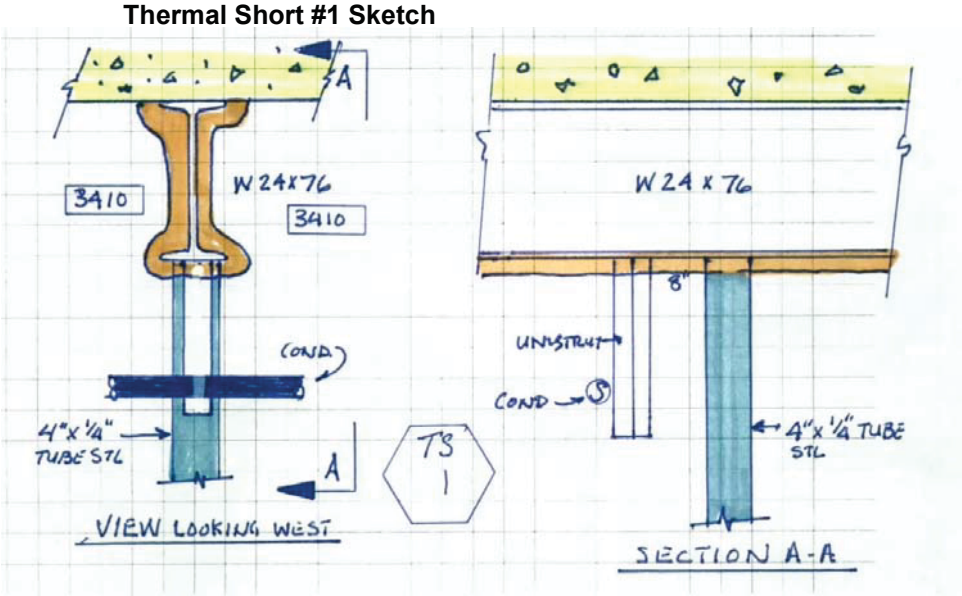


Structural Steel Fireproofing Data

Appendix G4C

3410-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3408-2016** **Building:** Control **Fire Area:** C-16

Description: Switchboard Rm No. 1

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	C-0S3001
Member Type:	Beam	Column
Member Size:	24 X 68	14 X 398
Comments:		

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

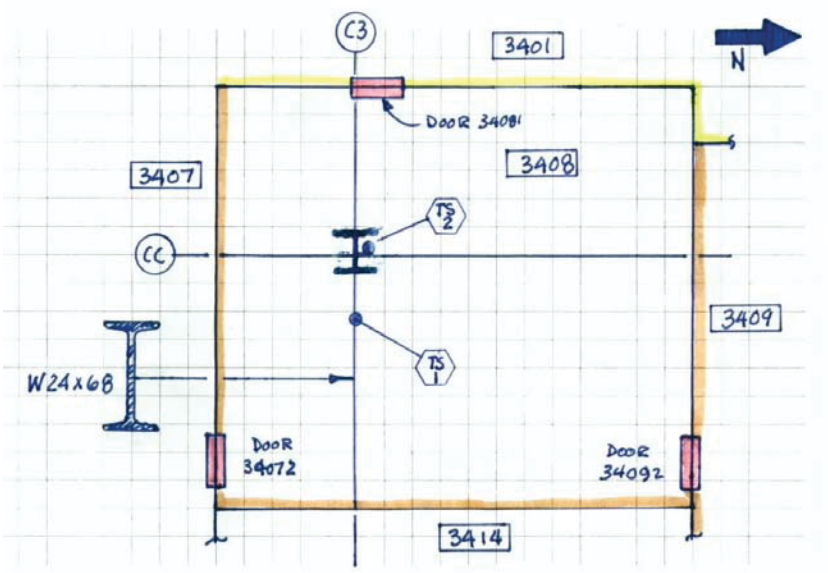
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimal, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 2.00E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	22
Compartment Length (ft):	18
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **541.47**

Room Sketch:

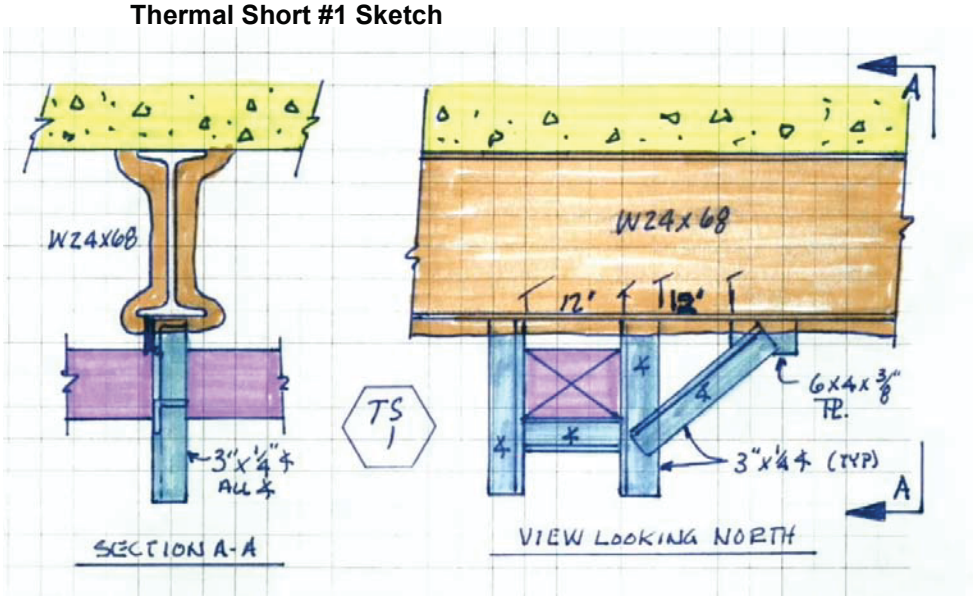


Structural Steel Fireproofing Data

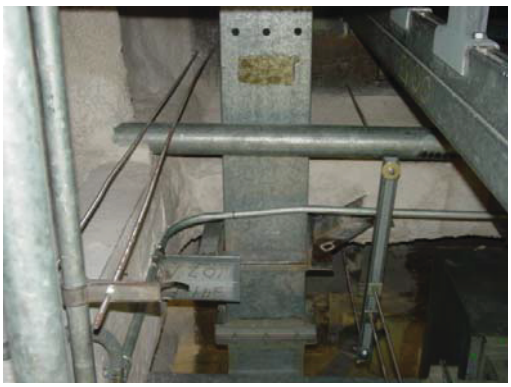
Appendix G4C

3408-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1



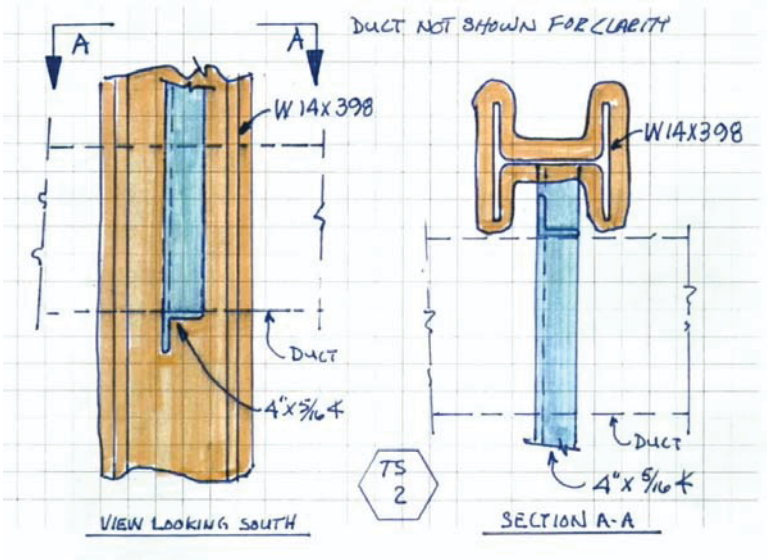
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4C

3408-2016

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2

Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3409-2016** **Building:** Control **Fire Area:** C-16

Description: Non-Vital Swgr & Xfmr Rm No. 2

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	27 X 94	N/A
Comments:	Additional Items in close proximity (4" I's and 21/2" angles).	No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

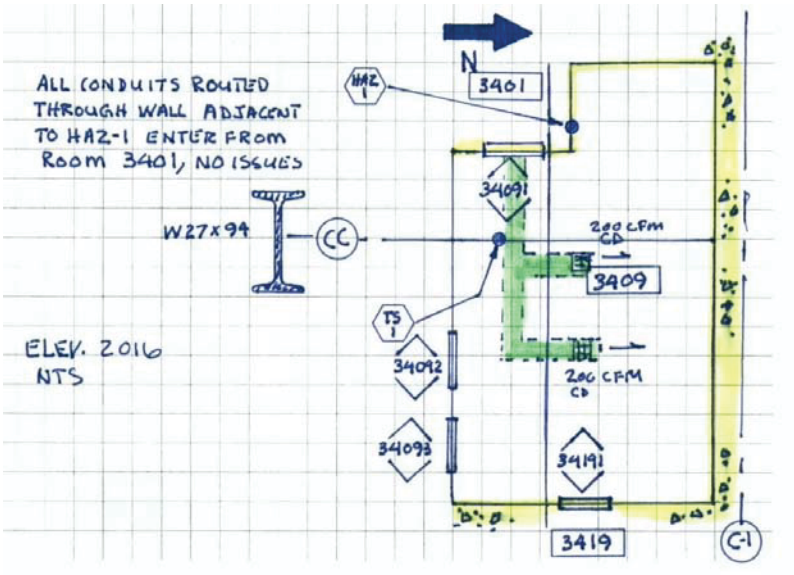
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimal, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 2.22E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	28
Compartment Length (ft):	12.25
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **565.18**

Room Sketch:

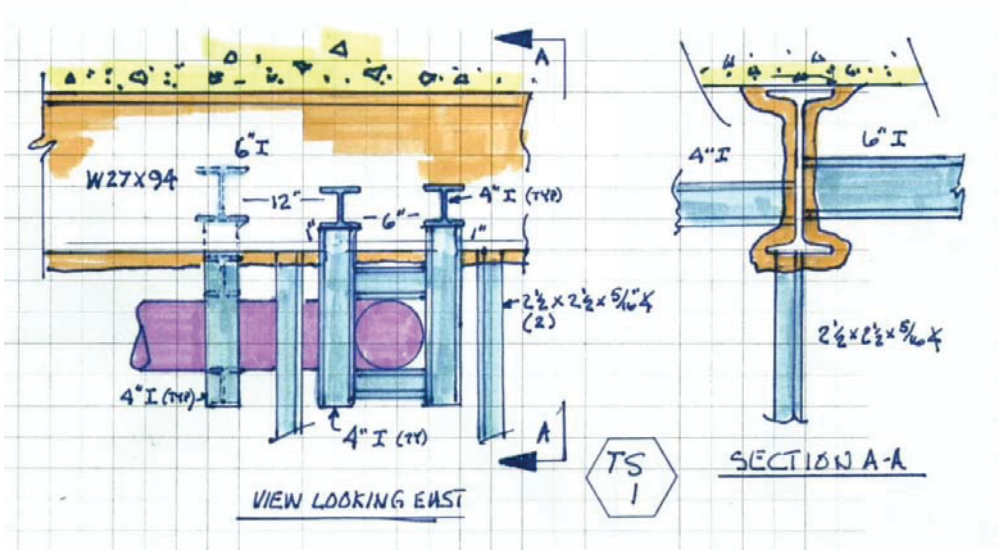


Structural Steel Fireproofing Data

Appendix G4C

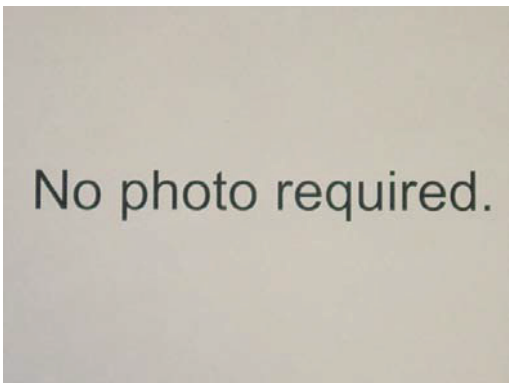
3409-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G4C

Room-Elevation: **3414-2016** **Building:** Control **Fire Area:** C-16

Description: Switchboard Rm No. 3

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 68	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.3_temperature_cc_rev1.xls (Version 1805.1)

Credible Fire HRR (kW: 200 KW

Credible Fire Basis:

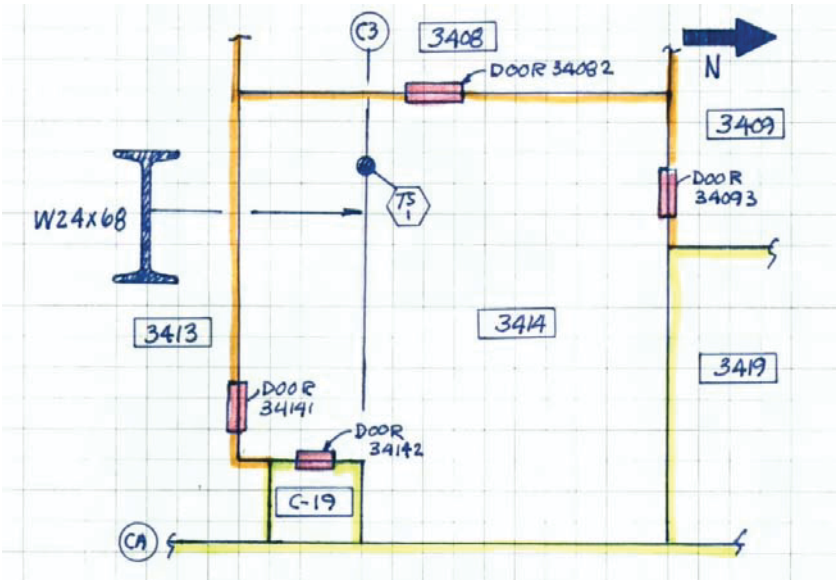
SWGR: Moderate Fire
MCC: Moderate Fire
Cabinet: Small Fire
Transformer 480V Moderate Fire
Exposed cable: Minimal, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 1.93E-03

Barrier Type:	Block
Barrier Thickness (in):	8
Compartment Width (ft):	19
Compartment Length (ft):	18
Compartment Height (ft):	15.25
Initial Room Temp. (F):	90

NUREG-1805 FDT Results

Hot Gas Layer Temperature @ 180 minutes (F): **591.41**

Room Sketch:

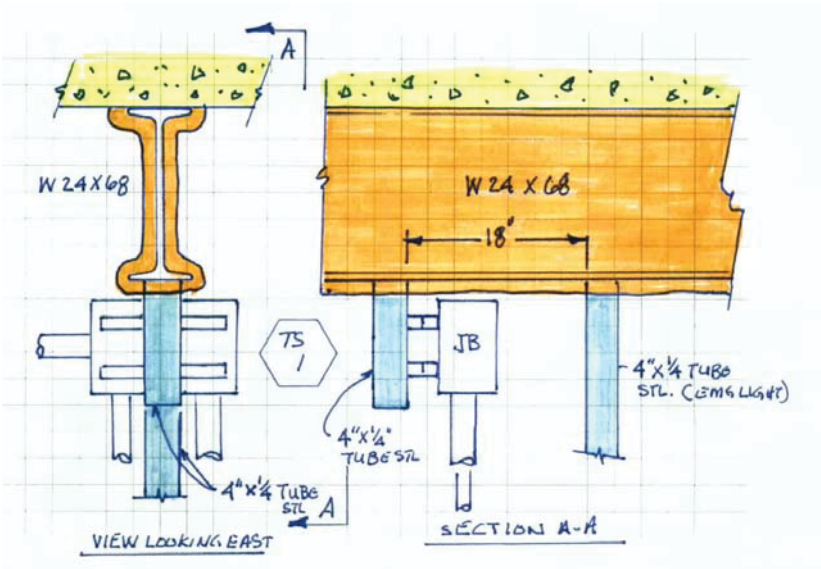


Structural Steel Fireproofing Data

Appendix G4C

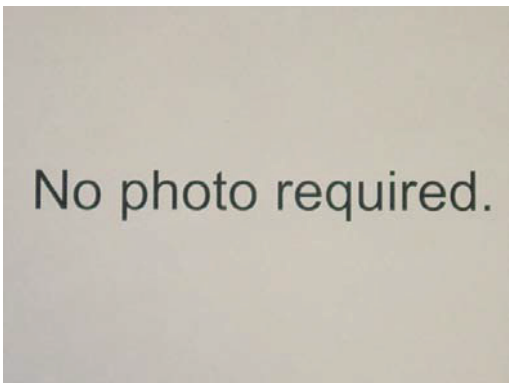
3414-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1407-2026** **Building:** Auxiliary **Fire Area:** A-03

Description: Boric Acid Batching Tank Area

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1521	N/A
Member Type:	Beam	Column
Member Size:	30 X 108	N/R
Comments:	Only 1 of 4 points are required to be evaluated.	No thermal short attachments on column, bounded by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 19

Compartment Length (ft): 29.75

Compartment Height (ft): 20

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Small Motors: Small Fire
Small Pumps: Small Fire
Cabinet: Small Fire
Exposed cable: Minimum, Small Fire
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 1.69E-03

Forced Ventilation Rate (cfm): Supply: 300, Open Grille
Exht: 300

Vent Description: No Attachments to columns, Open Grille

Barrier Type: Block

Barrier Thickness (in): 12

Initial Room Temp. (F): 104

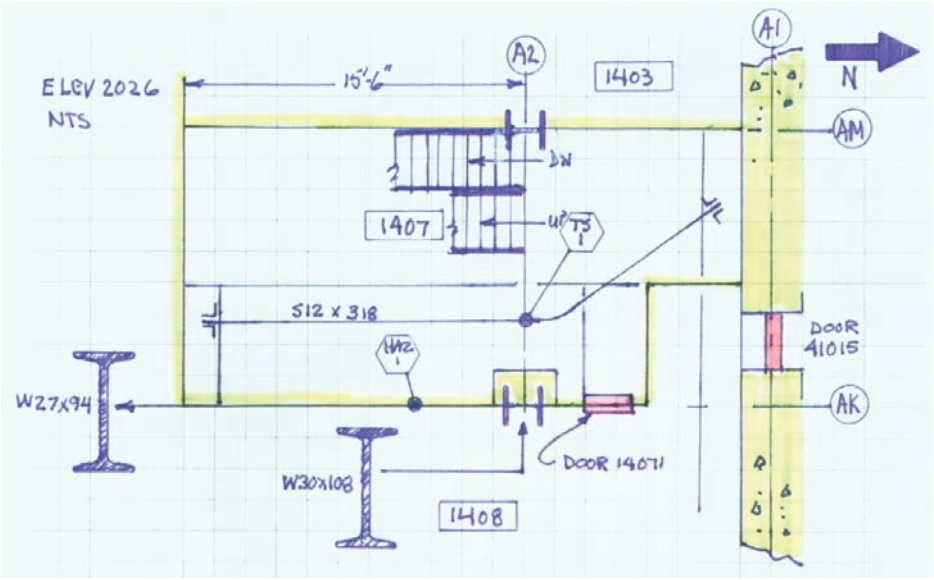
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 15

Compartment Starting Temp. for Closed Room No Vent FDT (F): 204.41

Hot Gas Layer Temperature @ 180 minutes (F): **303.16**

Room Sketch:

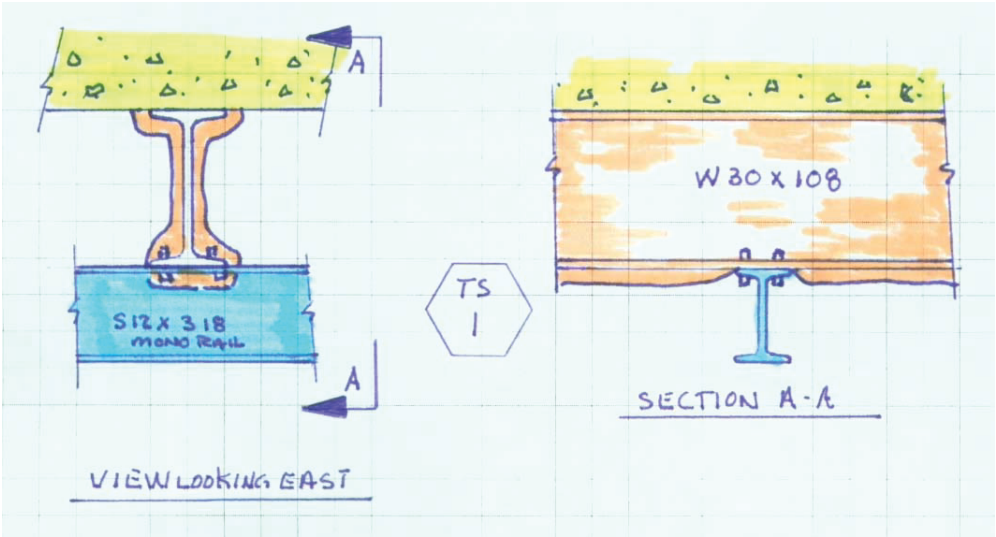


Structural Steel Fireproofing Data

Appendix G4D

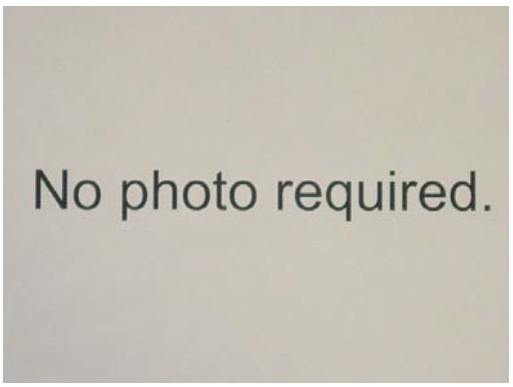
1407-2026

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1304-2013** **Building:** Auxiliary **Fire Area:** A-29

Description: Aux Feedwater Pipe Chase

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	C-1S1001
Member Type:	Beam	Column
Member Size:	18 X 50	14 X 111
Comments:	Additional attachments in close proximity.	Column in room only has Unistrut & JB's, column considered acceptable based on calculation FP-M-012.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 22

Compartment Length (ft): 10

Compartment Height (ft): 12

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Exposed cable: Negligible
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 3.76E-04

Forced Ventilation Rate (cfm): Supply: 150 Exht: 150

Vent Description:

Opening in floor where ladder is (3.5' X 3.5')

Barrier Type: Concrete

Barrier Thickness (in): 12

Initial Room Temp. (F): 104

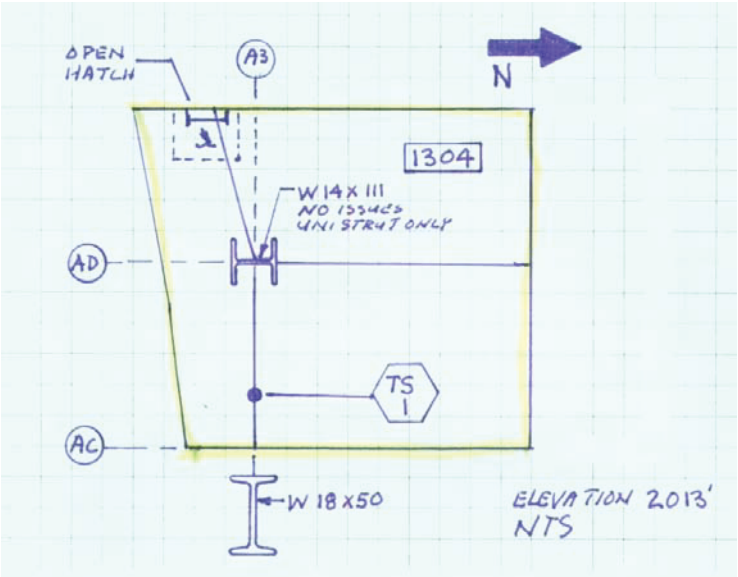
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 2

Compartment Starting Temp. for Closed Room No Vent FDT (F): 211.16

Hot Gas Layer Temperature @ 180 minutes (F): **380.73**

Room Sketch:

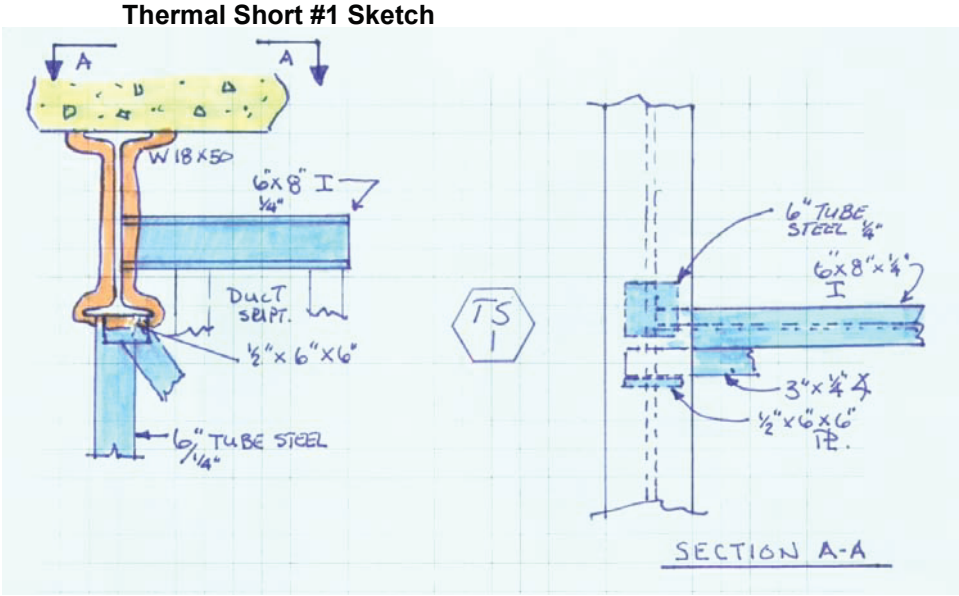


Structural Steel Fireproofing Data

Appendix G4D

1304-2013

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1327-2000** **Building:** Auxiliary **Fire Area:** A-29

Description: Feedwater Pump Valve Compartment No. 2

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	N/A
Member Type:	Beam	N/A
Member Size:	14 X 34	N/A
Comments:	Additional attachments in close proximity.	No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 10

Compartment Length (ft): 10

Compartment Height (ft): 12

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Exposed cable: Negligible
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 3.76E-04

Forced Ventilation Rate (cfm): Supply: 100
Exht: 100

Vent Description:

Barrier Type: Concrete

Barrier Thickness (in): 24

Initial Room Temp. (F): 104

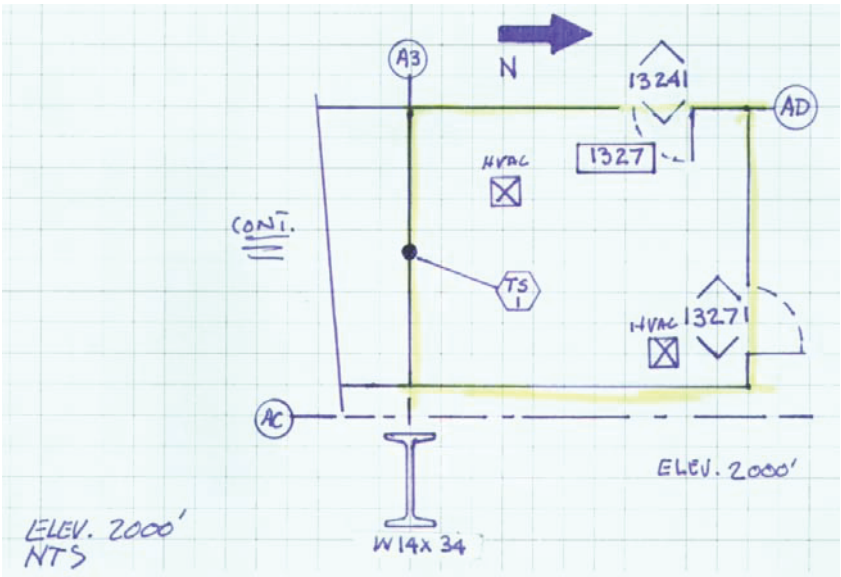
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): **502.33**

Room Sketch:

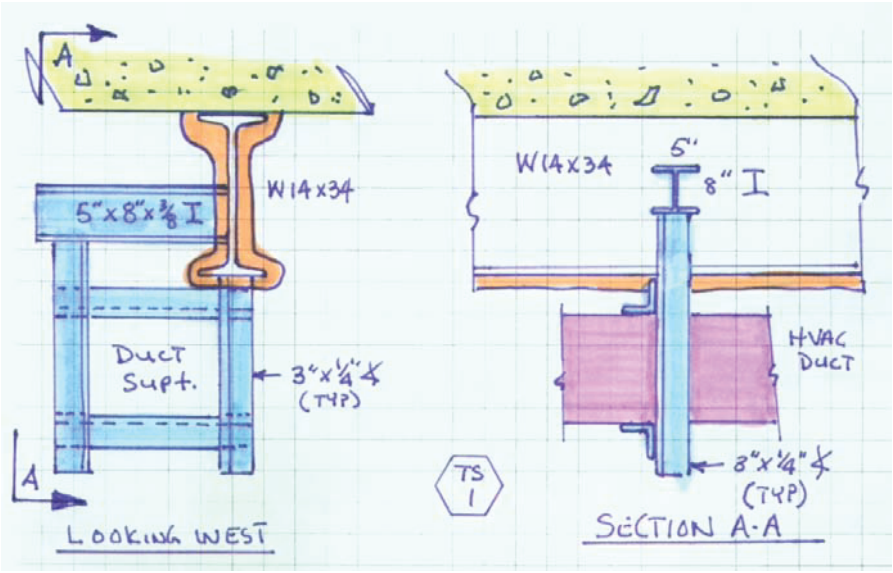


Structural Steel Fireproofing Data

Appendix G4D

1327-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1305-2013** **Building:** Auxiliary **Fire Area:** A-30

Description: Aux Feedwater Pipe Chase

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	C-1S1001
Member Type:	Beam	Column
Member Size:	18 X 50	14 X 111
Comments:	Additional attachments in close proximity orientation of 1 ea. 4" tube causes 40 SQ IN.	

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 22

Compartment Length (ft): 10

Compartment Height (ft): 12

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Exposed cable: Negligible
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 3.76E-04

Forced Ventilation Rate (cfm): Supply: 150 Exht: 150

Vent Description:

Opening in floor where ladder is (3.5' X 3.5')

Barrier Type: Concrete

Barrier Thickness (in): 12

Initial Room Temp. (F): 104

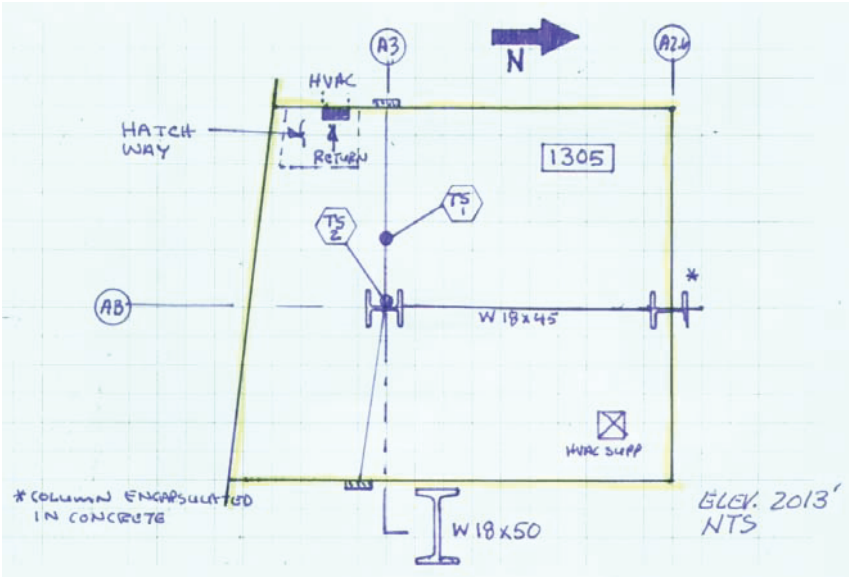
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 2

Compartment Starting Temp. for Closed Room No Vent FDT (F): 211.16

Hot Gas Layer Temperature @ 180 minutes (F): **380.73**

Room Sketch:

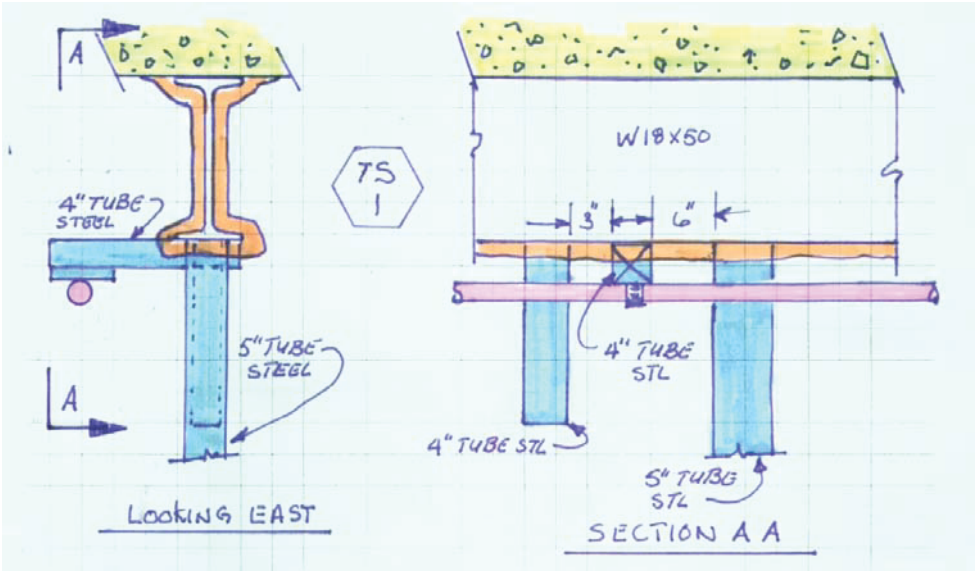


Structural Steel Fireproofing Data

Appendix G4D

1305-2013

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

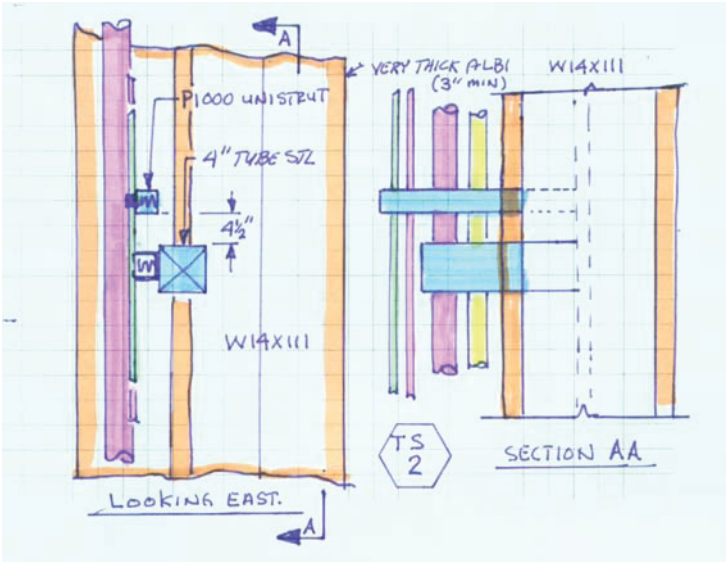
Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

1305-2013

Thermal Short #2 Sketch



Thermal Short #2 Photo 1

Thermal Short #2 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1328-2000** **Building:** Auxiliary **Fire Area:** A-30

Description: Feedwater Pump Valve Compartment No. 3

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	N/A
Member Type:	Beam	N/A
Member Size:	14 X 34	N/A
Comments:		Column encapsulated in concrete, columns considered bounded by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 10

Compartment Length (ft): 10

Compartment Height (ft): 12

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Exposed cable: Negligible
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 3.76E-04

Forced Ventilation Rate (cfm): Supply: 100 Exht: 100

Vent Description:

Barrier Type: Concrete

Barrier Thickness (in): 24

Initial Room Temp. (F): 104

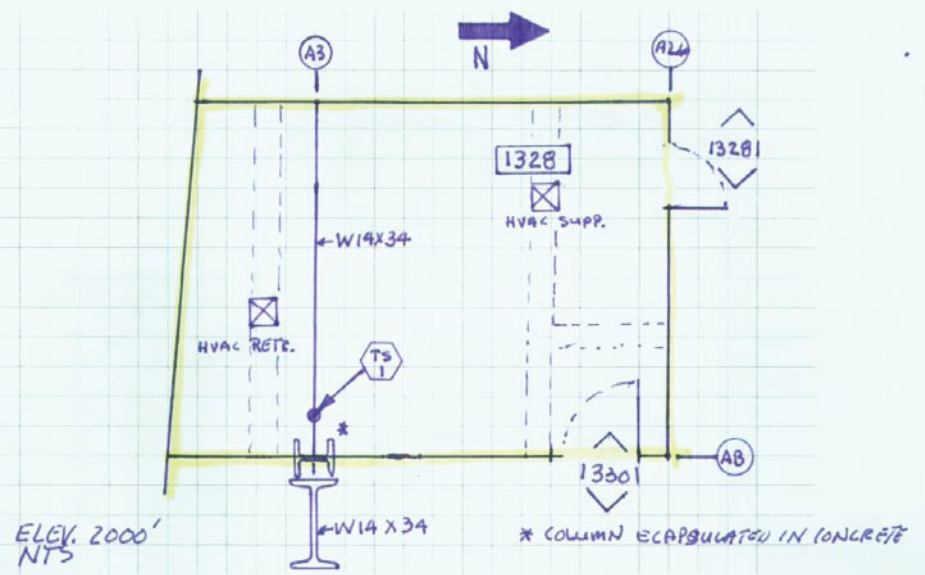
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): 502.33

Room Sketch:

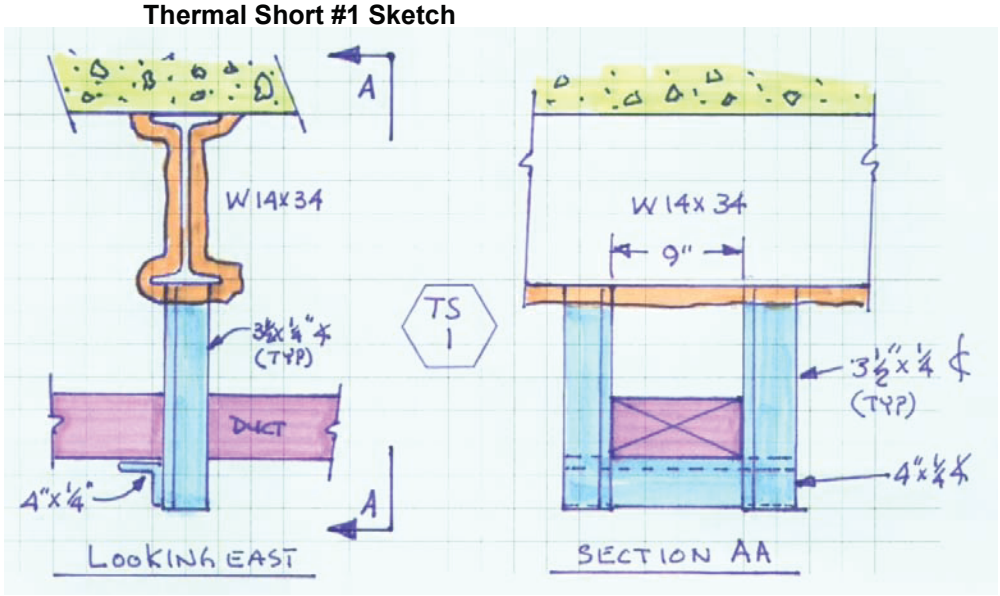


Structural Steel Fireproofing Data

Appendix G4D

1328-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **1329-2000** **Building:** Auxiliary **Fire Area:** A-33

Description: Vestibule

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-1S1352	N/A
Member Type:	Beam	N/A
Member Size:	10 X 21	N/A
Comments:	Only 1 of 6 points are required to be evaluated.	Column encapsulated in concrete, columns considered bounded by testing.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 7

Compartment Length (ft): 27.75

Compartment Height (ft): 12

Credible Fire HRR (kW): 70 KW

Credible Fire Basis:

Exposed cable: Negligible
Transient Package: Majority of BTU: Small Fire
IPEEE Ignition Source Evaluation: 3.76E-04

Forced Ventilation Rate (cfm): Supply: 100 Exht: 100

Vent Description:

Vent at floor (Hatchway to 1207, 3.5' X 3.5'). Temp not in USAR Table 3.11, used room 1207 below

Barrier Type: Concrete

Barrier Thickness (in): 12

Initial Room Temp. (F): 106

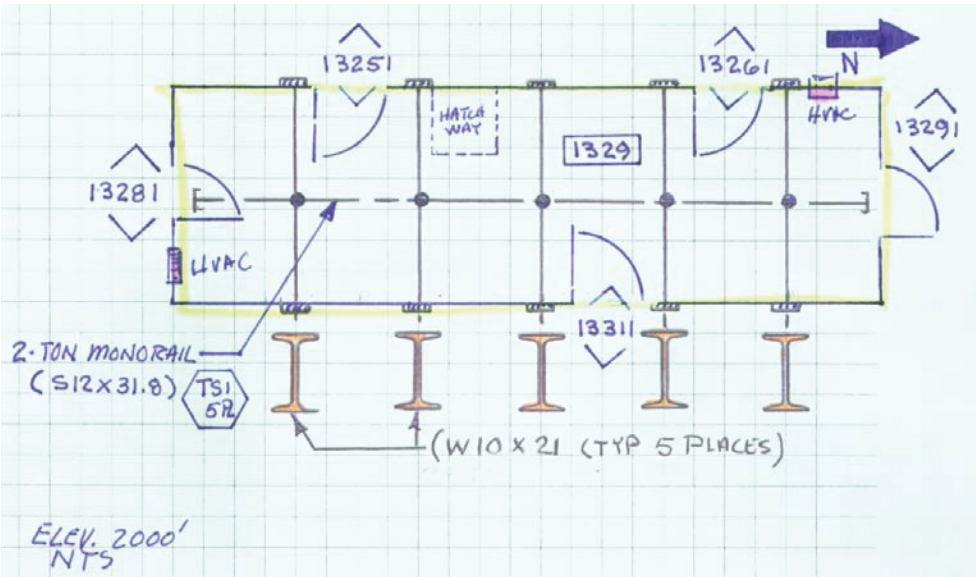
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): 368.12

Room Sketch:

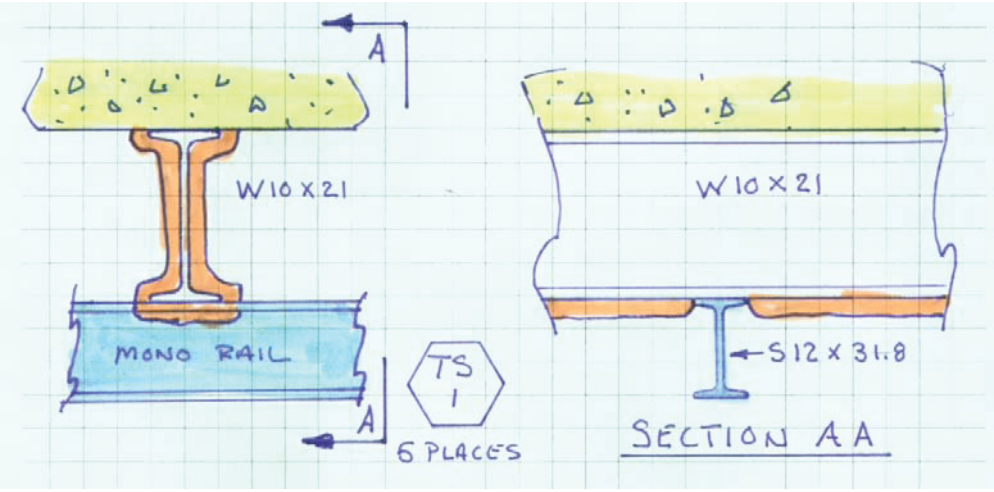


Structural Steel Fireproofing Data

Appendix G4D

1329-2000

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **3405-2016** **Building:** Control **Fire Area:** C-15

Description: Battery Rm No. 4

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	C-0S3001
Member Type:	Beam	Column
Member Size:	24 X 76	14 X 426
Comments:		Column embedded on both sides. ALBI is 2-1/2" thick minimum due to finish requirements.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 20.5

Compartment Length (ft): 12

Compartment Height (ft): 15.25

Credible Fire HRR (kW): 200 KW

Credible Fire Basis:

Batteries
IPEEE Ignition Source
Evaluation: 7.76E-04

Forced Ventilation Rate (cfm): Supply: 300
Exht: 390

Vent Description:

Barrier Type: Block

Barrier Thickness (in): 8

Initial Room Temp. (F): 90

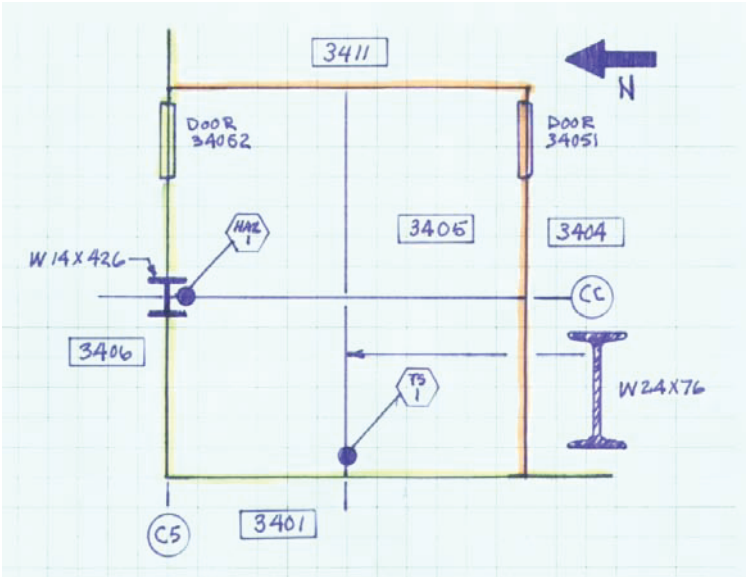
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): 812.83

Room Sketch:

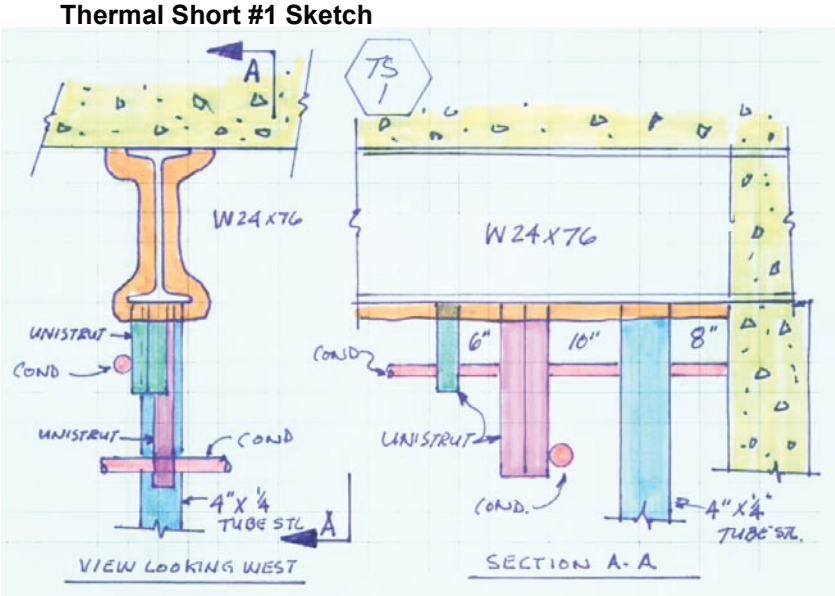


Structural Steel Fireproofing Data

Appendix G4D

3405-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **3407-2016** **Building:** Control **Fire Area:** C-16

Description: Battery Rm No. 1

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 68	N/A
Comments:	Additional items in close proximity.	No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 12

Compartment Length (ft): 20.5

Compartment Height (ft): 15.25

Credible Fire HRR (kW): 200 KW

Credible Fire Basis:

Batteries
IPEEE Ignition Source
Evaluation: 7.76E-04

Forced Ventilation Rate (cfm): Supply: 300
Exht: 390

Vent Description:

Barrier Type: Block

Barrier Thickness (in): 8

Initial Room Temp. (F): 90

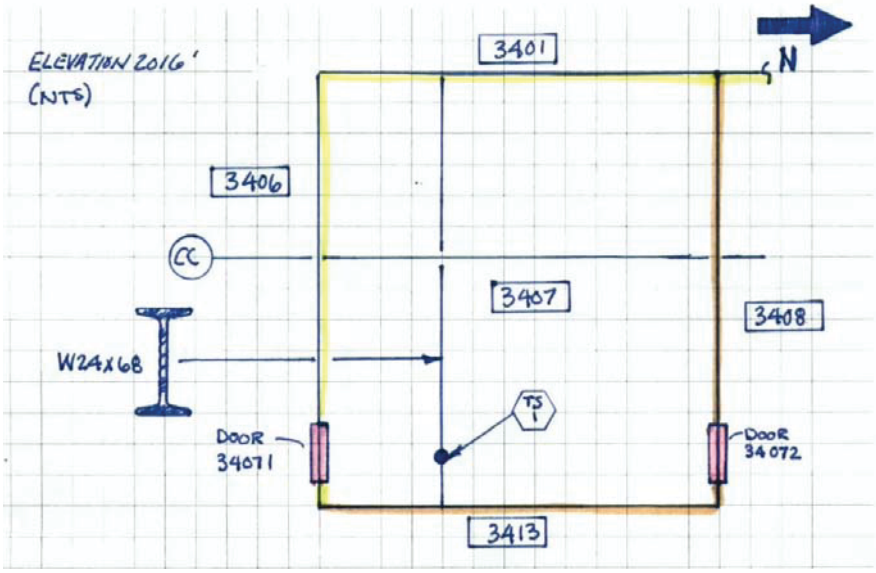
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): 812.83

Room Sketch:

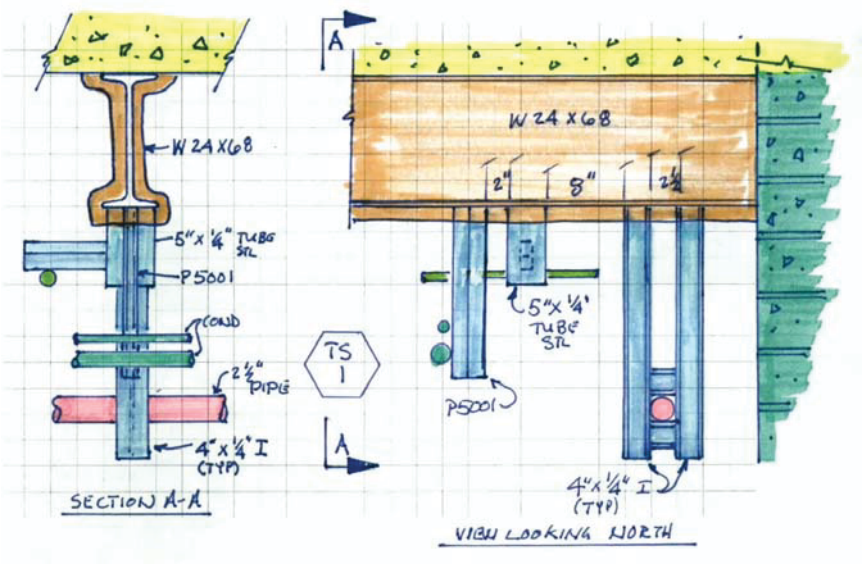


Structural Steel Fireproofing Data

Appendix G4D

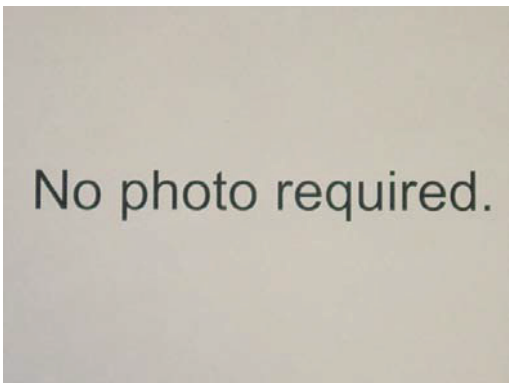
3407-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2



Structural Steel Fireproofing Data

Appendix G4D

Room-Elevation: **3413-2016** **Building:** Control **Fire Area:** C-16

Description: Battery Rm No. 3

	Thermal Short #1 (TS1) Data	Thermal Short #2 (TS2) Data
Drawing:	C-0S3511	N/A
Member Type:	Beam	N/A
Member Size:	24 X 68	N/A
Comments:		No columns.

NUREG-1805 FDT Input Data

NUREG-1805 FDT: 02.2_Temperature_FV.xls (Version 1805.0) _02.3_temperature_cc_rev1.xls (Version 1805.1)

Compartment Width (ft): 21

Compartment Length (ft): 12

Compartment Height (ft): 15.25

Credible Fire HRR (kW): 200 KW

Credible Fire Basis:

Batteries
IPEEE Ignition Source
Evaluation: 7.76E-04

Forced Ventilation Rate (cfm): Supply: 200
Exht: 340

Vent Description:

Barrier Type: Block

Barrier Thickness (in): 8

Initial Room Temp. (F): 90

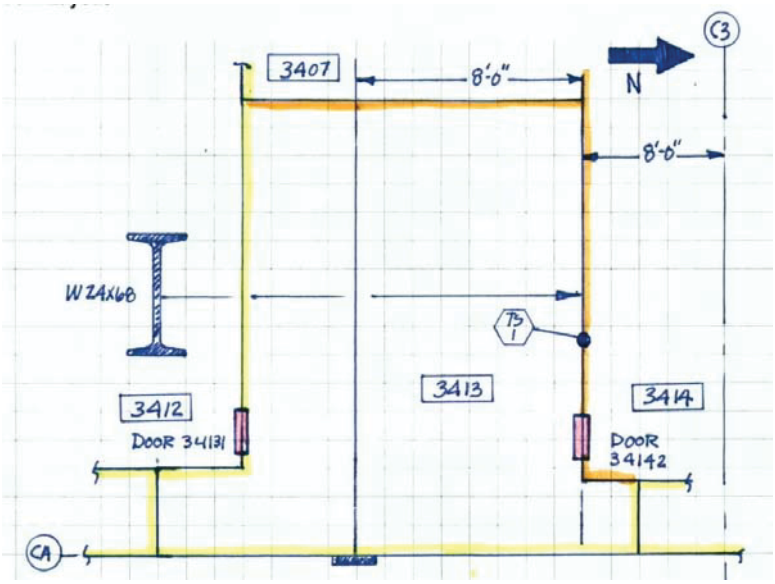
NUREG-1805 FDT Results

Time When Forced Ventilation Exceeds 200 F (min): 1

Compartment Starting Temp. for Closed Room No Vent FDT (F): 200

Hot Gas Layer Temperature @ 180 minutes (F): **801.75**

Room Sketch:

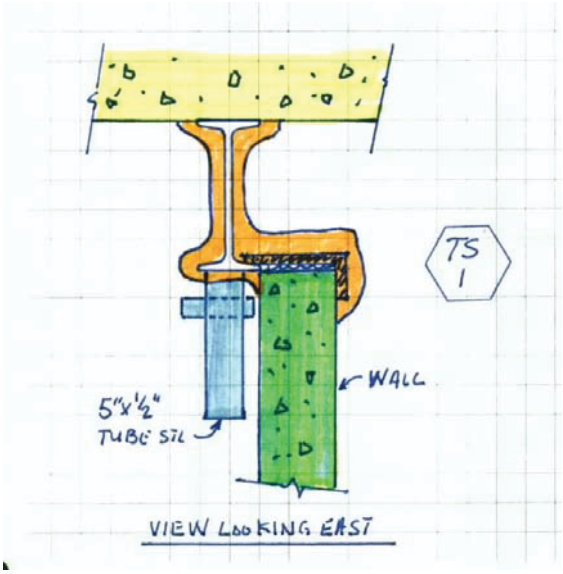


Structural Steel Fireproofing Data

Appendix G4D

3413-2016

Thermal Short #1 Sketch



Thermal Short #1 Photo 1

Thermal Short #1 Photo 2

WOLF CREEK
NUCLEAR OPERATING CORPORATION

M-663-00017A

Attachment G5

Fire Protection Evaluation For
HAZ Assessment of Structural Steel Integral to Fire Boundary

Rev. No.	Prepared By	Date	Reviewed By	Date
W03	Wayne S. Ingold	7/6/2007	Jeff Dutton	7/6/2007

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Appendix G5A, Room Data Sheets…… (63 Total Pages)

Revision Log

Revision	Reason for Revision
W03	Original Issue

1.0 Purpose

1.1 The purpose of this document is to evaluate the Heat Affected Zone (HAZ) impact of 10 CFR 50 Appendix R fire barriers containing integral structural steel where either of the following is present:

- Steel is provided with fireproofing on only one barrier side.
- Fireproofing is provided on both steel sides and an unprotected thermal short attachment larger than Unistrut is present.

This evaluation was conducted in accordance with the guidance of NRC Generic Letter 86-10.

2.0 Scope

2.1 This evaluation is applicable to the Rooms identified in Table II.

3.0 References

3.1 NRC Generic Letter 86-10, Implementation of Fire Protection Requirements, dated April 24, 1986

3.2 10 CFR 50 Appendix R, Fire Protection Program For Nuclear Power Facilities Operating Prior To January 1, 1979

3.3 ASTM E-119, Standard Test Methods for Fire Tests of Building Construction and Materials

3.4 UL N-711, (A-126-00001), Fire Test Report Of Loaded Restrained Beams Protected By Cementitious Mixture, Dated August 11, 1976

3.5 UL N-712, (A-126-00002), Fire Test Report Of Loaded Restrained Beams Protected By Cementitious Mixture, Dated May 13, 1977

3.6 A-126, Technical Specification For Cementitious Fireproofing Of Structural Steel For The Standardized Nuclear Unit Power Plant Unit (SNUPPS)

3.7 PIR 2002-2287, Structural Steel Fireproofing With Unprotected Attachments

3.8 FP-M-012, Rev 0, Structural Steel Fireproofing Thermal Shorts and Omissions Evaluation

3.9 CNT-MC-600, Rev. 2, Fireproofing of Structural Steel

3.10 E-15000, Electrical Cable And Raceway List, Rev. 65

3.11 A-126, Cementitious Fireproofing of Structural Steel, Rev. 7

3.12 Updated Safety Analysis Report (USAR) Section 9.5.1.2.2.3.a, Rev. 19

3.13 Change Package 012323, M-663-00017A Revision to incorporate Structural Steel Fireproofing Evaluation and Analysis, Rev. 0

3.14 IEEE 383, Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations

4.0 Assumptions

4.1 It is assumed that fireproofing material used to protect building steel is applied to a thickness as required by CNT-MC-600. This is an acceptable assumption based on a review of the Quality Control documentation maintained during initial fireproofing installation activities and subsequent inspections during ongoing plant repairs witnessed by Fire Protection personnel and inspections performed during the this evaluation process.

5.0 Assessment of Condition to Design Requirements

5.1 Requirements

USAR Section 9.5.1.2.2.3.a identifies that the design, construction, test method, and acceptance criteria for fire rated barriers is per applicable sections (determined by construction type) of ASTM E-119, UL standards, and state building codes.

5.2 Assessment

Fire testing does not directly bound the use of protected steel as part of a fire barrier assembly. Such a configuration presents the potential to transmit detrimental temperatures from the fire side through the steel element of the fire barrier to insitu combustibles and/or post-fire safe shutdown (PFSSD) circuits located in close proximity to the unexposed side of the steel fire barrier segment. Attachment G1, Section 7.1, evaluated that steel with fireproofing on both barrier sides containing unprotected thermal short attachments no larger than Unistrut in size and mass provides an equivalent 3-hour F and T rated configuration. Therefore, HAZ review, similar to that discussed in Section 7.2.3 of M-663-00017A for non-T rated penetration seals, is only necessary for structural steel integral to a fire barrier assembly where either of the following is present:

- Steel is provided with fireproofing on only one barrier side.
- Fireproofing is provided on both steel sides and an unprotected thermal short attachment larger than Unistrut is present.

6.0 Methodology

Where a HAZ review was necessary for steel that is integral to a fire barrier assembly, a review similar to M-663-00017A Section 7.2.3 was conducted with the exception that a review distance of two feet from the unexposed steel surface was utilized. This is an acceptable distance considering the air gap temperature drop discussion provided in M-663-00017A Section 7.2.3. This two-foot distance from the structural steel member on the unexposed side is the area that encompasses the HAZ. Assuming an ASTM E-119 three-hour fire duration, a temperature of either 1925°F or 1100°F was assigned to the unexposed barrier side based on the fireproofing configuration provided, including consideration for unprotected thermal short attachments larger than Unistrut.

A 1925°F temperature was utilized for the following configurations:

- Fireproofing is single sided with an unprotected attachment on either barrier side.
- Fireproofing is provided on both barrier sides and an unprotected attachment larger than Unistrut is located on the fire side such that it is in proximity (within two feet) to an unexposed side attachment that supports a raceway within the HAZ.

An unexposed side temperature assignment of 1925°F for the above configurations is a conservative approach, as it utilizes the maximum temperature attained during ASTM E-119 fire testing, with no credit given for concrete barrier heat sink or recognition that the hot spot created by the unprotected thermal short on the exposed barrier side will be localized.

An 1100°F temperature was utilized for the following configurations:

- Fireproofing is single sided and no unprotected attachments larger than Unistrut are present on either barrier side.
- Fireproofing is provided on both barrier sides and an unprotected attachment larger than Unistrut is not in close proximity (within two feet) of an unprotected attachment on the opposing barrier side.

An unexposed side temperature assignment of 1100°F for the above configurations is a an acceptable approach based on subtraction of ASTM E-119 furnace temperature (1925°F) from Reference 3.4 and 3.5 thermocouple data (1,100°F). This yields an approximate 825°F temperature drop across the exposed fireproofing during ASTM E-119 fire endurance testing.

For PFSSD circuits and IEEE-383 cable, an insult temperature limitation of 700°F was utilized. A temperature limitation of 400°F was utilized for other Class A combustibles. These temperature limitations are consistent with M-663-00017A, Section 7.2.3.

Figure 6-1 reflects the review process utilized to assess HAZ impact.

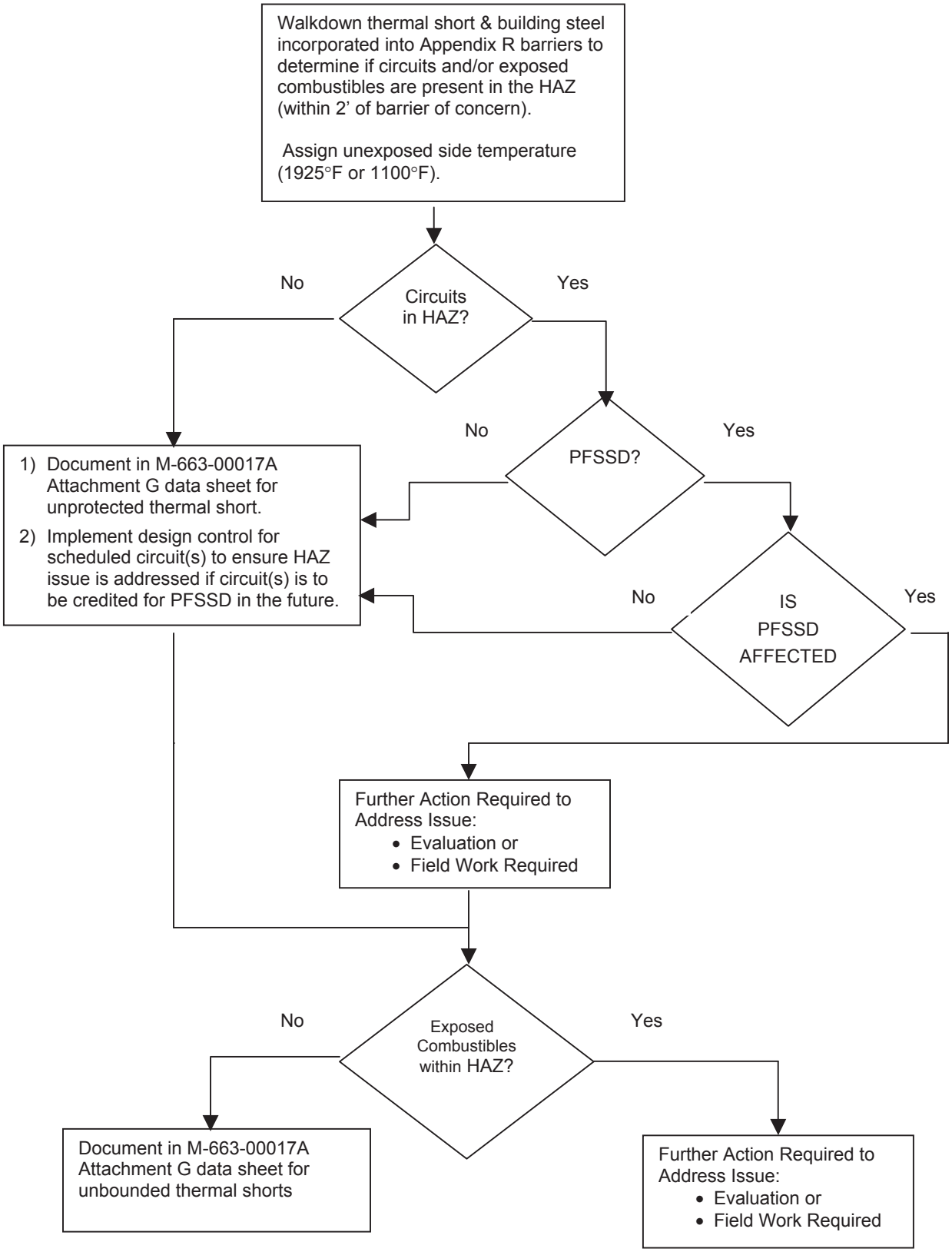


Figure 6-1, Heat Affected Zone Review Process

7.0 Evaluation

7.1 Where structural steel is incorporated into a 10 CFR 50 Appendix R barrier, one-sided protection does not satisfy cold side temperatures, when considering an ASTM E-119 3-hour design basis fire. The one-sided protection configuration will not allow flame passage through the barrier. However, it could result in temperatures up to 1100°F or 1925ºF on the unexposed steel surface of the barrier. Each room was reviewed for HAZ impact in effort to document each raceway and insitu combustibles within two (2) feet of the barrier segment containing steel protected with cementitious fireproofing to ensure PFFSD is not impacted. In addition, two-side protection with unprotected attachments can also produce localized high temperatures. Therefore, protected steel with unprotected attachments was also reviewed for HAZ impact at barriers separating fire areas. No credit was given to area suppression systems, in effort to achieve a level of conservatism in the analysis process.

One sided structural steel fireproofing is determined to be “F” rated only and does not satisfy “T” rating requirements when exposed to a design basis fire. Specification A-126, Section 7.1 states in part, “stair towers and elevator construction shall be protected from external hazards”, thus in these cases structural steel fireproofing was not required on both sides of the barrier. Where these barriers provide 10 CFR 50 Appendix R separation, this configuration does not satisfy maximum cold side temperature limitations required by the WCNOC Fire Protection Program (250°F plus ambient for fire barrier construction and 325°F plus ambient for fire barrier penetration seals). Therefore, each location where one-sided fireproofing or significant attachments are present was evaluated for HAZ impact to ensure PFSSD is not affected. As such, any raceway/circuit or component within 2 feet of the one-sided protected barrier steel and/or two-sided protected steel with large thermal shorts will be considered within the HAZ and will be evaluated for PFSSD impact utilizing the Figure 6-1 methodology. Thermal shorts attached to stairwell steel will not impact the structural integrity of the steel or induce steel failure due to the corbel support afforded by the under supporting walls.

Table II defines the review scope and identifies the communicating rooms and fire areas along with the raceways that are potentially subject to thermal insult, based on proximity to the barriers evaluated. Each room and raceway (where applicable) is dispositioned in the “Comments/Disposition” Section of Table II, with reference provided to the appropriate evaluation paragraph section below. Area walkdown reviews revealed that no insitu combustibles (other than IEEE-383 cable) were located within the HAZ for each of the Table II areas.

Appendix G5A documents the result of the Fire Protection reviews and assessments for each room and area listed in Table II, below. The data sheets contain relevant information for each location reviewed for HAZ impact.

TABLE II

HAZ Barrier Review

Fire Area	Room	Bldg	Elev.	Room Description:	Communicating Rooms/ Fire Areas		Air Gap[1] (TempºF) (Inches)	Comments/Disposition:
A-1	1201	Aux	1988-0	Vestibule	1201 A-1	1119 A-5	1925ºF N/A	1). No HAZ review required, no items in close proximity.
A-3	1116	Aux	1974-0	Boric Acid Tank Room B	1116 A-3	1301 A-8	Bounded N/A	1.) No HAZ review required, embedded steel (Concrete) on backside.
	1117			Boric Acid Tank Room A	1117 A-3	1320 A-8	Bounded N/A	1.) No HAZ review required, embedded steel (Concrete) on backside.
	1407	Aux	2026-0	Boric Acid Batching Tank Area	1407 A-3	1408 A-16	Bounded N/A	1.) No HAZ review required, embedded steel (Concrete) on backside.
A-5	1119	Aux	1988-0	Aux. Stair A-1	1119 A-5	1201 A-1	1100ºF N/A	1). No HAZ review required, no items in close proximity.
		Aux	2000-0			1321 A-8	1925ºF N/A	1). No HAZ review required, no items in close proximity.
		Aux	2047-6			1502 A-20	**1100ºF-R**	***Items 1, 2 & 3 are <u>NOT</u> PFSSD:***
							4" (R)[1]	1). Conduit 5U4B8R, See Section 7.1.3, NO Set Route Control Required
							4" (R)[1]	2). Conduit 6U1214, See Section 7.1.3, NO Set Route Control Required
							4" (R)[1]	3). Conduit 5C1014, See Section 7.1.3, NO Set Route Control Required
A-6	1127	Aux	1974-0	Aux. Stair A-2	1127 A-6	1120 A-1	1925ºF N/A	1). No HAZ review required, no items in close proximity.
		Aux	2000-0			1320 A-8	**1925ºF-C** **1100ºF-R**	***Items 1 and 2 are <u>NOT</u> PFSSD. Item 3 <u>IS</u> PFSSD:***
							¾" (C)[1]	1). Conduits 1J1E1D, **Set Route Control Required See Section 7.1.2**
							1½" (C)[1]	2). Conduit 1U1F2G, **Set Route Control Required See Section 7.1.2**
							4" (C)[1]	3). Conduit 4U3D5H, **Set Route Control Required See Section 7.1.6**
A-8	1320	Aux	2000-0	Aux. Corridor No. 4	1320 A-8	1127 A-6	**1100ºF-R**	***Item 1 is NOT PFSSD:***
							14½" (R)[1]	1). Conduit 4J3C1E, See Section 7.1.3, NO Set Route Control Required
	1321	Aux	2000-0	Exit Vestibule	1321 A-8	1119 A-5	1100ºF-R N/A	1). No HAZ review required, no items in close proximity.
A-26	1405	Aux	2026-0	Chemical Storage Area	1405 A-26	1401 A-16	Bounded N/A	1.) No HAZ review required, embedded steel (Concrete) on backside.

Fire Area	Room	Bldg	Elev.	Room Description:	Communicating Rooms/ Fire Areas		Air Gap[1] (TempºF) (Inches)	Comments/Disposition:
C-2	3106	Cntrl	1974-0	Electrical Chase	3106 C-2	3101 C-1	**1100ºF-R**	***Items 1, 2 & 3 are NOT PFSSD:***
							6" (C)[1] 3" (R)[1]	1). Cable Tray 5J1A90, See Section 7.1.3, NO Set Route Control Required
							6" (C)[1] 3" (R)[1]	2). Cable Tray 5U4A90, See Section 7.1.3, NO Set Route Control Required
							6" (C)[1] 3" (R)[1]	3). Cable Tray 5U1B90, See Section 7.1.3, NO Set Route Control Required
C-3	3105	Cntrl	1974-0	Electrical Chase	3105 C-3	3101 C-1	**1100ºF-R**	***Items 1 & 2 are NOT PFSSD:***
							9" (C)[1] 7" (R)[1]	1). Cable Tray 6U1B90, See Section 7.1.3, NO Set Route Control Required
							6" (C)[1] 2" (R)[1]	2). Cable Tray 6U3G90, See Section 7.1.3, NO Set Route Control Required
C-6	3201	Cntrl	1984-0	Control Building, Stair C-1	3201 C-6	0SAC C-6	1100ºF-R N/A	1). N/A lighting conduit, Same Fire Area, No HAZ review required, See Section 7.1.1, no items in close proximity.
		Cntrl	2000-0		3201 C-6	3302 C-10	1925ºF-R N/A	1). N/A lighting and communications conduit No HAZ review required, See Section 7.1.1, no items in close proximity.
		Cntrl	2016-0		3201 C-6	3403 C-15	**1925ºF-R**	***Items 1 is NOT PFSSD and Item 2 IS PFSSD:***
							23" (C)[1] 15" (R)[1]	1). Cable Tray 6J8D22, See Section 7.1.3, NO Set Route Control Required
							23" (C)[1] 3" (R)[1]	2). Cable Tray 6U3E21, **Set Route Control Required See Section 7.1.5**
		Cntrl	2032-0		3201 C-6	3501 C-21	1100ºF-C N/A	1). Lighting conduit, Same Fire Area, No HAZ review required, See Section 7.1.1, no items in close proximity.
		Cntrl	2047-6		3201 C-6	3605 C-17	**1100ºF-R**	***Item 1 is NOT PFSSD:***
							14" (R)[1]	1). Conduit 6J1T1A, See Section 7.1.3, NO Set Route Control Required
							1925ºF-C	***Items 2 & 3 are NOT PFSSD:***
							21" (C)[1]	2). Conduit 4J3006, **Set Route Control Required See Section 7.1.2**
							7" (C)[1]	3). Conduit 4J3007, **Set Route Control Required See Section 7.1.2**
		Cntrl	2073-0		3201 C-6	3801 C-22	1100ºF-R N/A	1). No HAZ review required, items noted were Lighting and Detection conduits no other items in close proximity, See Section 7.1.1.
C-8	3229	Cntrl	1984-0	Electrical Chase	3229 C-8	3204 C-6	**1100ºF-R**	***Item 1 is NOT PFSSD:***
							7" (R)[1]	1). Cable Tray 6U3G90, See Section 7.1.3, NO Set Route Control Required

Fire Area	Room	Bldg	Elev.	Room Description:	Communicating Rooms/ Fire Areas		Air Gap[1] (TempºF) (Inches)	Comments/Disposition:
C-9	3301	Cntrl	2000-0	ESF Switchgear Room No. 1	3301 C-9	3306 C-12	**1100ºF-R**	***Item 1 IS PFSSD & Item 2 is NOT PFSSD:***
							6" (C)[1] 4" (R)[1]	1). Cable Tray 5C8Q81, See Section 7.1.4, NO Set Route Control Required
							6" (C)[1] 2" (R)[1]	2). Cable Tray 5C8A81, See Section 7.1.3, NO Set Route Control Required
C-11	3305	Cntrl	2000-0	Electrical Chase	3305 C-11	3302 C-10	**1100ºF-R**	***Items 1 & 2 are NOT PFSSD:***
							5" (R)[1]	1). Cable Trays 6J1S70, See Section 7.1.3, NO Set Route Control Required
							23" (R)[1]	2). Cable Trays 6U3H70, See Section 7.1.3, NO Set Route Control Required
C-13	3415	Cntrl	2016-0	Access Ctrl & Elec Equip A/C Units No. 1	3415 C-13	3416 C-14	**1100ºF-C**	***Items 1& 2 are NOT PFSSD:***
							1½" (C)[1]	1). Conduit 4U3061, **Set Route Control Required See Section 7.1.2**
							1925ºF-C	***Item 2 is NOT PFSSD:***
							12" (C)[1] 2" (R)[1]	2). Conduit 6U3089, **Set Route Control Required See Section 7.1.2**
C-15	3403	Cntrl	2016-0	Non-Vital Swgr & Xfmr Rm No. 1	3403 C-15	3404 C-15	Bounded N/A	1). No HAZ Issue, Lighting Conduit Only, See Room 3201-2016, No HAZ review required
	3404	Cntrl	2016-0	Switchboard Rm No. 4	3404 C-15	3403 C-15	Bounded N/A	1). Same Fire Area, No HAZ review required
	3405	Cntrl	2016-0	Battery Rm No. 4	3405 C-15	3406 C-35	Bounded N/A	1). Same Fire Area, No HAZ review required
	3410	Cntrl	2016-0	Switchboard Rm No. 2	3410 C-15	3418 C-17	**1100ºF-R**	***Item 1 is NOT PFSS:***
							12" (C)[1] 10" (R)[1]	1). Conduit 5J3027, See Section 7.1.3, NO Set Route Control Required
C-16	3409	Cntrl	2016-0	Non-Vital Swgr & Xfmr Rm No. 2	3409 C-16	3401 C-35	1100ºF-R N/A	1). No HAZ review required, no items in close proximity.
C-17	3418	Cntrl	2016-0	Electrical Chase	3418 C17	3410 C-15	**1100ºF-R**	***Items 1 and 2 ARE PFSSD and Item 3 is NOT PFSSD:***
							8" (R)[1]	1). Cable Tray 6C8A60, See Section 7.1.4, NO Set Route Control Required
							8" (R)[1]	2). Cable Tray 6U3H60 See Section 7.1.4, NO Set Route Control Required
							8" (R)[1]	3). Cable Tray 6J1A60, See Section 7.1.3, NO Set Route Control Required
C-18	3419	Cntrl	2016-0	Electrical Chase	3419 C-18	3414 C-16	**1100ºF-R**	***Item 1 is NOT PFSSD and Item 2 IS PFSSD:***
							8" (C)[1] 3" (R)[1]	1). Cable Tray 5C8A70, See Section 7.1.3, NO Set Route Control Required
							8" (C)[1] 3" (R)[1]	2). Cable Tray 5C8Q70, See Section 7.1.4, NO Set Route Control Required
C-21	3501	Cntrl	2032-0	Lower Cable Spreading Room	3501 C-21	3505 C-23	1100ºF-R N/A	1). See Room 3505, Item 1. No HAZ review required, no items in close proximity.

Fire Area	Room	Bldg	Elev.	Room Description:	Communicating Rooms/ Fire Areas		Air Gap[1] (TempºF) (Inches)	Comments/Disposition:
C-22	3801	Cntrl	2073-0	Upper Cable Spreading Room	3801 C-22	3201 C-6	1100ºF-R N/A	1). No HAZ Issue, Gatronics Conduit Only, See Section 7.1.1
C-23	3505	Cntrl	2032-0	Electrical Chase	3505 C-23	3501 C-21	**1100ºF-R** 7" (R)[1]	***Item 1 is NOT PFSSD:*** 1). Cable Tray 6J1A56, See Section 7.1.3, NO Set Route Control Required
C-27	3605	Cntrl	2047-6	Equipment Cabinet Area	3605 C-27	3617 C-30	N/A	1). See Room 3617, Duplicate HAZ
C-30	3617	Cntrl	2047-6	Electrical Chase	3617 C-30	3605 C-27	**1100ºF-R** 18" (C)[1] ½"" (R)[1] 8" (R)[1] 8" (R)[1]	***Items 1, 2 & 3 are NOT PFSSD:*** 1). Conduit 4J1032, **Set Route Control Required See Section 7.1.2** 2). Cable Tray 6J1A40, See Section 7.1.3, NO Set Route Control Required 3). Cable Tray 6C8A40, See Section 7.1.3, NO Set Route Control Required
C-35	3406	Cntrl	2016-0	Corridor No. 2	3406 C-35	3405 C-15	1100ºF-R N/A	1). Grid Plug Mounting, No HAZ review required. No HAZ Issues
	3412	Cntrl	2016-0	Emergency Shower & Eyewash Area	3412 C-35	3101 C-1 Duct Chase	**1100ºF-R** 2" (C)[1] 2" (C)[1] 2" (C)[1]	***Items 1, 2 and 3 are NOT PFSSD:*** 1). Conduit 4U1E2N, **Set Route Control Required See Section 7.1.2** 2). Conduit to JB 4U3045, **Set Route Control Required See Section 7.1.2** 3). Conduit to JB 4U3046, **Set Route Control Required See Section 7.1.2**
					3412 C-35	3411 C-15	**1100ºF-R** 8" (C)[1] 2" (R)[1]	***Item 1 is NOT PFSSD:*** 1). Conduit 4U1E2N, See Section 7.1.3, NO Set Route Control Required
C-36	C36	Cntrl	2000-0	Cable Chase @ CA-C6, 2000-0 to 2016-0,	C36 C-36	3302 C-10	1100ºF-R N/A	1). Conduits in close proximity enter adjacent FA, No HAZ Issue
C-37	C37	Cntrl	2000-0	Cable Chase @ CA-C3, 2000-0 to 2016-0	Elec. Chase C-37	3301 C-9	**Bounded** 1½" (R)[1]	***Item 1 is NOT PFSSD:*** 1). Conduit 2U1034, See Section 7.1.3, NO Set Route Control Required Unistrut only, no thermal impact
F-4	6203	Fuel	2026-0	Air Handling Equipment Room	6203 F-4	6202 F-5	1925ºF-C N/A	***Item 1 is NOT PFSSD:*** 1). Conduit 6J6014, **Assumed failed, see Room 6202**
F-5	6202	Fuel	2026-0	Electrical Equipment Room	6202 F-5	6203 F-4	**1925ºF-C** 14" (C)[1]	*Item 1 is NOT PFSSD:* 1). Conduit 6J6014, **Set Route Control Required See Section 7.1.2**

Table Notes:

1. To determine acceptable air gap distance, conductive pathways, estimated exposure temperature is based on existing steel protection configuration and whether the exposure is C-Conduction or R-Radiant. In each case, the worse case Conductive and Radiant distance is used, either cumulative or a single thermal pathway exposure were reviewed as applicable.

7.1.1 Unscheduled conduit such as communication, fire detection and general plant lighting are not considered relevant to PFSSD and are not evaluated for PFSSD impact. Cabling contained within conduit cannot support combustion, propagate flame or hot gases. Therefore, fire propagation is not credible.

7.1.2 Scheduled Non-PFSSD conduits referring to this section are located within the HAZ and cable within the conduits have the potential to sustain damage from heat transmission through the barrier segment fabricated from building steel protected with cementitious fireproofing, as postulated temperature exposure exceeds 700ºF for the respective raceway. However, fire propagation will not occur, as cabling contained within conduit cannot support combustion, propagate flame or hot gases; therefore, fire propagation is not credible. Future use of these raceways shall be restricted or may require field modification if they are credited for PFSSD in the future. E-15000 set-route control is required for these raceways to ensure future raceway use continue to satisfy the conclusions of this evaluation. Referenced E-15000 set-route changes were completed by change package 012323.

7.1.3 Scheduled Non-PFSSD conduit and cable tray raceways referring to this section have been determined to have sufficient distance from the point of thermal insult and will not be thermally affected by conductive or radiant heat on the unexposed barrier side. This determination is supported by use of the air gap methodology described in M-663-00017A, Section 7.2.3, which credits air space to reduce exposure temperatures to cabling and combustibles within or adjacent to the HAZ. Each HAZ issue was reviewed to ensure combustibles on the unexposed side of the barrier would not be affected by radiant energy and/or auto-ignition. Air gaps and thermal short distances were measured to permit use of the 222ºF temperature drop rule for every 1” of air gap. After considering the air gap distance, each of the HAZ issues would have to meet acceptable cable exposures of <700ºF. Maintaining exposure temperatures below this limitation will ensure that fire propagation cannot occur, and the raceway will not be affected through conduction or radiant heat.

7.1.4 PFSSD credited conduit or cable tray raceways referring to this section have been determined to have sufficient distance from the point of thermal insult and will not be thermally affected by conductive or radiant heat on the unexposed barrier side. This determination is supported by use of the air gap methodology described in M-663-00017A, Section 7.2.3, which credits air space to reduce exposure temperatures to cabling and combustibles within or adjacent to the HAZ. Each HAZ issue was reviewed to ensure combustibles on the unexposed side of the barrier would not be affected by radiant energy and/or auto-ignition. Air gaps and thermal short distances were measured to permit use of the 222ºF temperature drop rule for every 1” of air gap. After considering the air gap distance, each of the HAZ issues would have to meet acceptable cable exposures of <700ºF. Maintaining exposure temperatures below this limitation will ensure that fire propagation cannot occur, and the raceway will not be affected through conduction or radiant heat.

7.1.5 PFSSD credited cable tray 6U3E21, located in Room 3403, is a 12” X 4” open cable tray in close proximity to a 6” x .375 thick I beam that is attached to the building steel. The building steel separates 10 CFR 50 Appendix R fire areas and is protected on the cable tray side with cementitious fireproofing (one-sided protection). The exposed side of the barrier is Room 3201, North Control Building Stairwell.

The cable tray is 23” away from the postulated exposure temperature of 1925ºF as determined by the steel configuration and one-side fireproofing. Conservatively applying the M-663-00017A, Table 7.2.3-2B review distance for a 12” diameter pipe, in relation to the 6” beam, reveals that at 24” the thermal exposure would be approximately 1209°F. Application of the air gap methodology of 222°F drop per 1” air gap reveals an approximate temperature of 543°F for the cables within the tray of concern. This is less than the 700°F insult temperature limitation for the IEEE-383 cable. However, this raceway requires E-15000 set route control to ensure future cable additions consider impact to this evaluation. This E-15000 set-route change was completed by change package 012323.

7.1.6 PFSSD credited conduit 4U3D5H, located in Room 1320 is a 3” rigid steel conduit supported by a 4” tube steel and Unistrut design mounted to the vertical column separating fire areas. The conduit contains PFSSD cabling associated with BIT injection. The building steel separates 10 CFR 50 Appendix R fire areas and is protected on the conduit side with cementitious fireproofing (one-sided protection). The exposed side of the barrier is Room 1127, North Auxiliary Building Stairwell.

The conduit is 4” away and mounted directly on to the conductive path to the postulated exposure temperature of 1925ºF, as determined by the steel configuration and one-side fireproofing. The thermal path is conductive and thermal failure is expected due to the close proximity of the conduit to the exposure temperature of 1925ºF. A fire in A-6 does not require BIT injection. Seal injection is available with no inventory loss through letdown. Therefore, PFSSD capability is not affected if a fire would occur in Fire Area A-6. However, this raceway requires E-15000 set route control to ensure future cable additions consider impact to this evaluation. This E-15000 set-route change was completed by change package 012323.

7.2 Post Fire Safe Shutdown Impact

There is no impact to PFSSD capability, as the evaluation demonstrates that steel integral to 10 CFR 50 Appendix R fire barriers will prevent fire propagation. The comprehensive walkdown review for each of the areas revealed that no exposed insitu combustibles or PFSSD capability is negatively affected by the steel fire barrier segments.

8.0 Conclusions

Based on physical plant walk downs, reviews and assessments performed by Fire Protection the room and areas identified in Table II above, contain protected structural steel that separate 10 CFR 50 Appendix R fire areas. Each of these barriers vary in configuration, some with one-sided protection and others with two-sided protection with unprotected attachments that could induce heat through the barrier beyond WCNOC cold side temperature limitations, if an ASTM E-119 three hour fire were to occur in the adjacent fire area. Therefore, each raceway that was located within the HAZ was reviewed for potential impact to PFSSD. All raceways listed in Table II above have been determined to be acceptable and do not affect PFSSD considering the protective coating or thermal short configurations that are present.

It is reasonable to conclude that the building steel integral to a fire barrier will satisfy regulatory expectations and commitments as well as WCNOC Fire Protection Program requirements, to prevent fire propagation and unacceptable thermal insult to raceways on the unexposed side of the fire barrier.

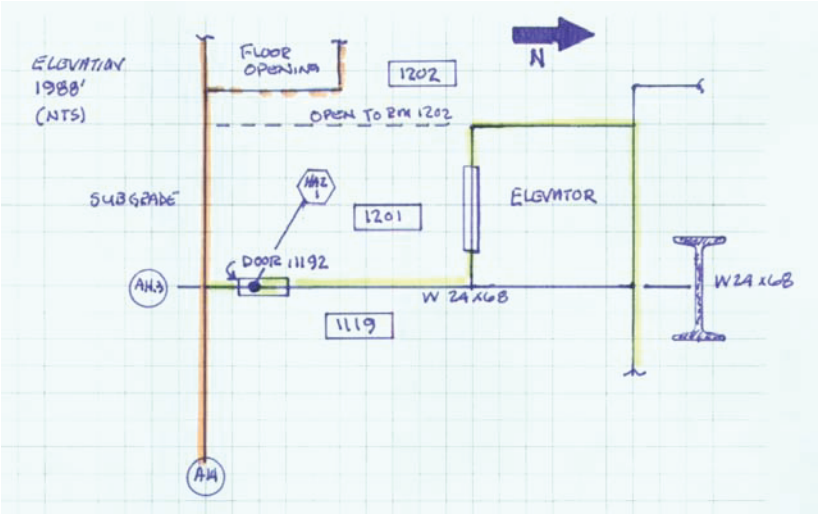
Structural Steel Fireproofing Data

Appendix G5A

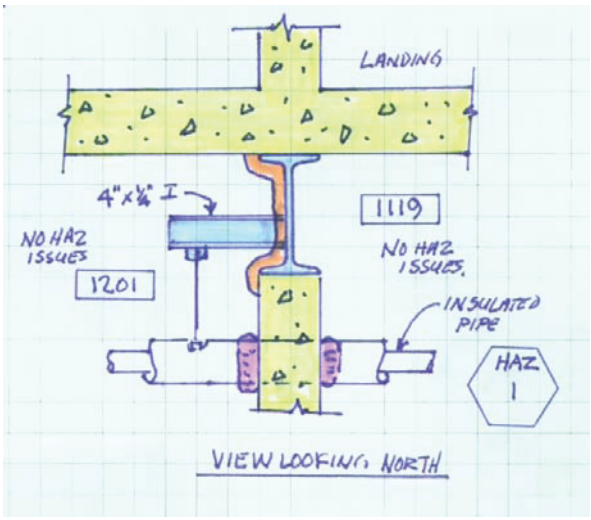
Room-Elevation: **1201-1988** **Building:** Auxiliary **Fire Area:** A-01

Description: Vestibule

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

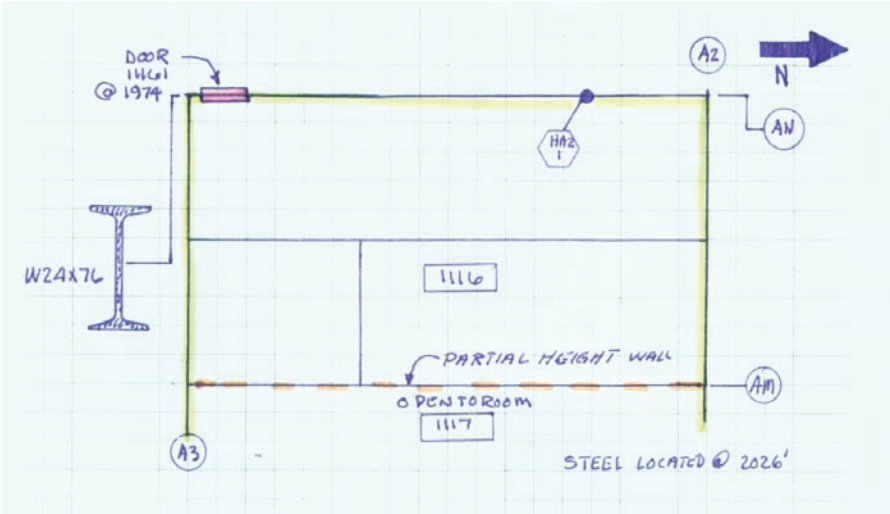
Structural Steel Fireproofing Data

Appendix G5A

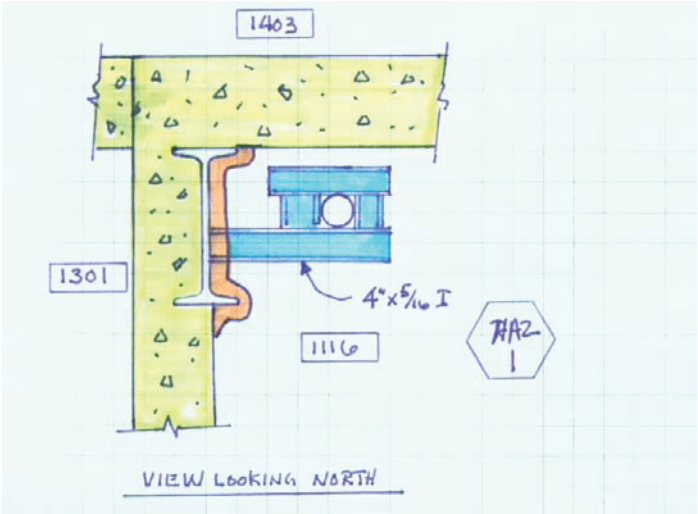
Room-Elevation: **1116-1974** **Building:** Auxiliary **Fire Area:** A-03

Description: Boric Acid Tank Room B

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

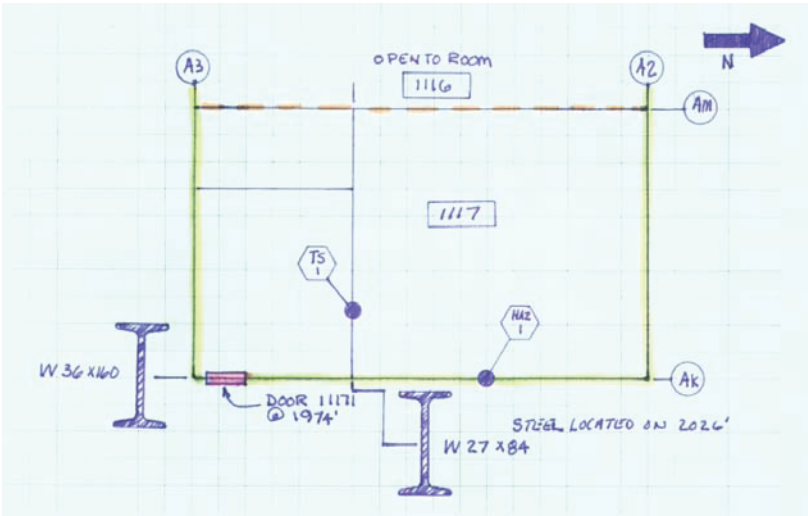
Structural Steel Fireproofing Data

Appendix G5A

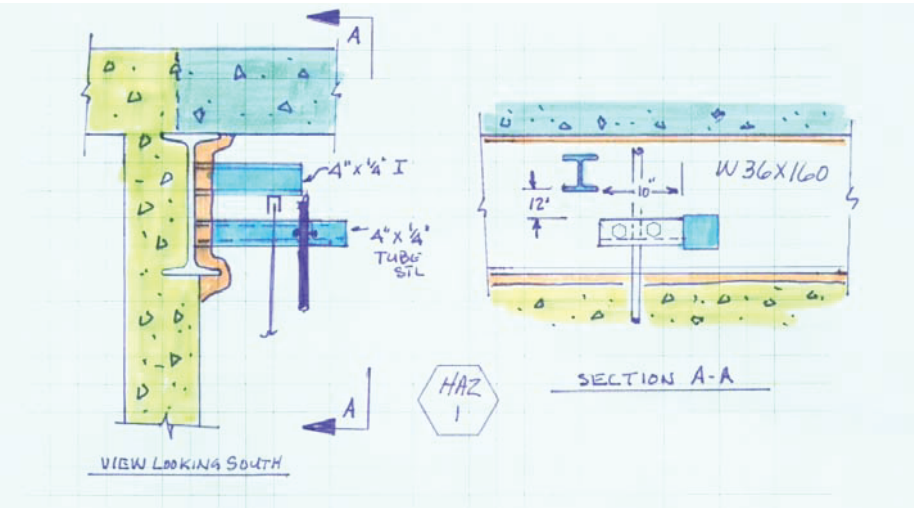
Room-Elevation: **1117-1974** **Building:** Auxiliary **Fire Area:** A-03

Description: Boric Acid Tank Room A

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

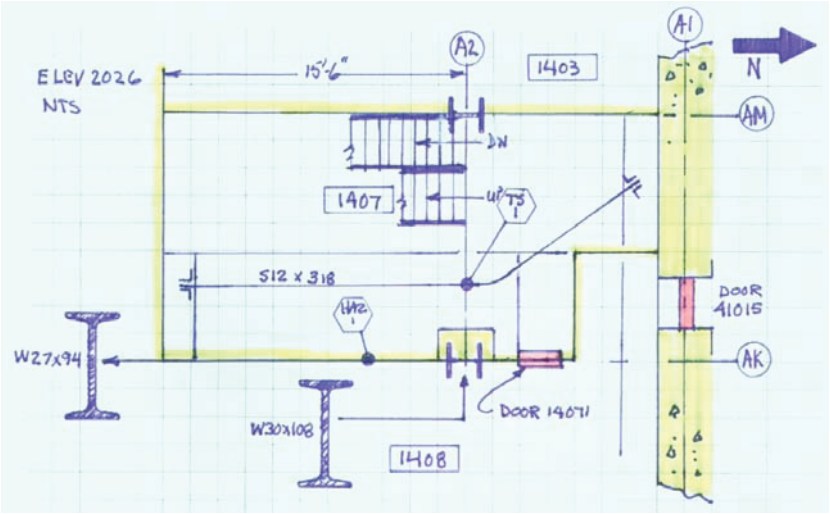
Structural Steel Fireproofing Data

Appendix G5A

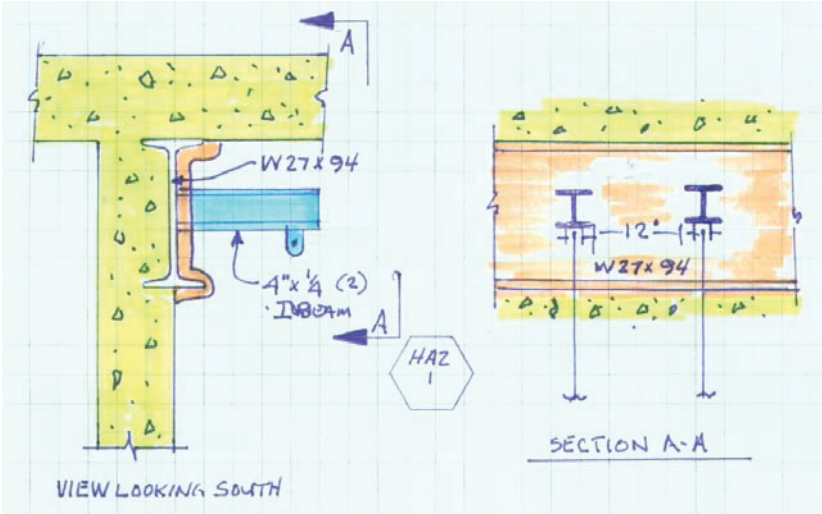
Room-Elevation: **1407-2026** **Building:** Auxiliary **Fire Area:** A-03

Description: Boric Acid Batching Tank Area

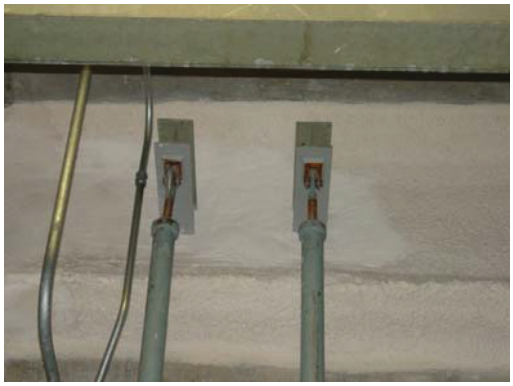
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



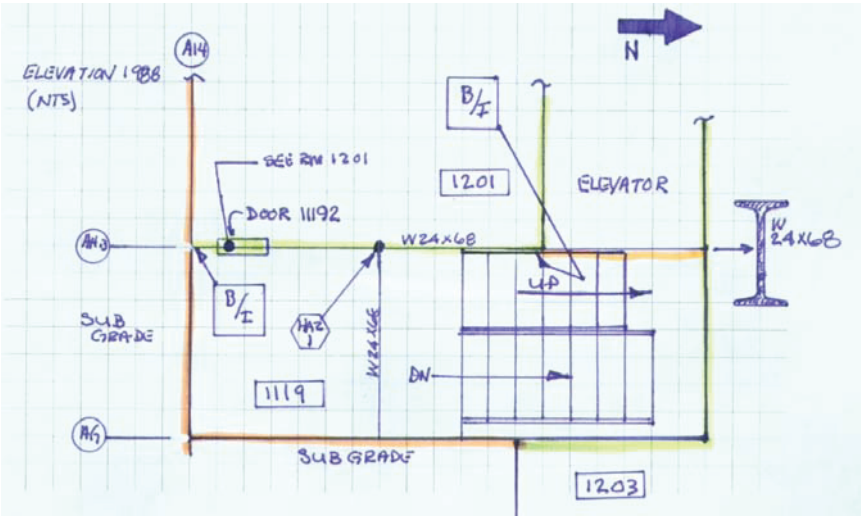
Structural Steel Fireproofing Data

Appendix G5A

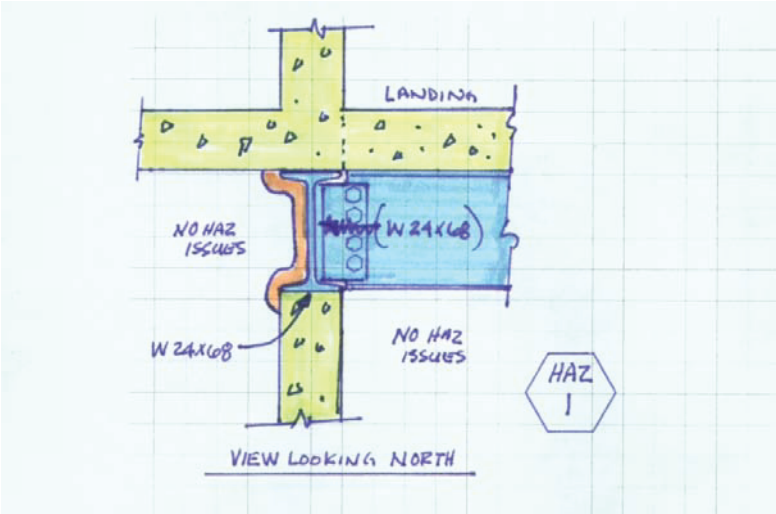
Room-Elevation: **1119-1988** **Building:** Auxiliary **Fire Area:** A-05

Description: Aux. Stair A-1 & A-1A

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

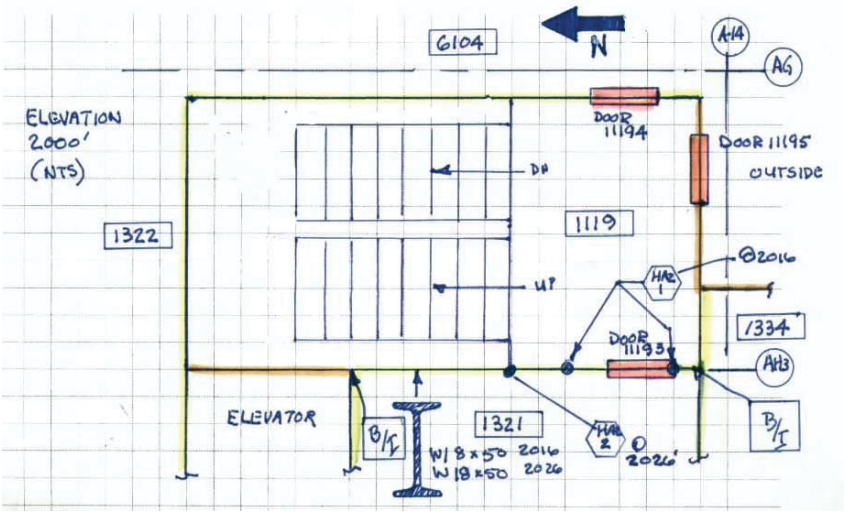
Structural Steel Fireproofing Data

Appendix G5A

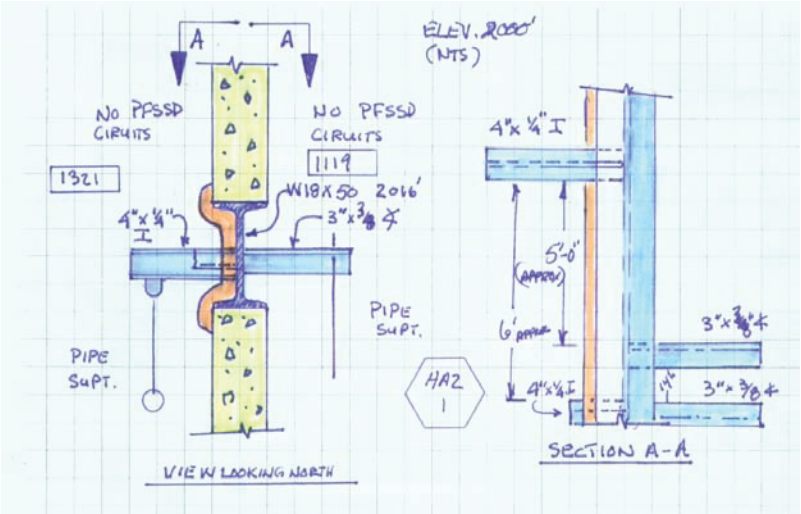
Room-Elevation: **1119-2000** **Building:** Auxiliary **Fire Area:** A-05

Description: Aux. Stair A-1 & A-1A

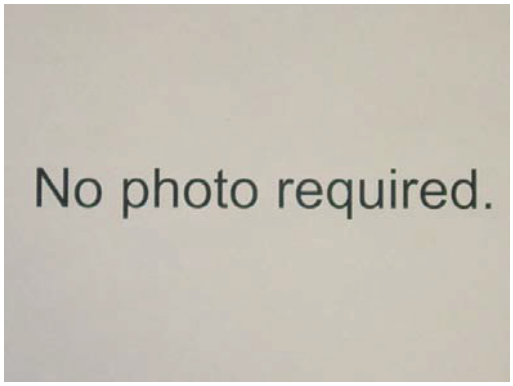
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

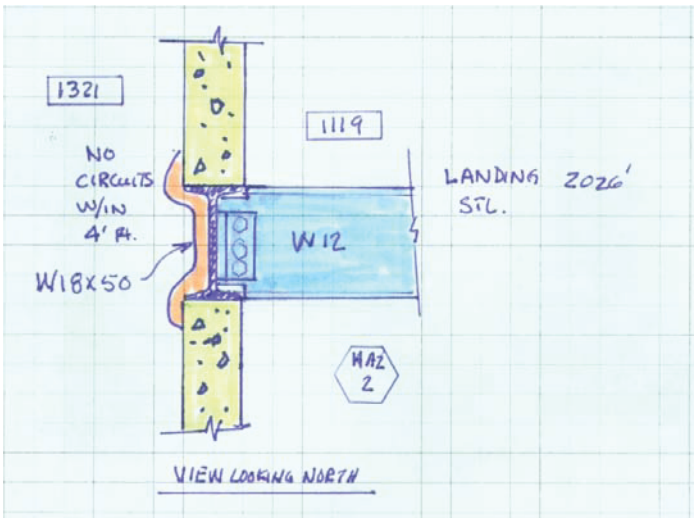


Structural Steel Fireproofing Data

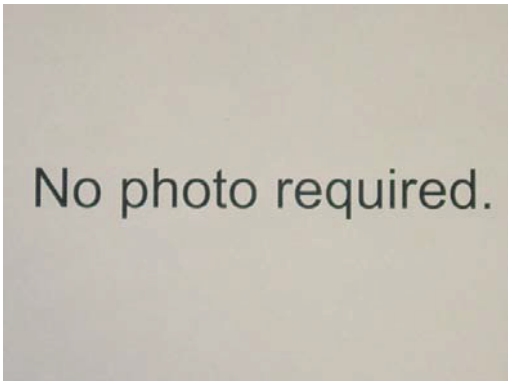
Appendix G5A

1119-2000

HAZ #2 Sketch



HAZ #2 Photo



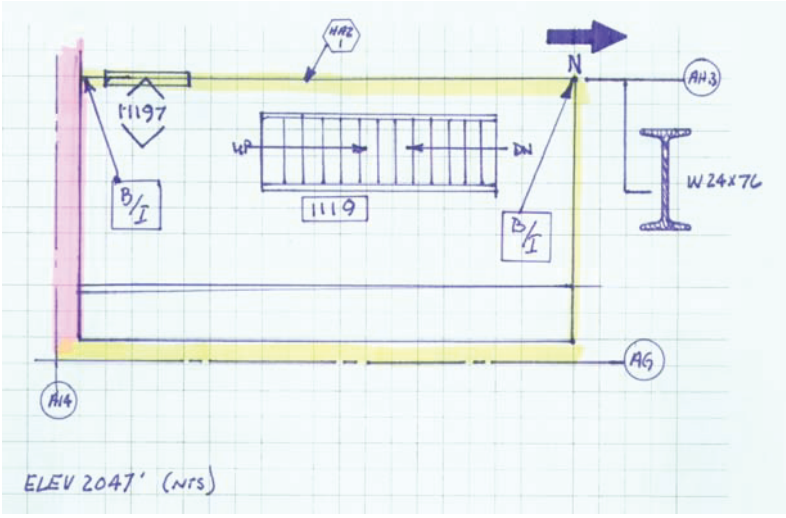
Structural Steel Fireproofing Data

Appendix G5A

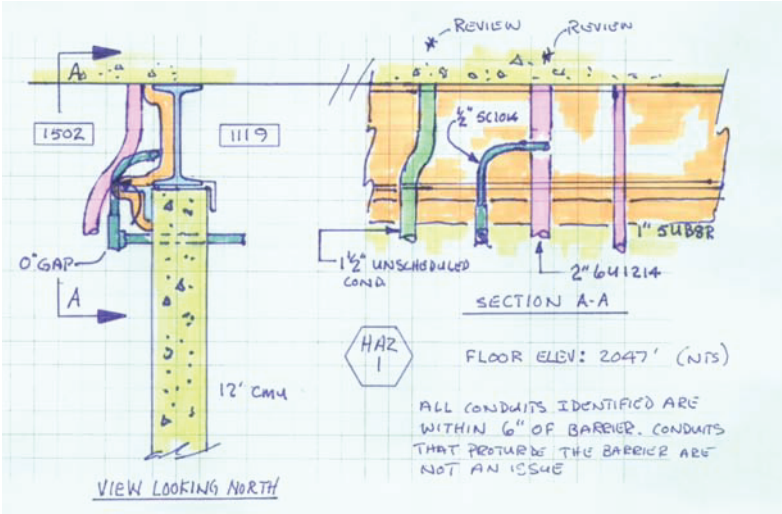
Room-Elevation: **1119-2047** **Building:** Auxiliary **Fire Area:** A-05

Description: Aux. Stair A-1 & A-1A

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

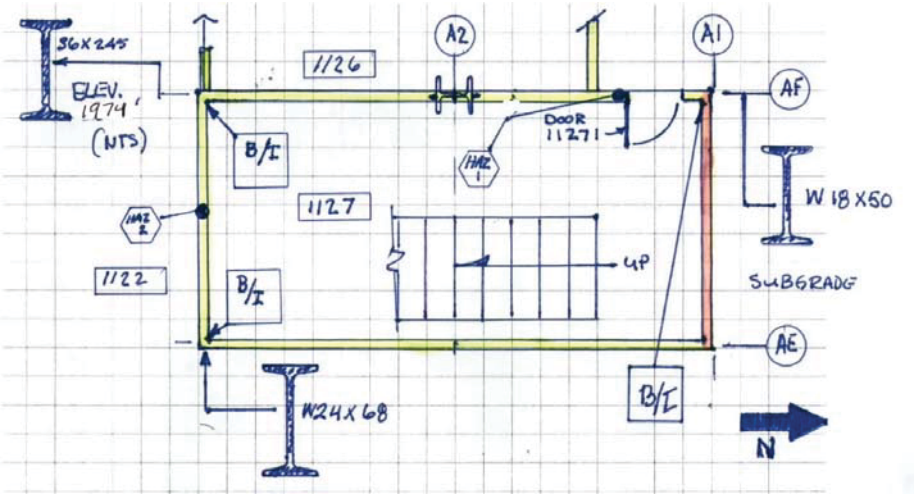
Structural Steel Fireproofing Data

Appendix G5A

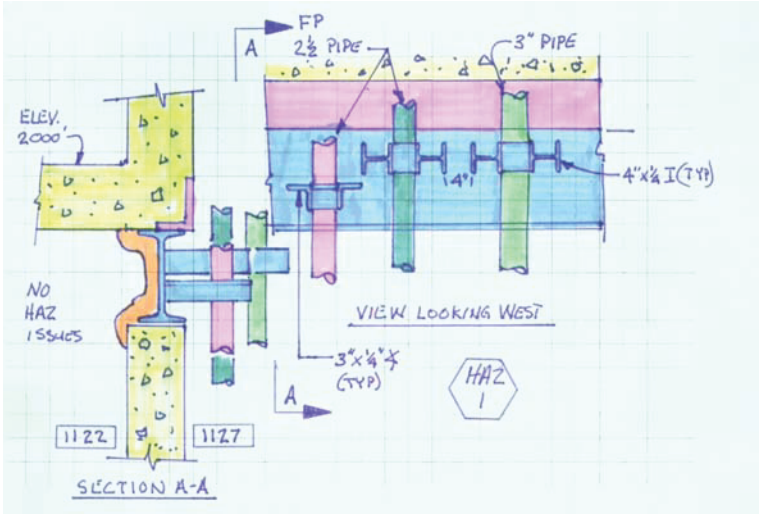
Room-Elevation: **1127-1974** **Building:** Auxiliary **Fire Area:** A-06

Description: Aux. Stair A-2

Room Sketch:



HAZ #1 Sketch



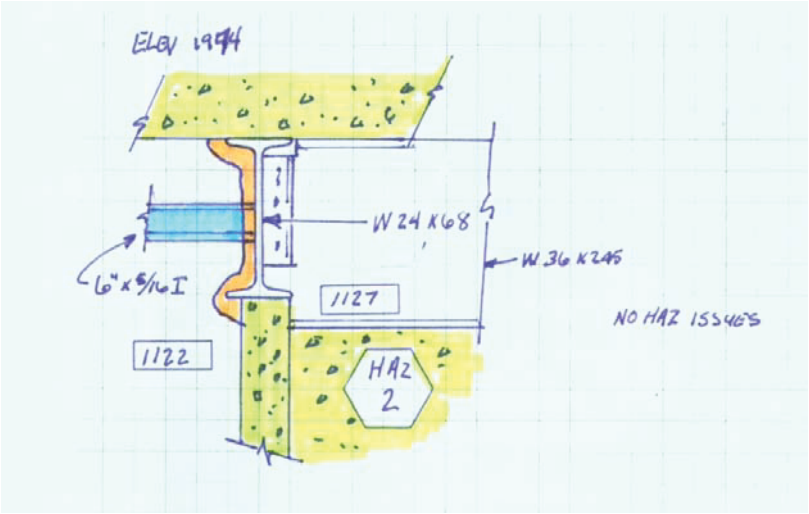
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

1127-1974

HAZ #2 Sketch



HAZ #2 Photo

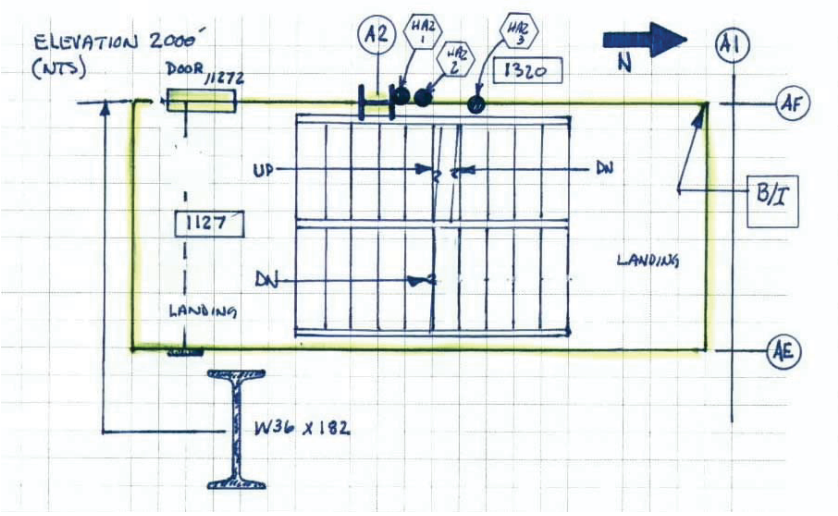
Structural Steel Fireproofing Data

Appendix G5A

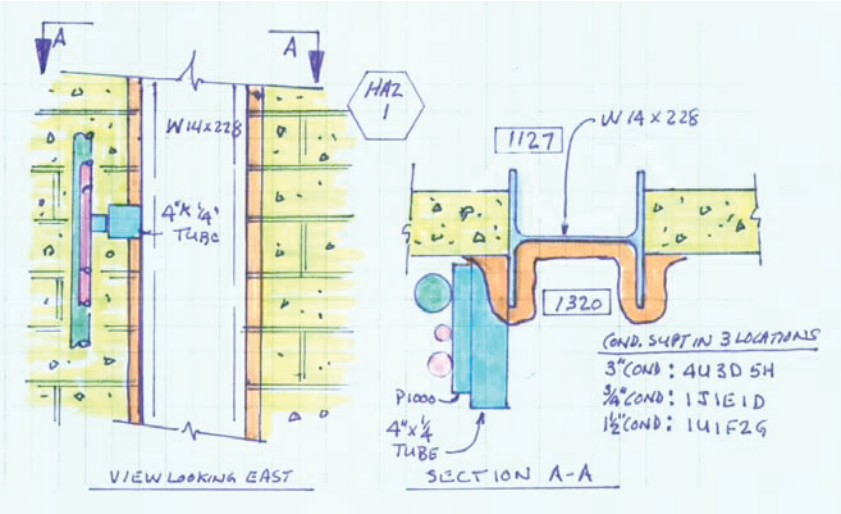
Room-Elevation: **1127-2000** **Building:** Auxiliary **Fire Area:** A-06

Description: Aux. Stair A-2

Room Sketch:



HAZ #1 Sketch



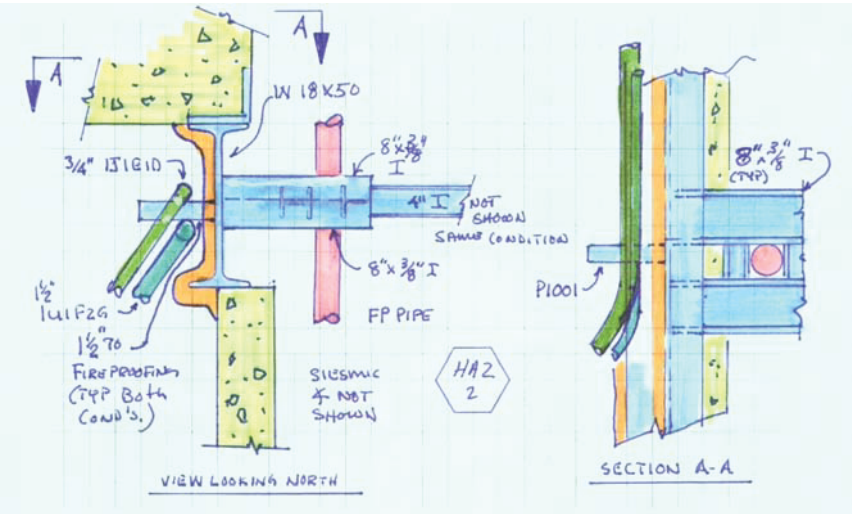
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

1127-2000

HAZ #2 Sketch



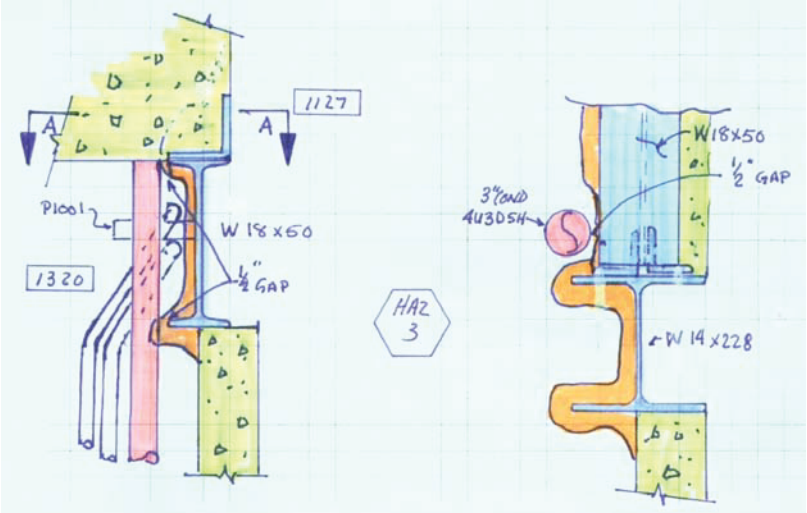
HAZ #2 Photo

Structural Steel Fireproofing Data

Appendix G5A

1127-2000

HAZ #3 Sketch



HAZ #3 Photo

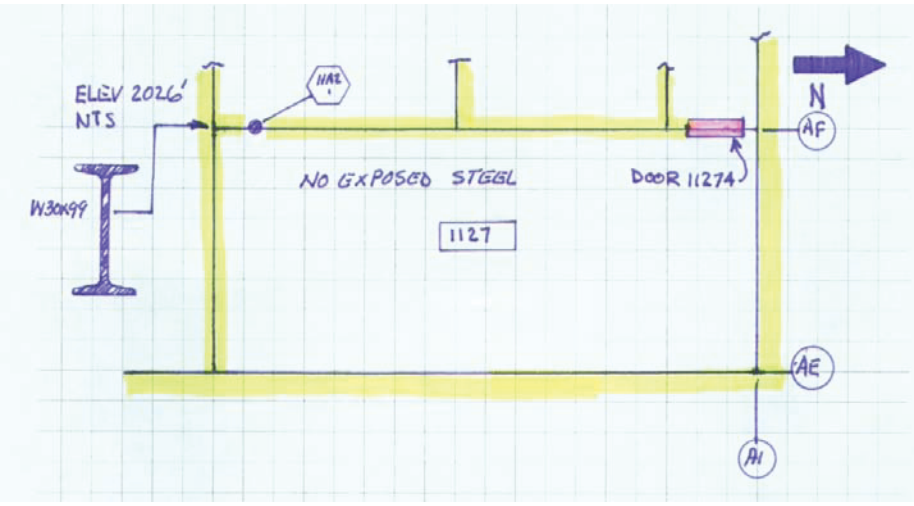
Structural Steel Fireproofing Data

Appendix G5A

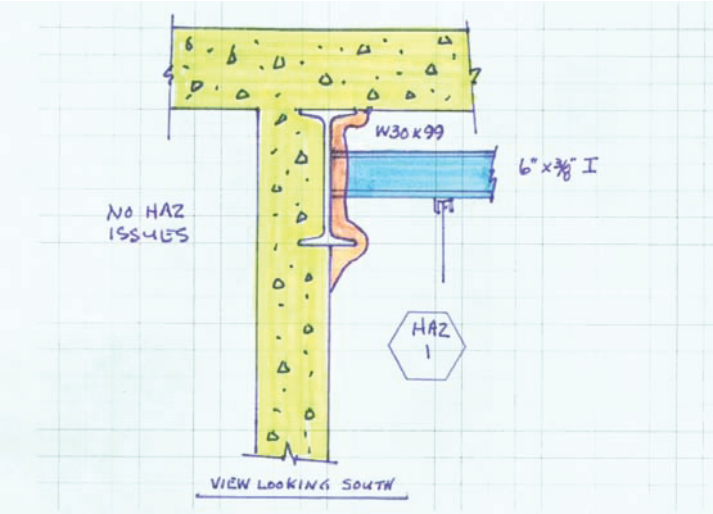
Room-Elevation: **1127-2026** **Building:** Auxiliary **Fire Area:** A-06

Description: Aux. Stair A-2

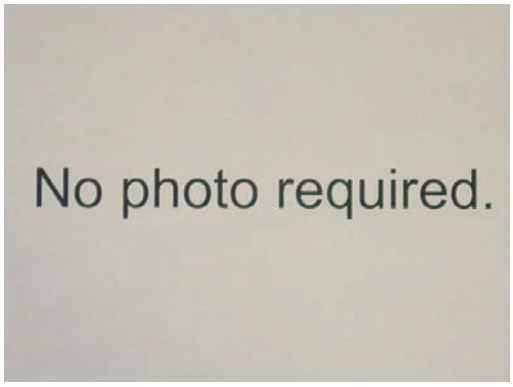
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



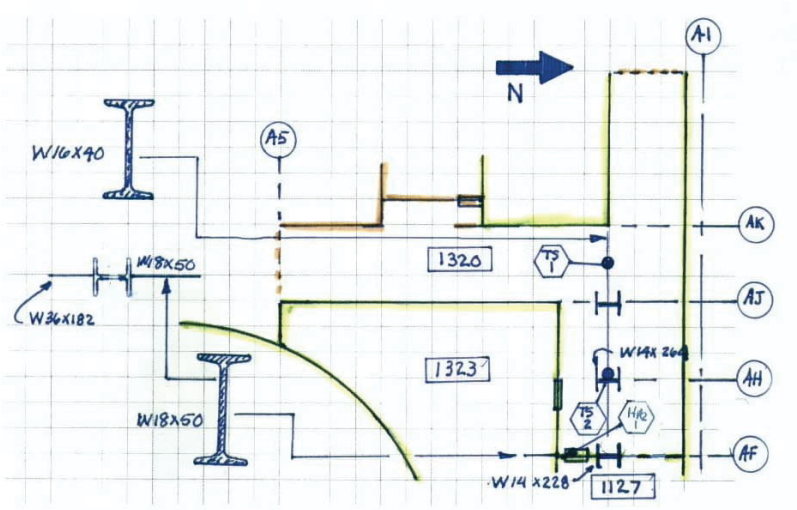
Structural Steel Fireproofing Data

Appendix G5A

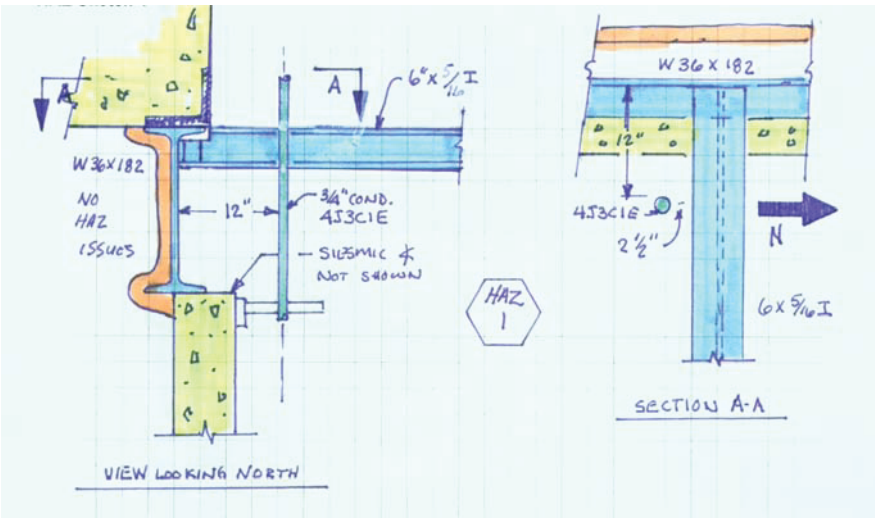
Room-Elevation: **1320-2000** **Building:** Auxiliary **Fire Area:** A-08

Description: Corridor No. 4

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

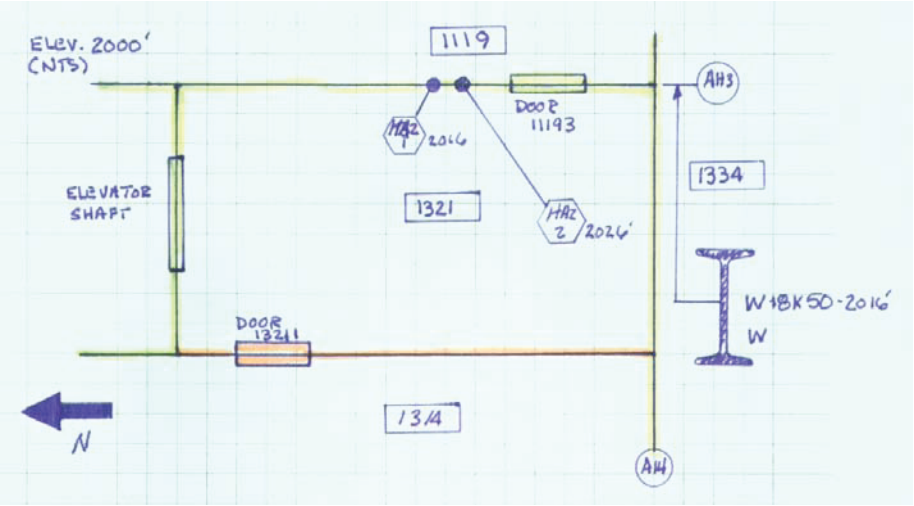
Structural Steel Fireproofing Data

Appendix G5A

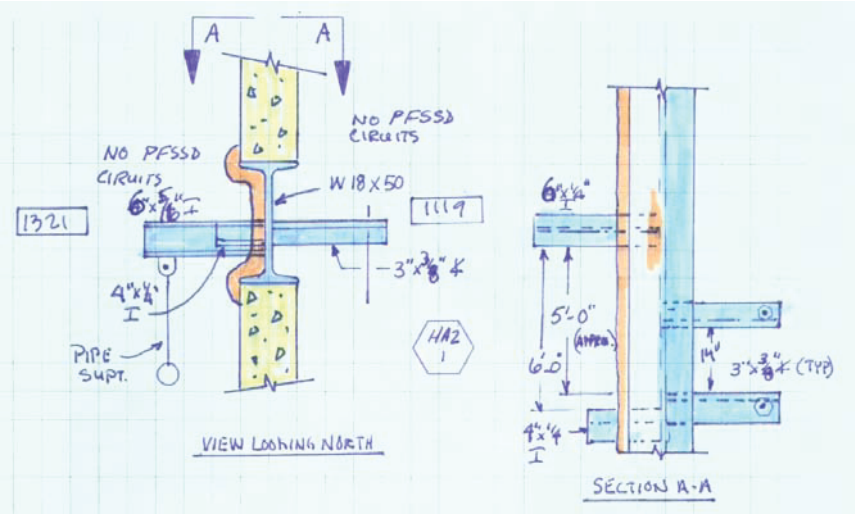
Room-Elevation: **1321-2000** **Building:** Auxiliary **Fire Area:** A-08

Description: Exit Vestibule

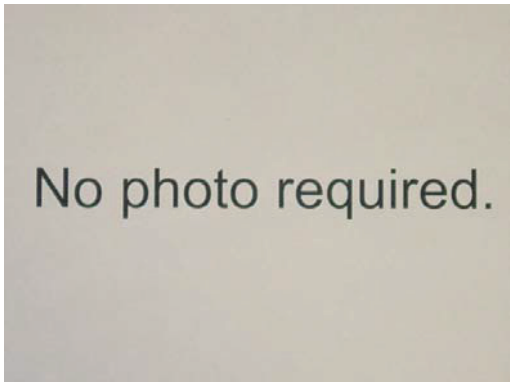
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



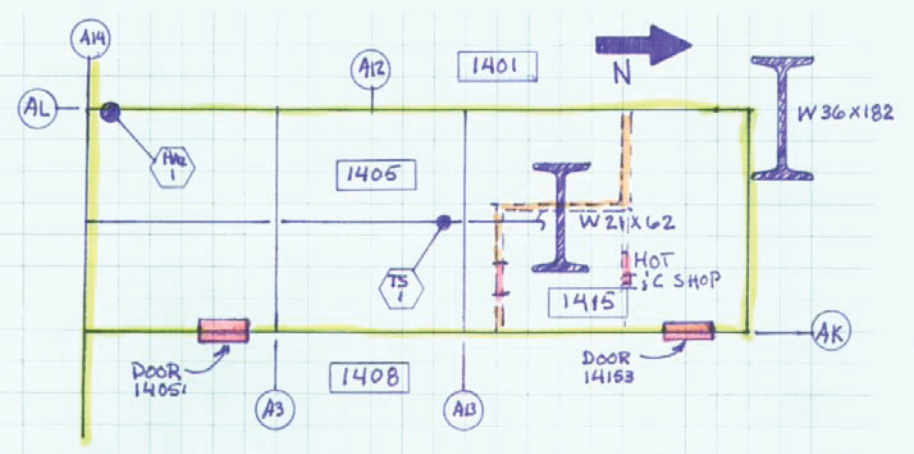
Structural Steel Fireproofing Data

Appendix G5A

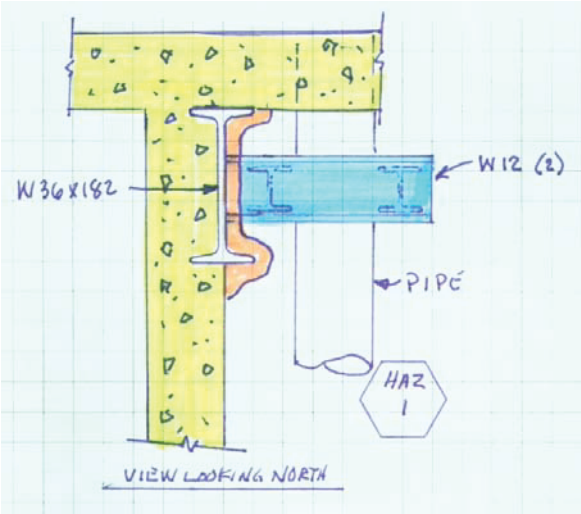
Room-Elevation: **1405-2026** **Building:** Auxiliary **Fire Area:** A-26

Description: Chemical Storage Area

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

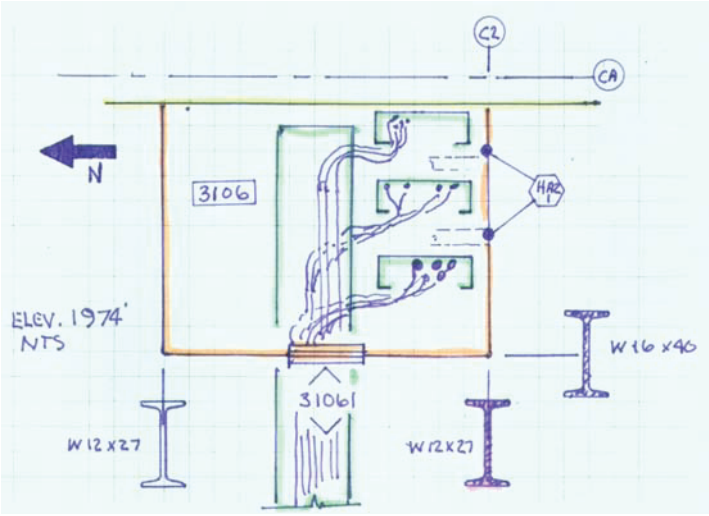
Structural Steel Fireproofing Data

Appendix G5A

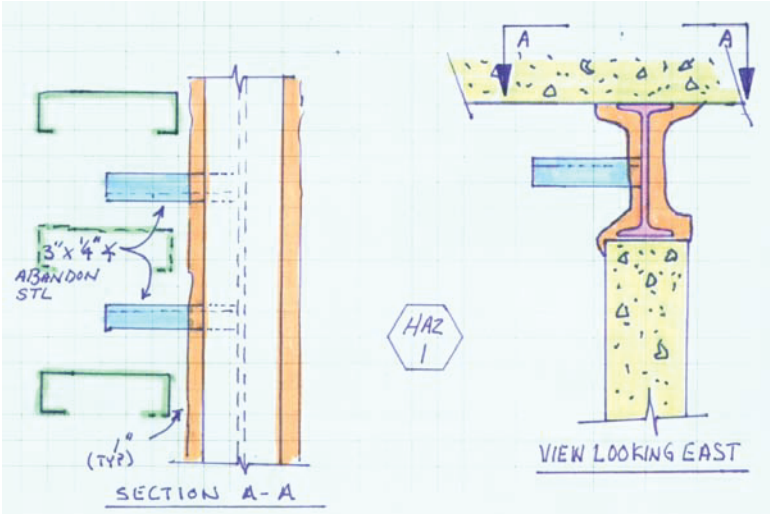
Room-Elevation: **3106-1974** **Building:** Control **Fire Area:** C-02

Description: Electrical Chase

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

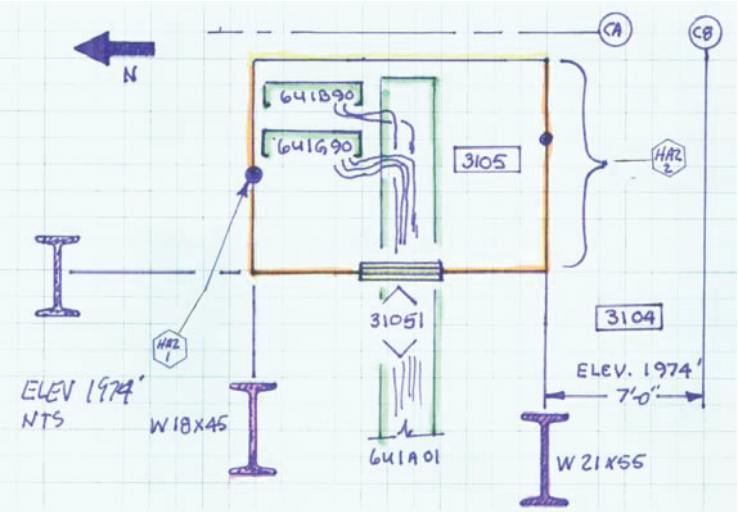
Structural Steel Fireproofing Data

Appendix G5A

Room-Elevation: **3105-1974** **Building:** Control **Fire Area:** C-03

Description: Electrical Chase

Room Sketch:



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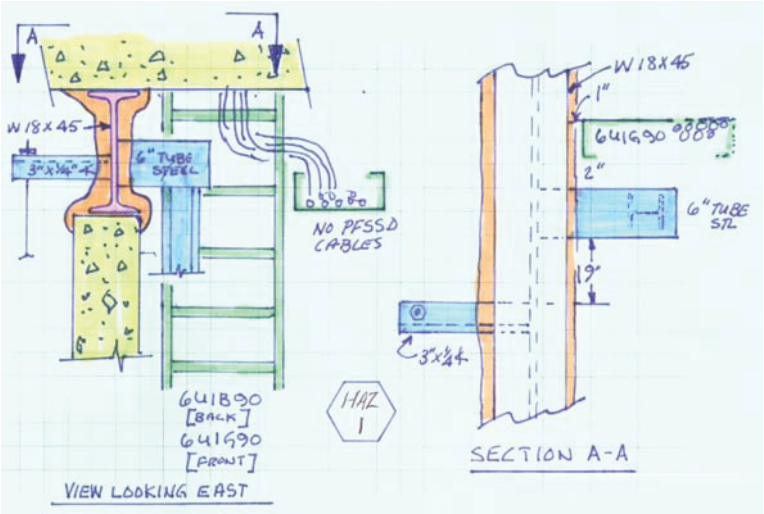


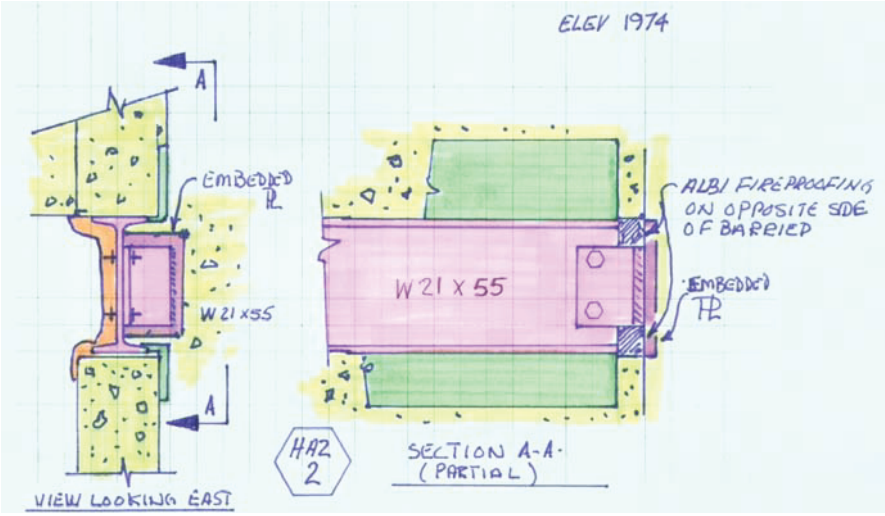
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3105-1974

HAZ #2 Sketch



HAZ #2 Photo

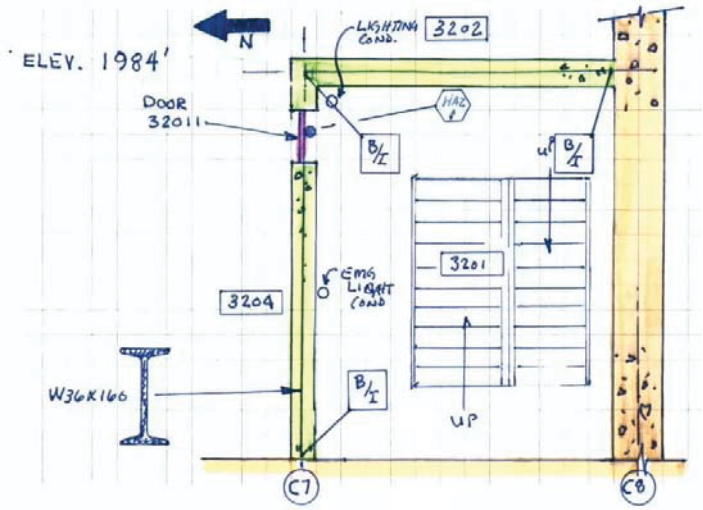
Structural Steel Fireproofing Data

Appendix G5A

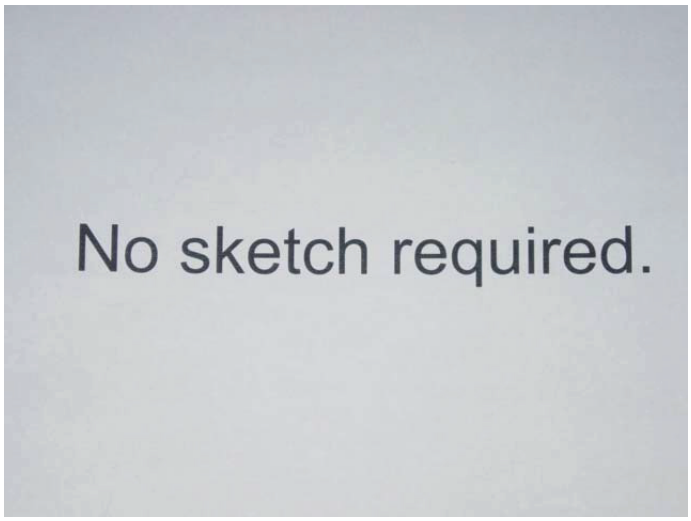
Room-Elevation: **3201-1984** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

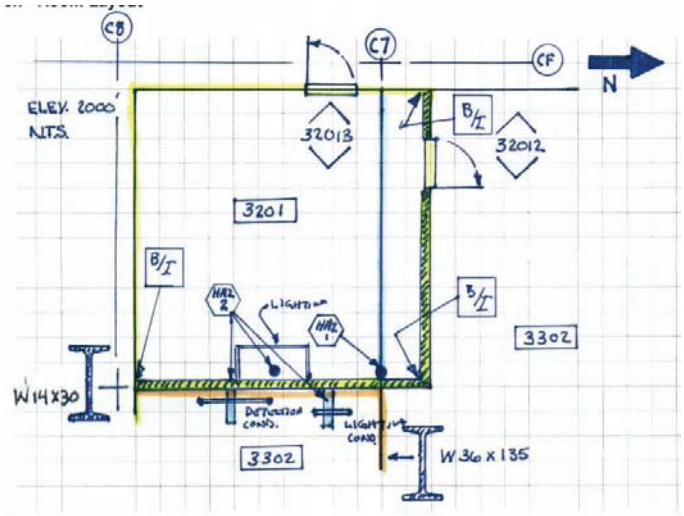
Structural Steel Fireproofing Data

Appendix G5A

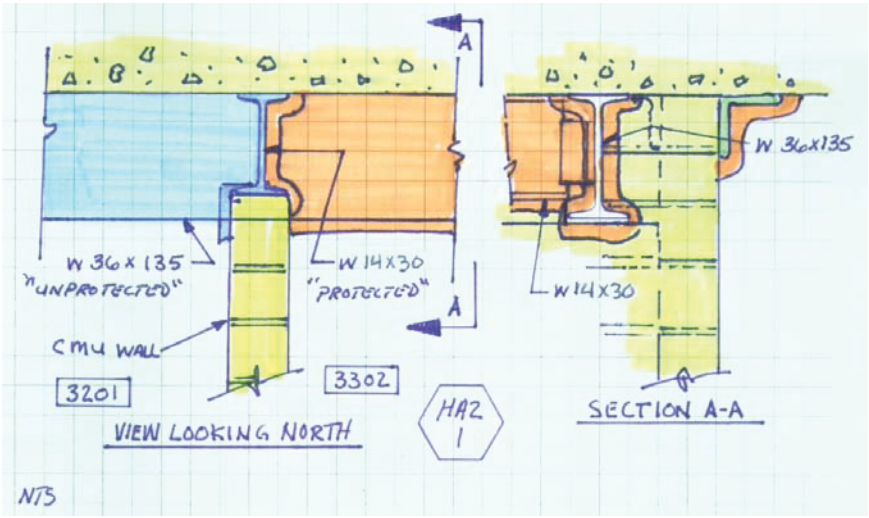
Room-Elevation: **3201-2000** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



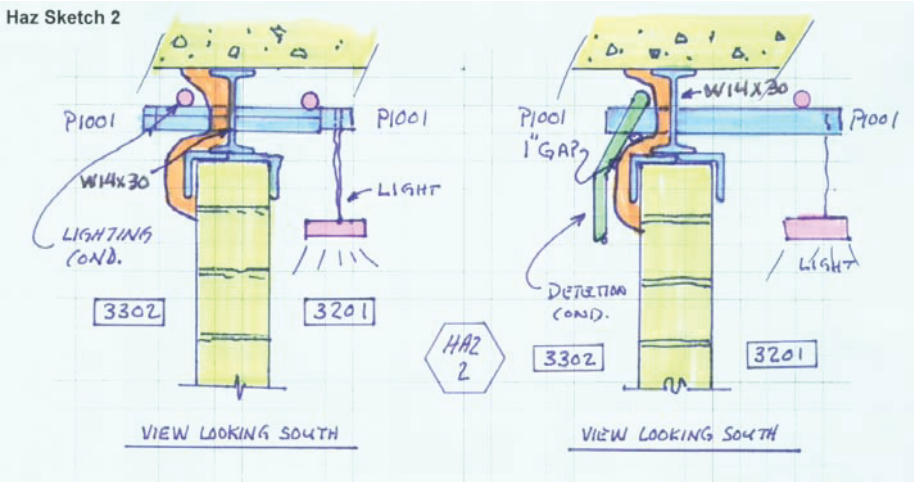
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3201-2000

HAZ #2 Sketch



HAZ #2 Photo

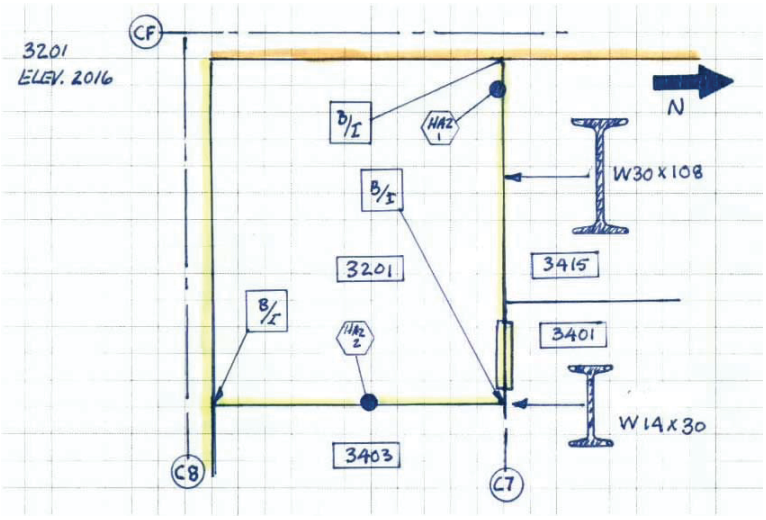
Structural Steel Fireproofing Data

Appendix G5A

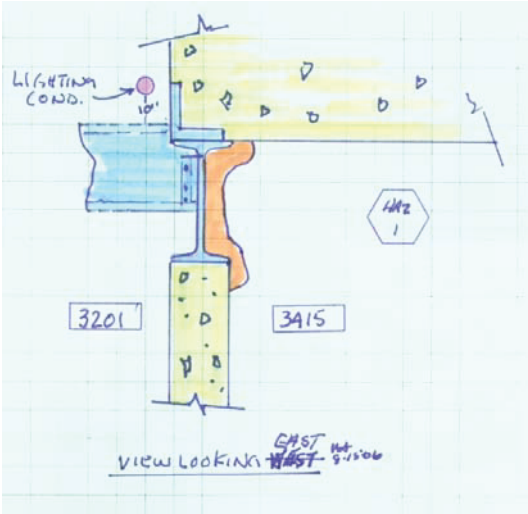
Room-Elevation: **3201-2016** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



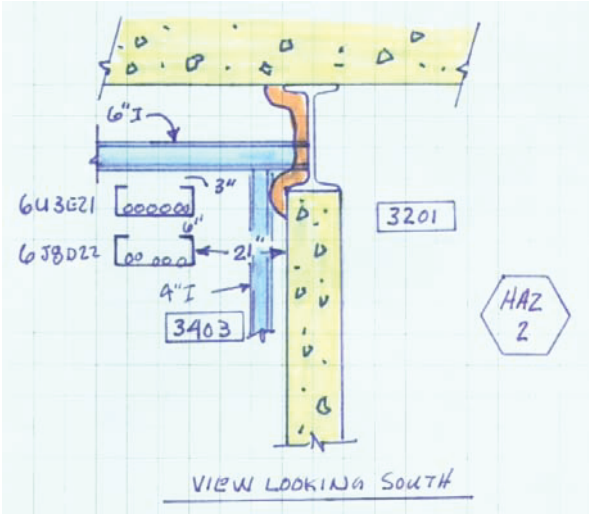
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3201-2016

HAZ #2 Sketch



HAZ #2 Photo

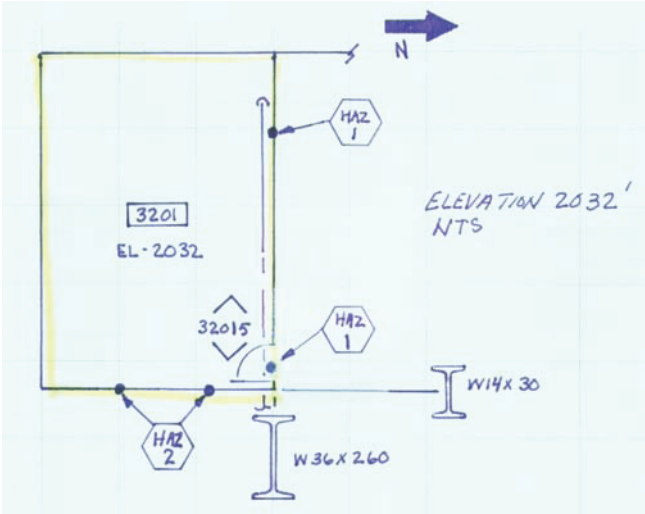
Structural Steel Fireproofing Data

Appendix G5A

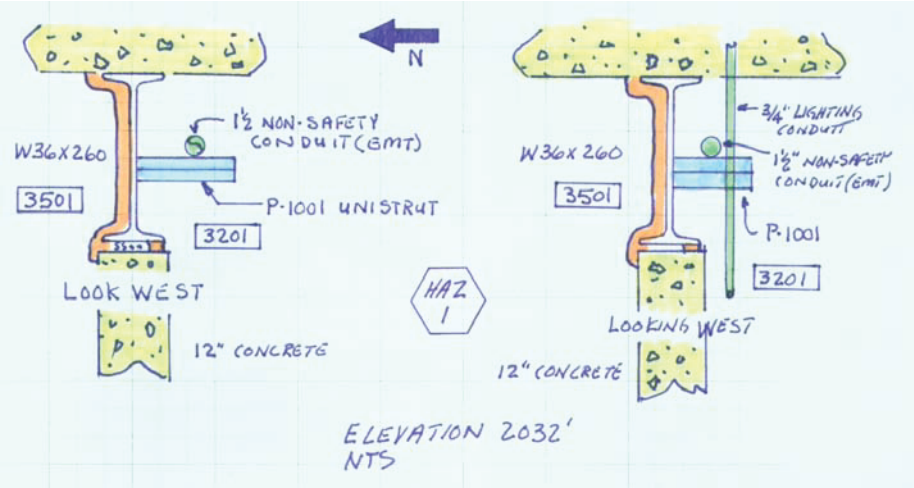
Room-Elevation: **3201-2032** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



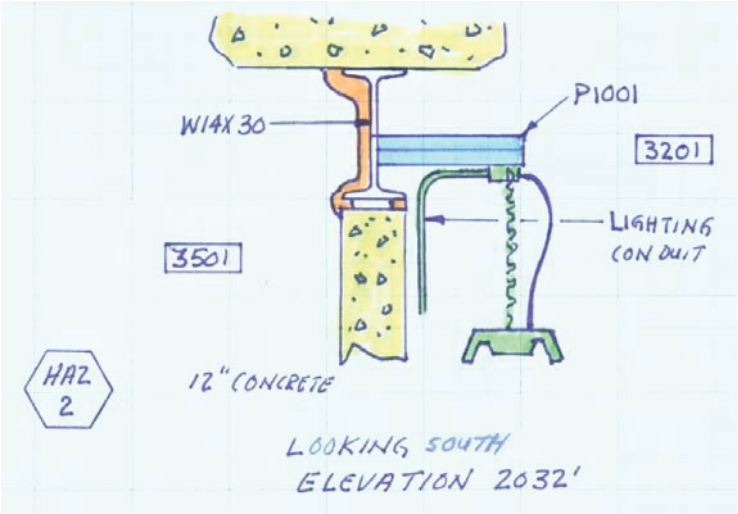
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3201-2032

HAZ #2 Sketch



HAZ #2 Photo

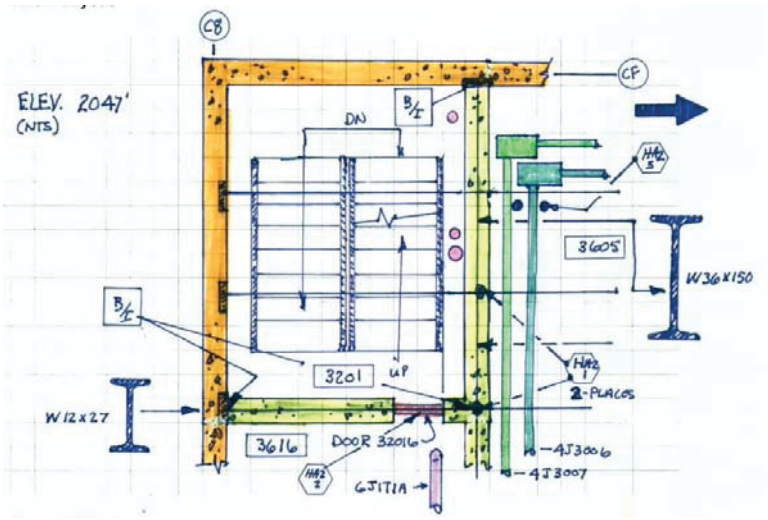
Structural Steel Fireproofing Data

Appendix G5A

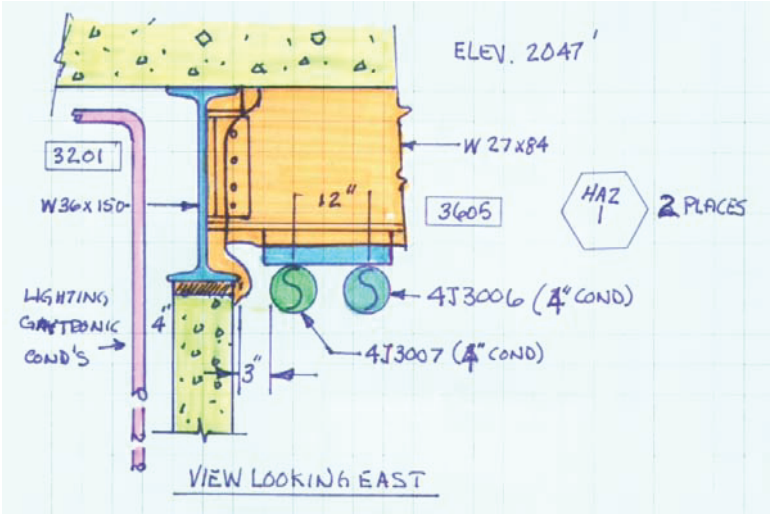
Room-Elevation: **3201-2047** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



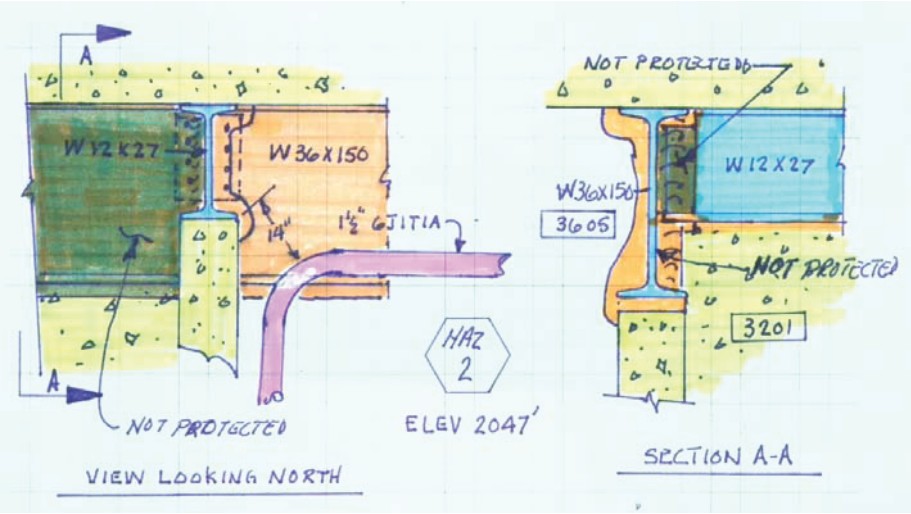
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3201-2047

HAZ #2 Sketch



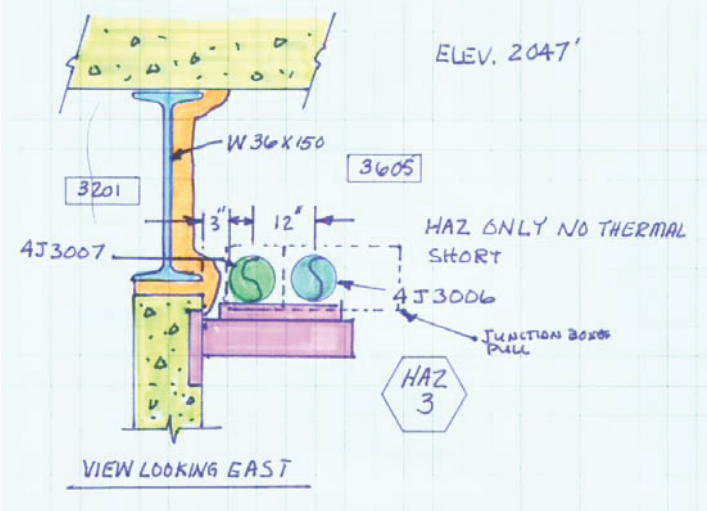
HAZ #2 Photo

Structural Steel Fireproofing Data

Appendix G5A

3201-2047

HAZ #3 Sketch



HAZ #3 Photo

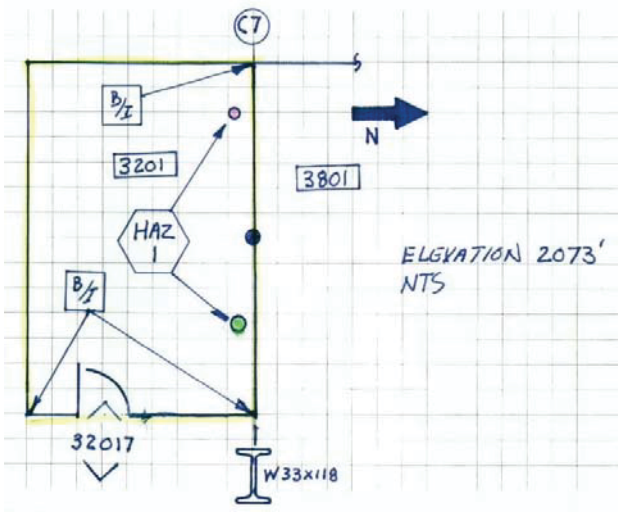
Structural Steel Fireproofing Data

Appendix G5A

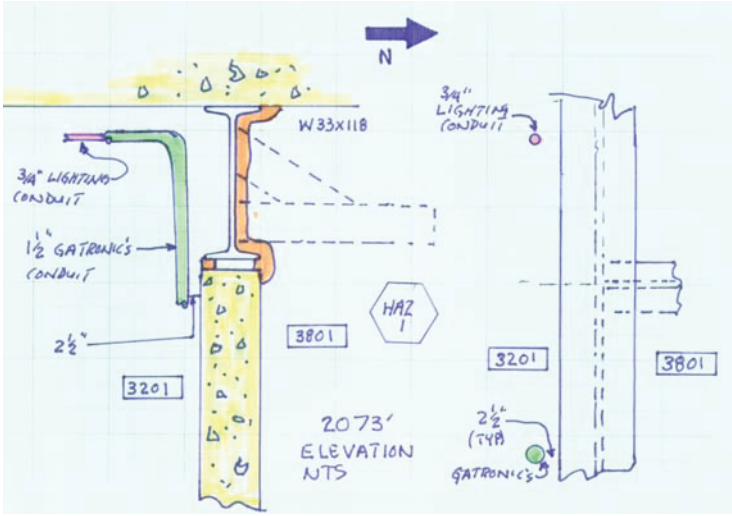
Room-Elevation: **3201-2073** **Building:** Control **Fire Area:** C-06

Description: Control, Stair C-1

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

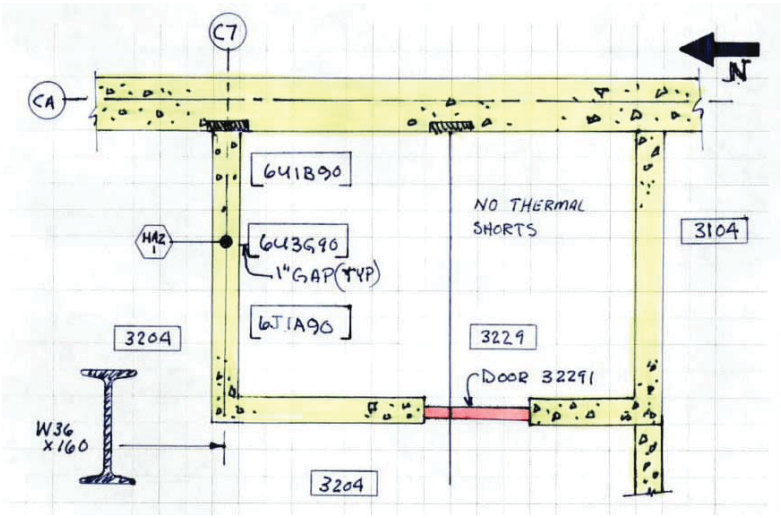
Structural Steel Fireproofing Data

Appendix G5A

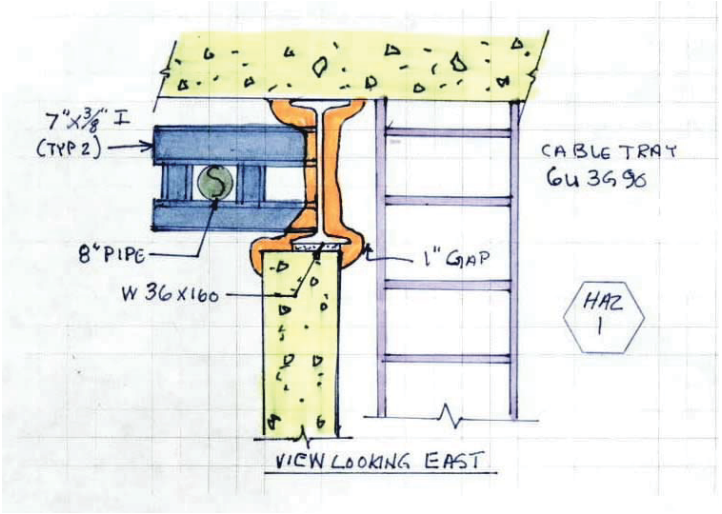
Room-Elevation: **3229-1984** **Building:** Control **Fire Area:** C-08

Description: Electrical Chase

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

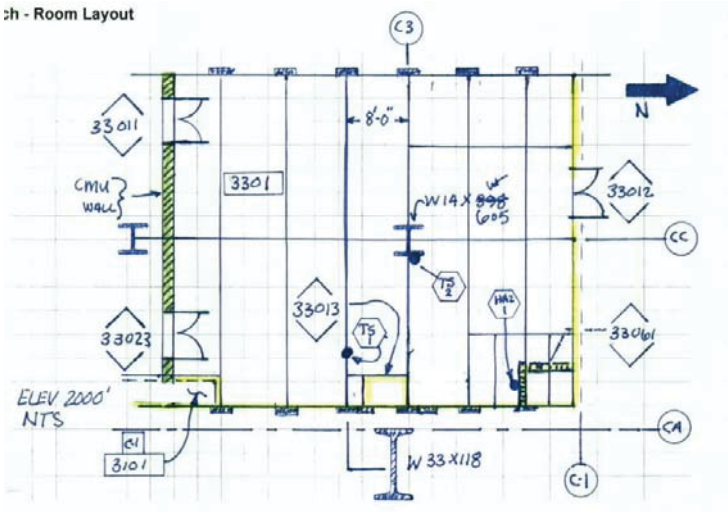
Structural Steel Fireproofing Data

Appendix G5A

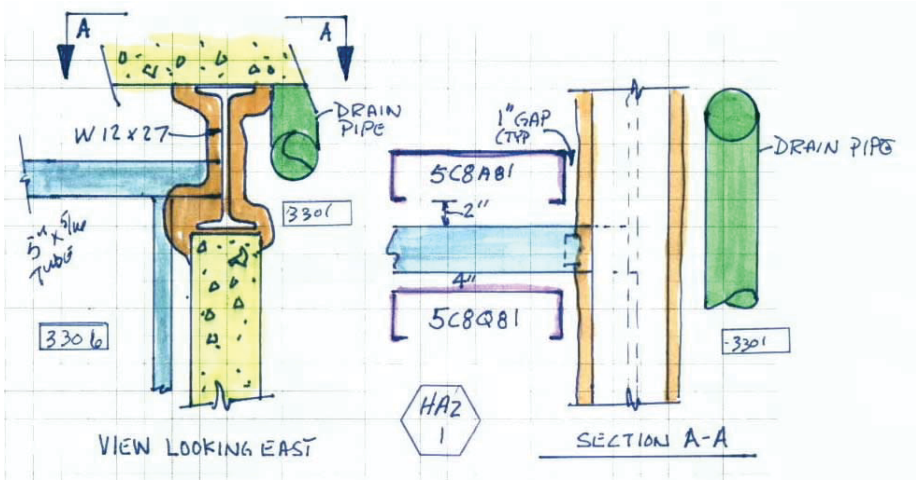
Room-Elevation: **3301-2000** **Building:** Control **Fire Area:** C-09

Description: ESF Switchgear Room No. 1

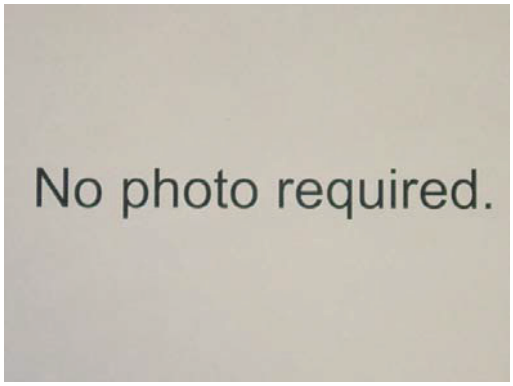
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



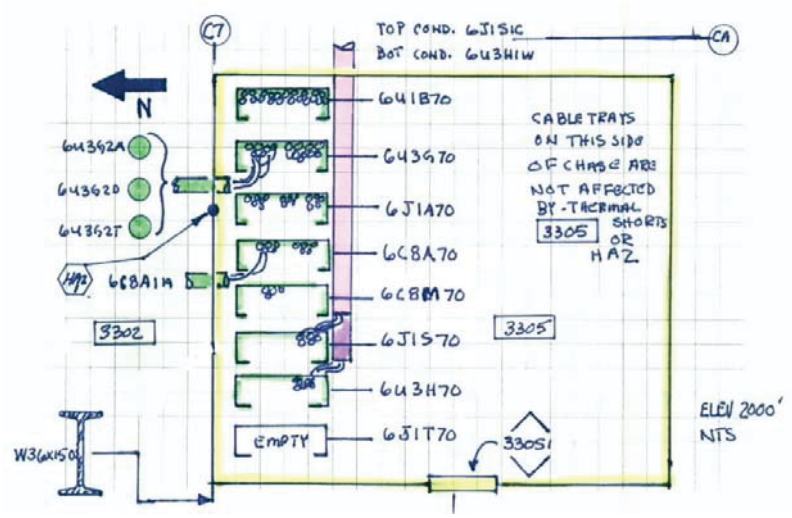
Structural Steel Fireproofing Data

Appendix G5A

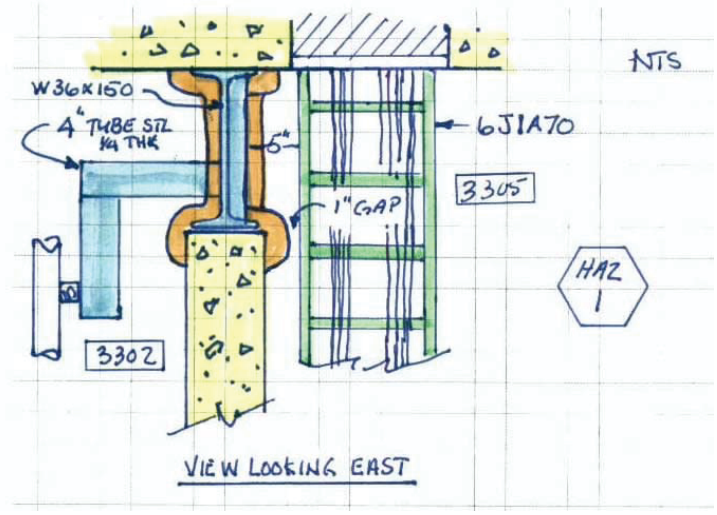
Room-Elevation: **3305-2000** **Building:** Control **Fire Area:** C-11

Description: Electrical Chase

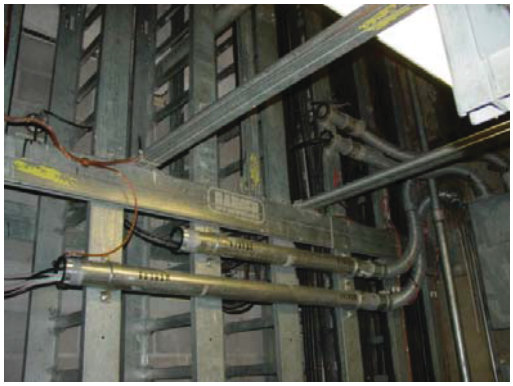
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

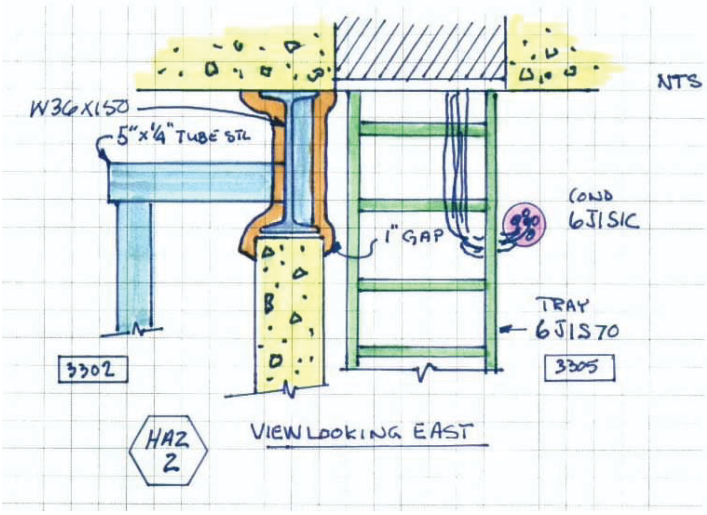


Structural Steel Fireproofing Data

Appendix G5A

3305-2000

HAZ #2 Sketch



HAZ #2 Photo

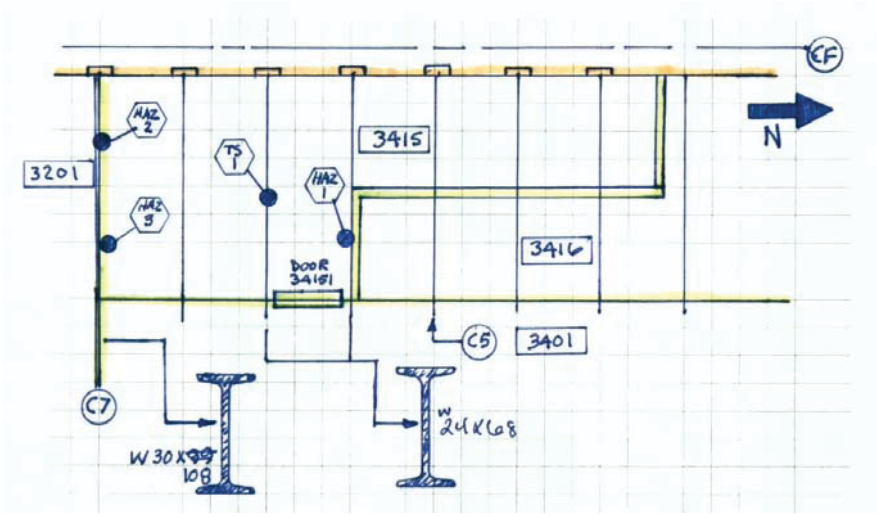
Structural Steel Fireproofing Data

Appendix G5A

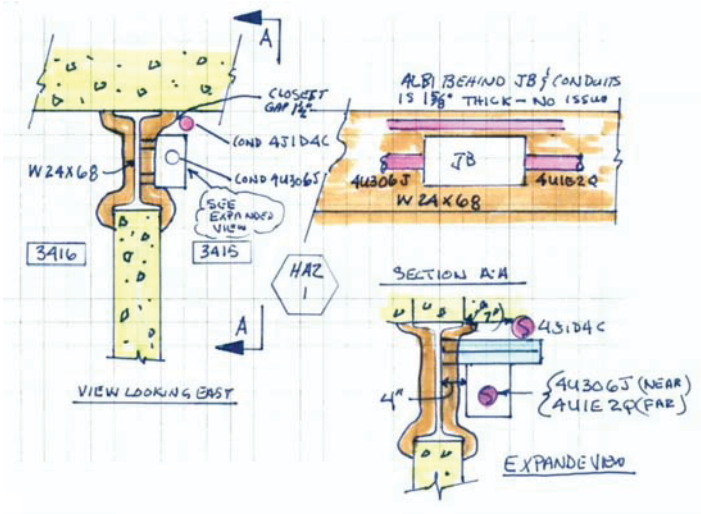
Room-Elevation: **3415-2016** **Building:** Control **Fire Area:** C-13

Description: Access Ctrl & Elec Equip A/C Units No. 1

Room Sketch:



HAZ #1 Sketch



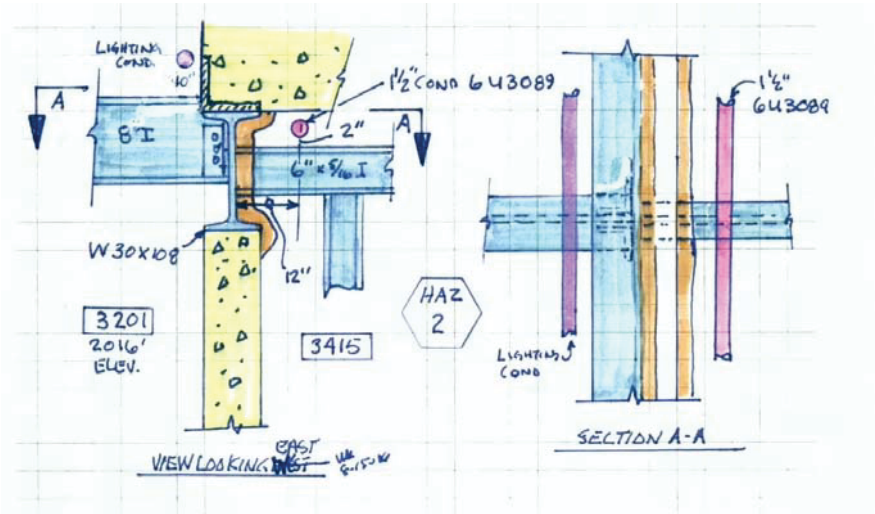
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3415-2016

HAZ #2 Sketch



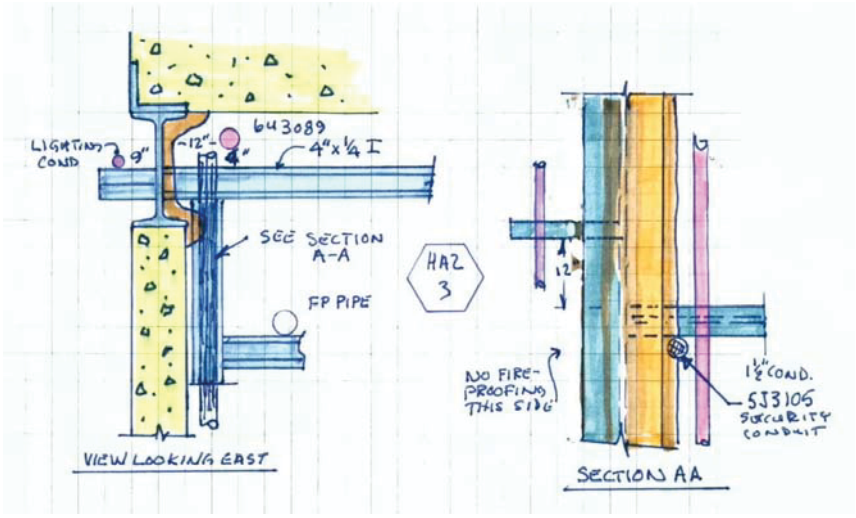
HAZ #2 Photo

Structural Steel Fireproofing Data

Appendix G5A

3415-2016

HAZ #3 Sketch



HAZ #3 Photo

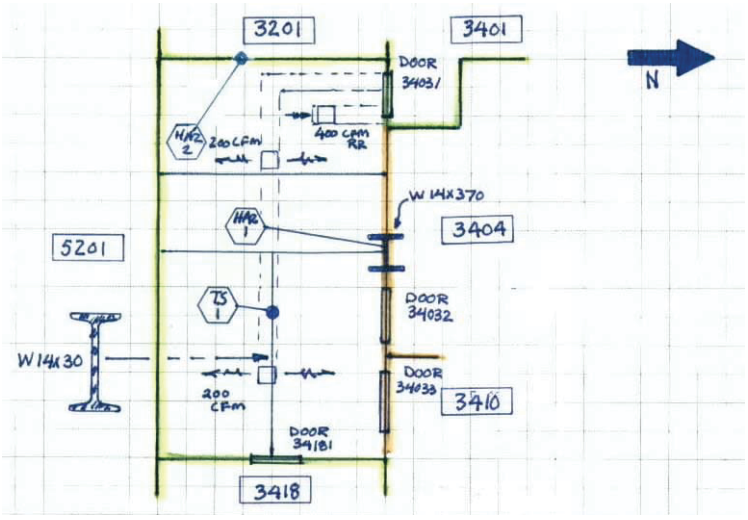
Structural Steel Fireproofing Data

Appendix G5A

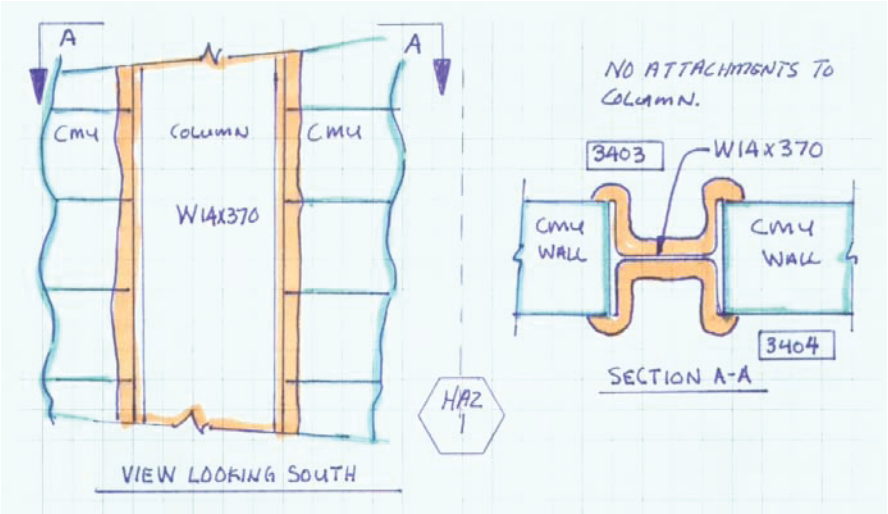
Room-Elevation: **3403-2016** **Building:** Control **Fire Area:** C-15

Description: Non-Vital Swgr & Xfmr Rm No. 1

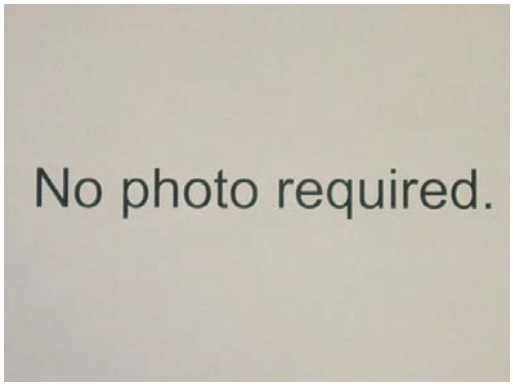
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

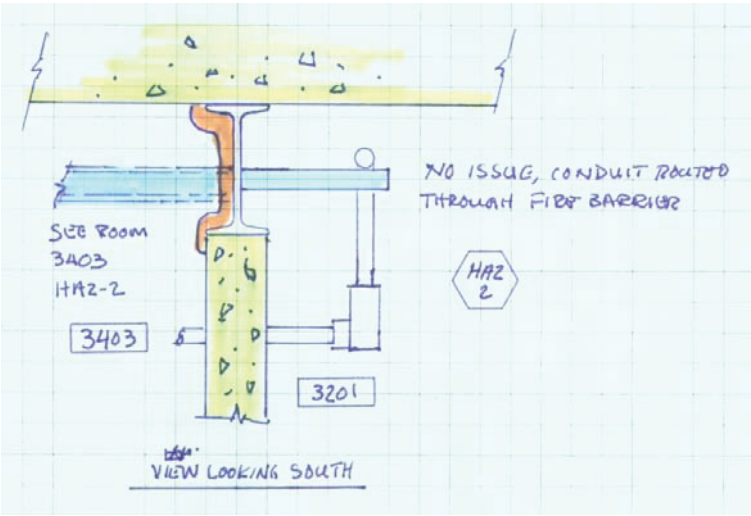


Structural Steel Fireproofing Data

Appendix G5A

3403-2016

HAZ #2 Sketch



HAZ #2 Photo

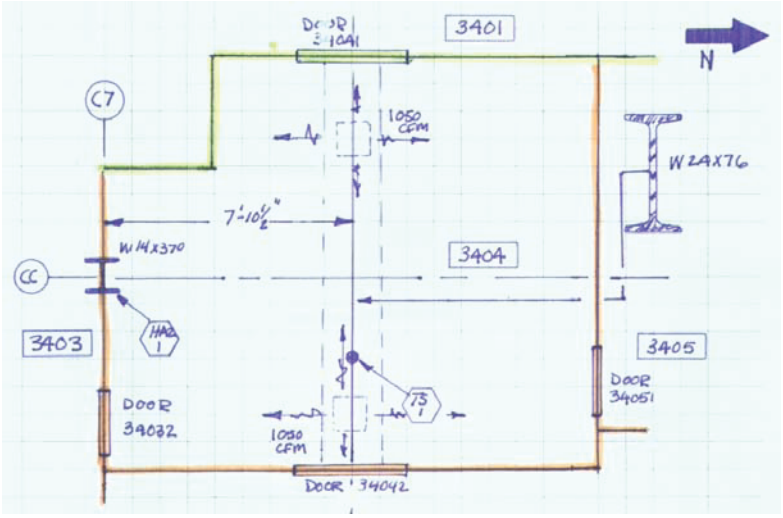
Structural Steel Fireproofing Data

Appendix G5A

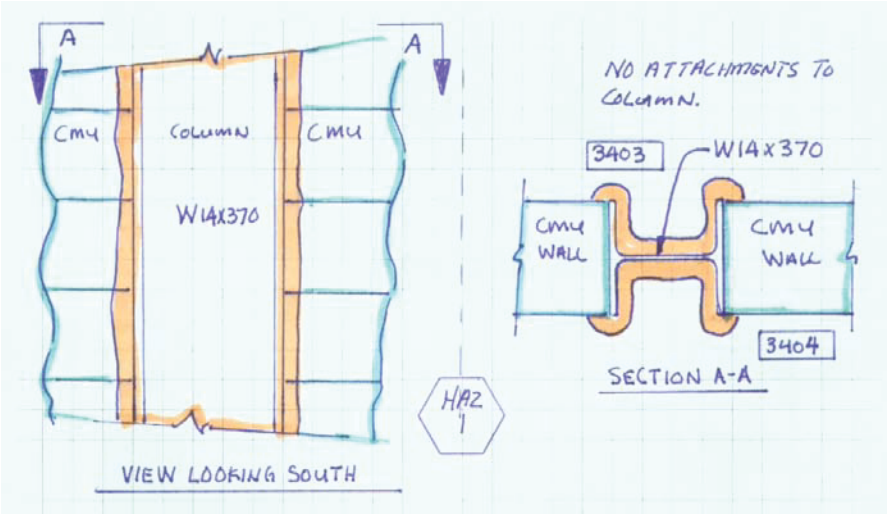
Room-Elevation: **3404-2016** **Building:** Control **Fire Area:** C-15

Description: Switchboard Rm No. 4

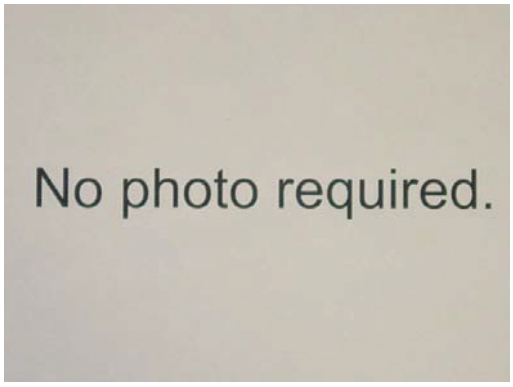
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



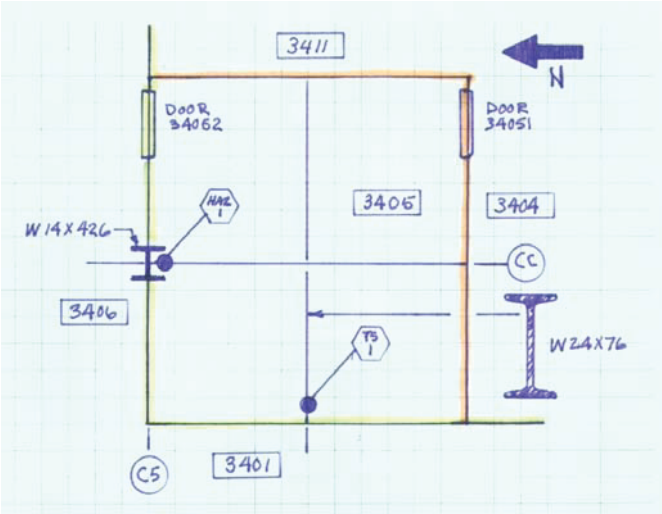
Structural Steel Fireproofing Data

Appendix G5A

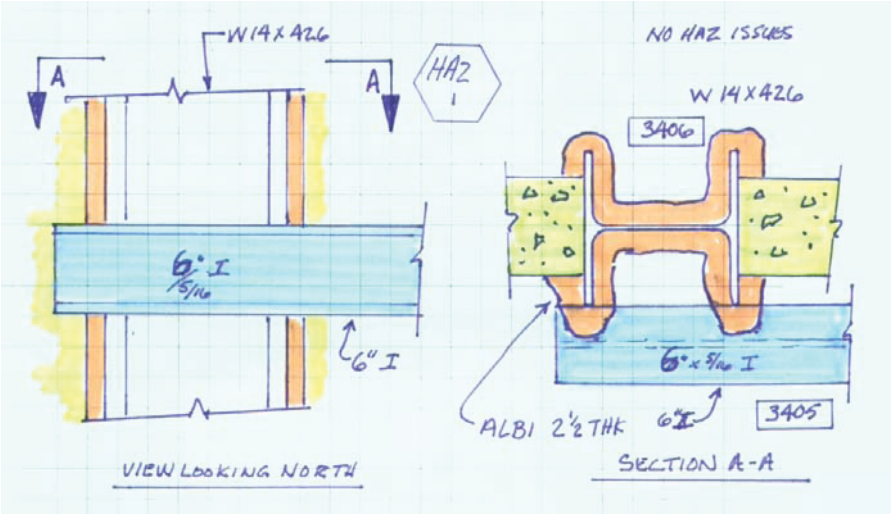
Room-Elevation: **3405-2016** **Building:** Control **Fire Area:** C-15

Description: Battery Rm No. 4

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

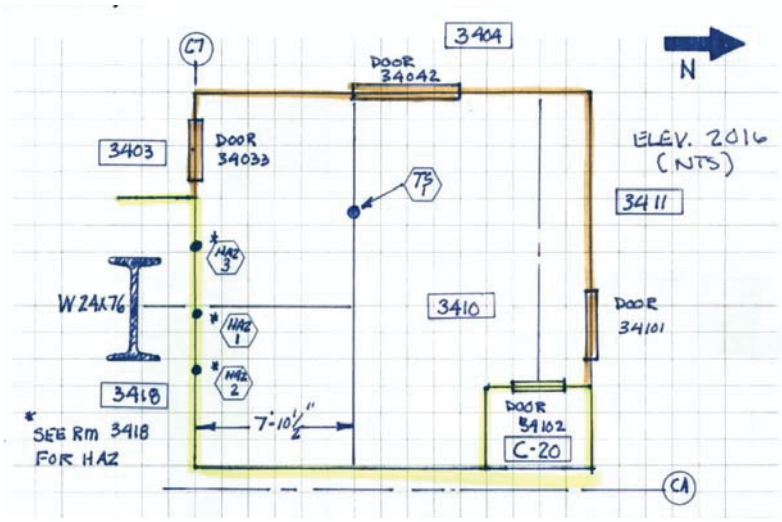
Structural Steel Fireproofing Data

Appendix G5A

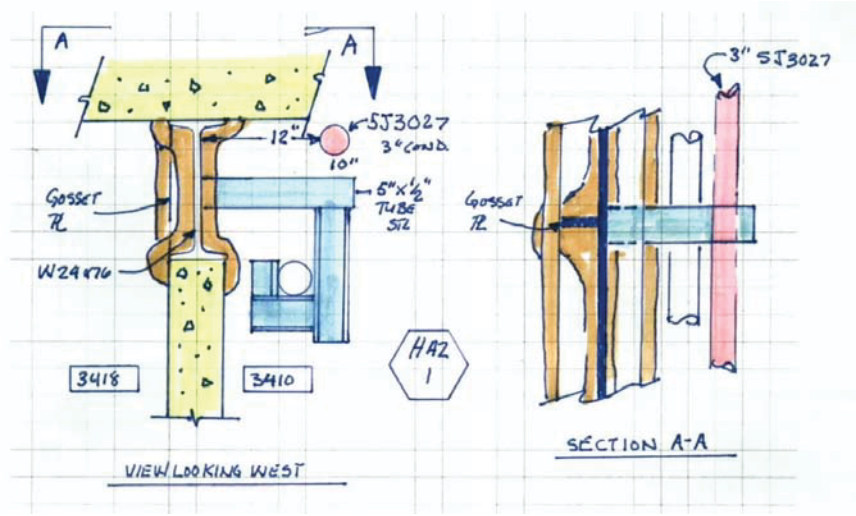
Room-Elevation: **3410-2016** **Building:** Control **Fire Area:** C-15

Description: Switchboard Rm No. 2

Room Sketch:



HAZ #1 Sketch



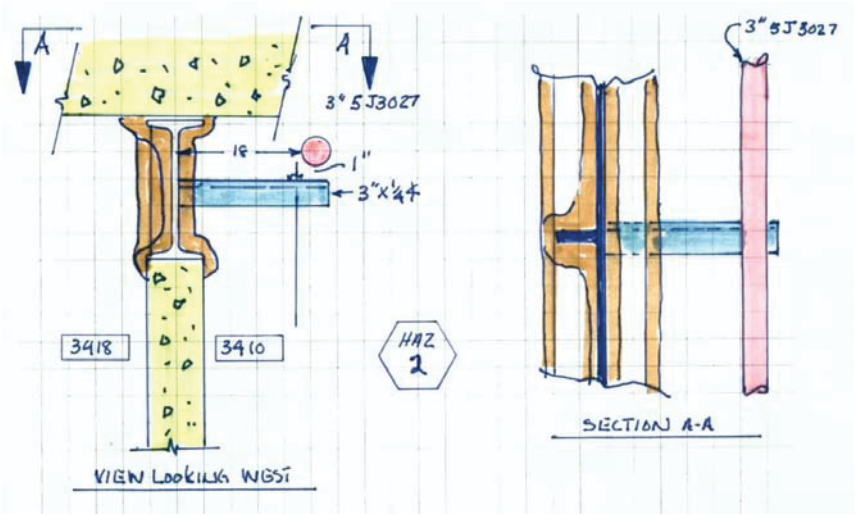
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3410-2016

HAZ #2 Sketch



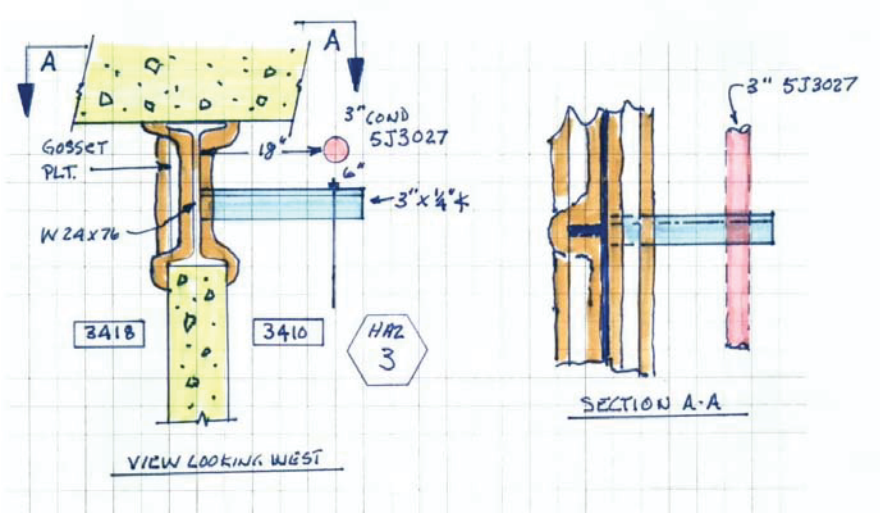
HAZ #2 Photo

Structural Steel Fireproofing Data

Appendix G5A

3410-2016

HAZ #3 Sketch



HAZ #3 Photo

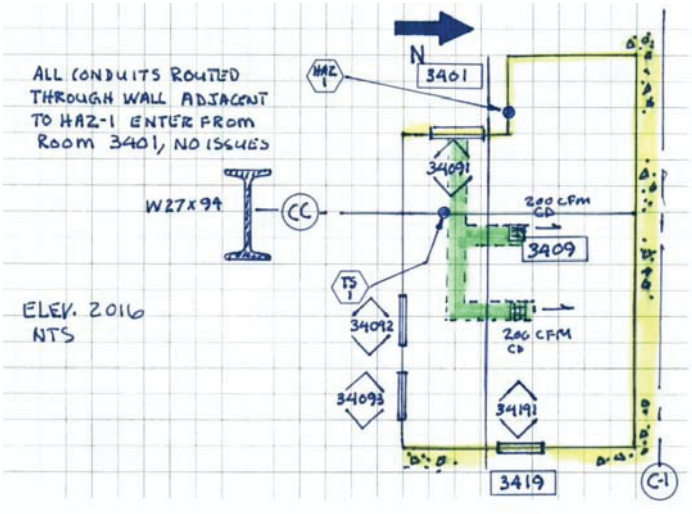
Structural Steel Fireproofing Data

Appendix G5A

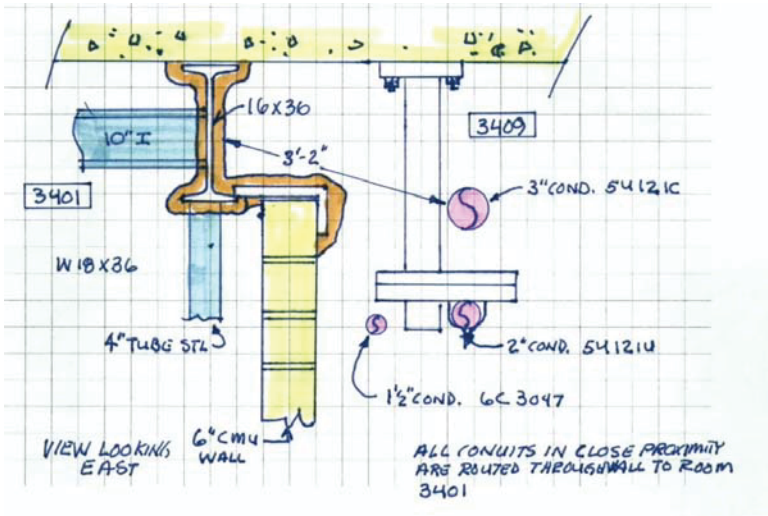
Room-Elevation: **3409-2016** **Building:** Control **Fire Area:** C-16

Description: Non-Vital Swgr & Xfmr Rm No. 2

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

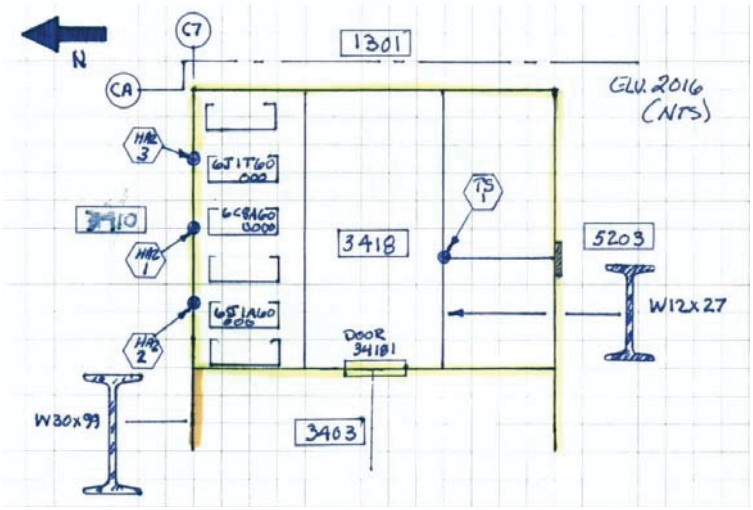
Structural Steel Fireproofing Data

Appendix G5A

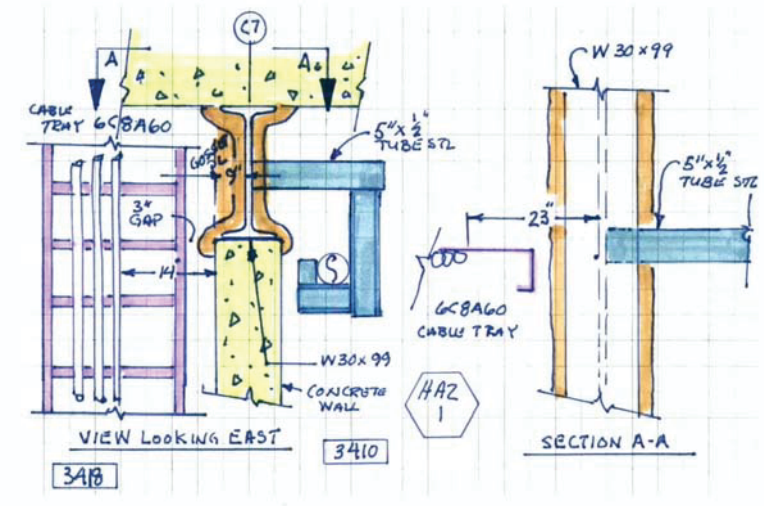
Room-Elevation: **3418-2016** **Building:** Control **Fire Area:** C-17

Description: Electrical Chase

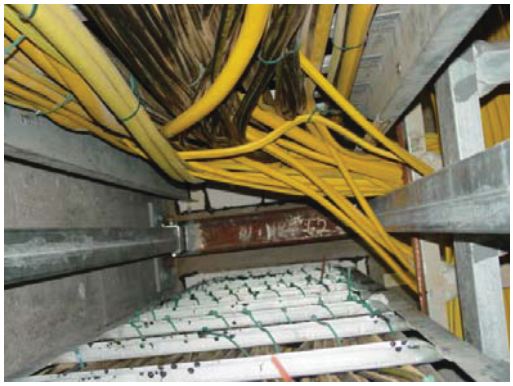
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

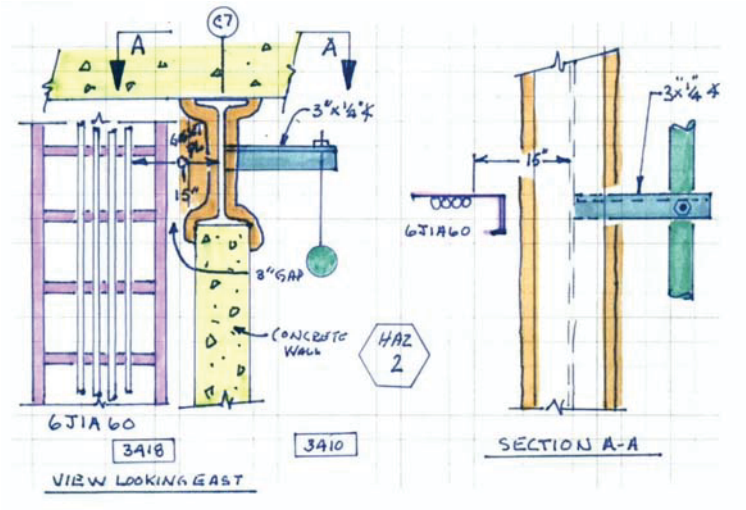


Structural Steel Fireproofing Data

Appendix G5A

3418-2016

HAZ #2 Sketch



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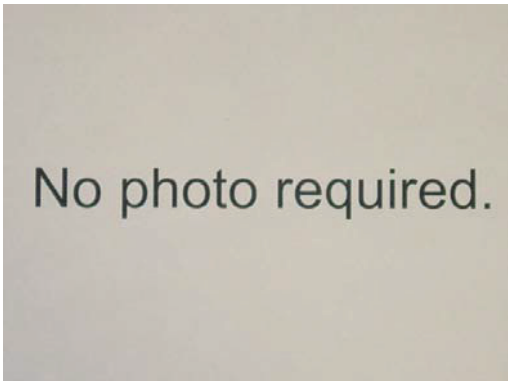
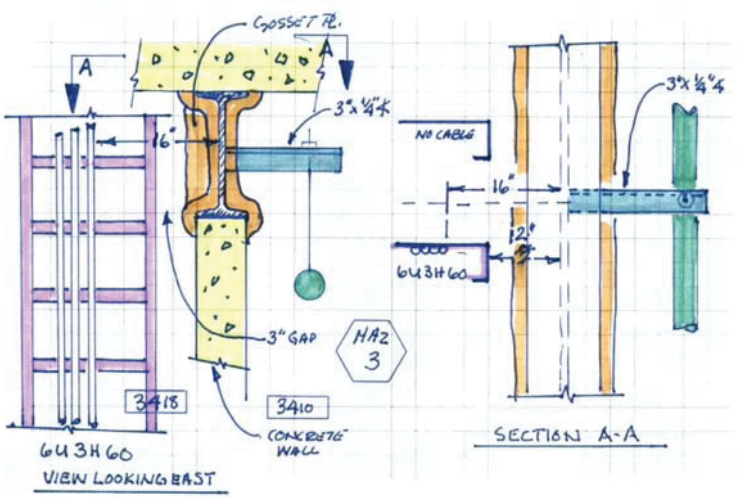


Structural Steel Fireproofing Data

Appendix G5A

3418-2016

HAZ #3 Sketch



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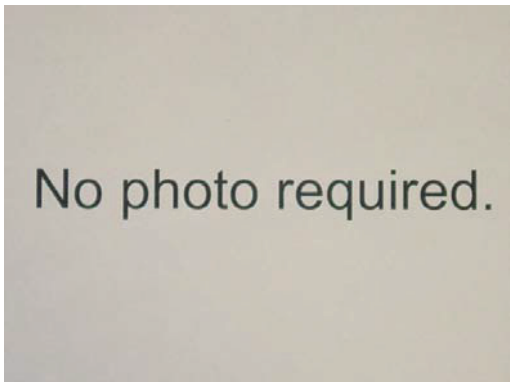


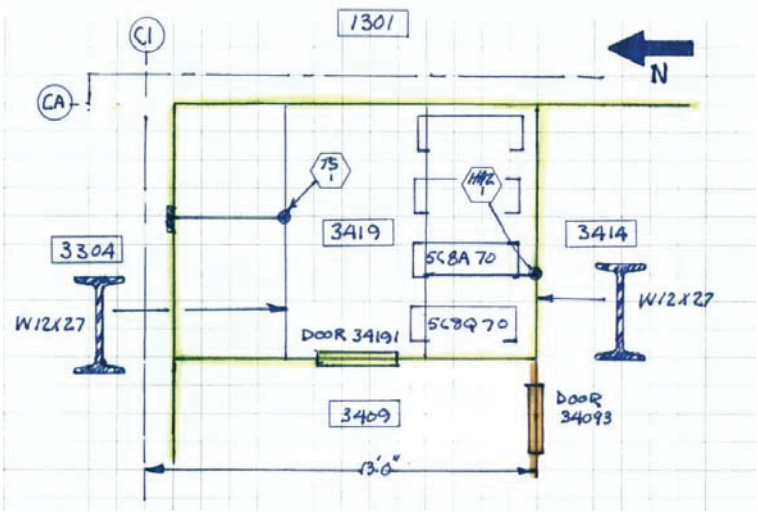
Structural Steel Fireproofing Data

Appendix G5A

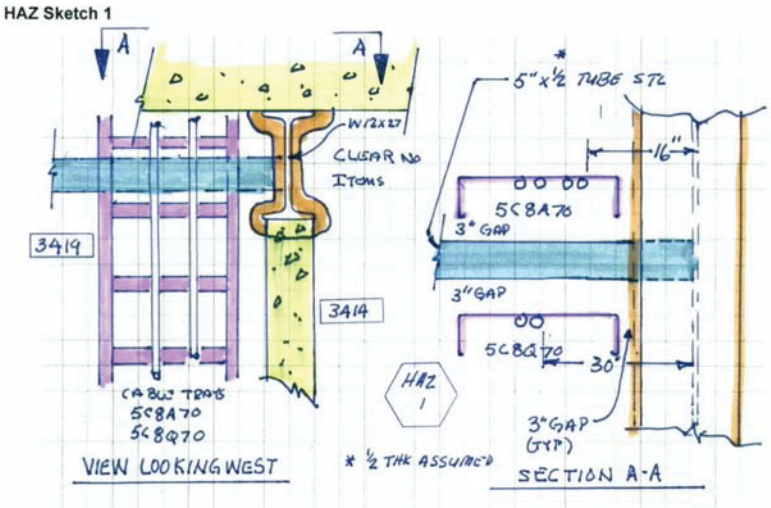
Room-Elevation: **3419-2016** **Building:** Control **Fire Area:** C-18

Description: Electrical Chase

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

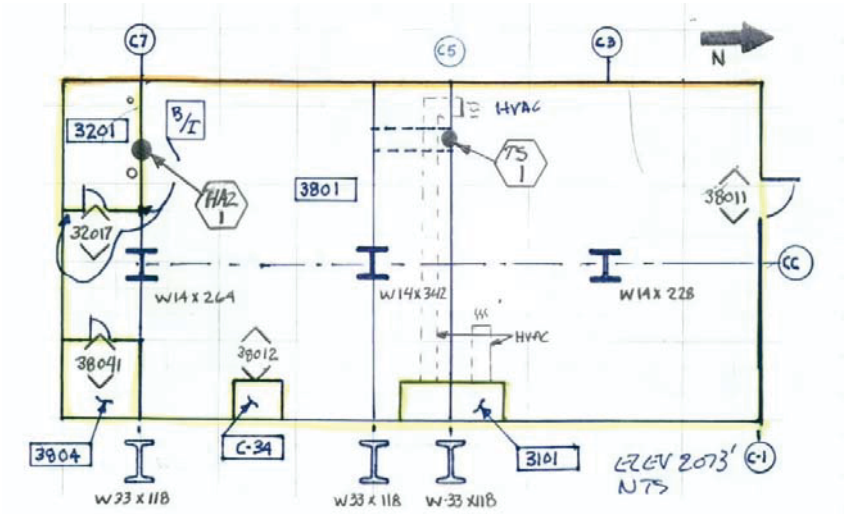
Structural Steel Fireproofing Data

Appendix G5A

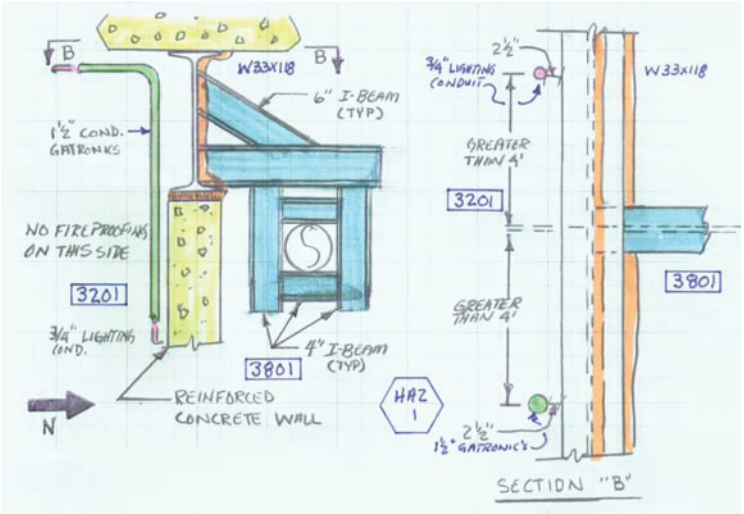
Room-Elevation: **3801-2073** **Building:** Control **Fire Area:** C-22

Description: Upper Cable Spreading Room

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

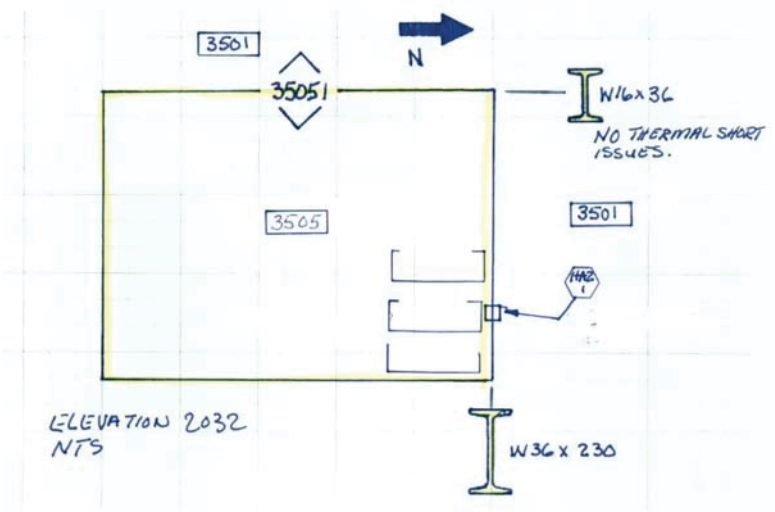
Structural Steel Fireproofing Data

Appendix G5A

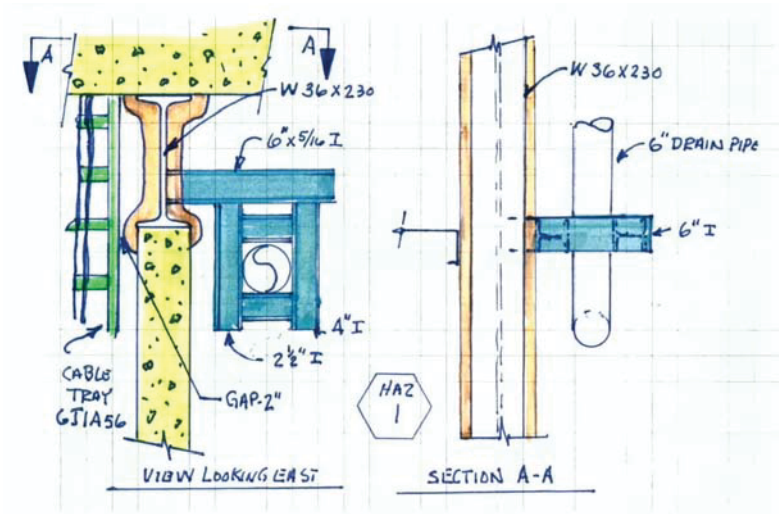
Room-Elevation: **3505-2032** **Building:** Control **Fire Area:** C-23

Description: Electrical Chase

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

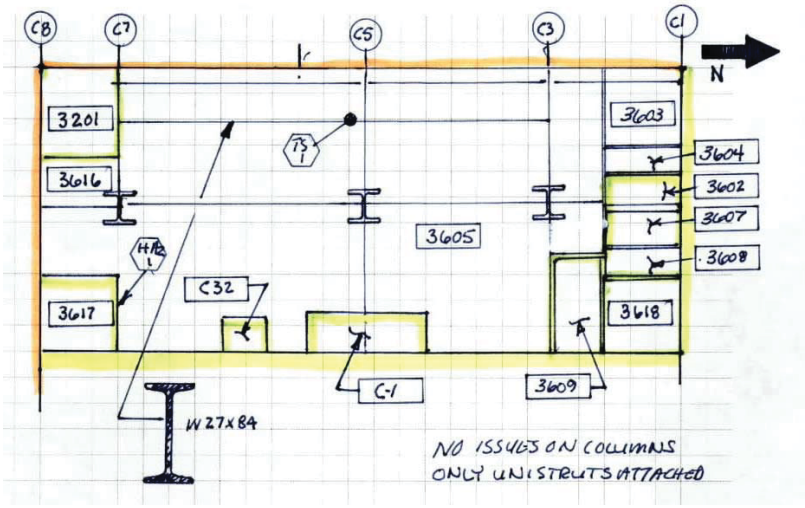
Structural Steel Fireproofing Data

Appendix G5A

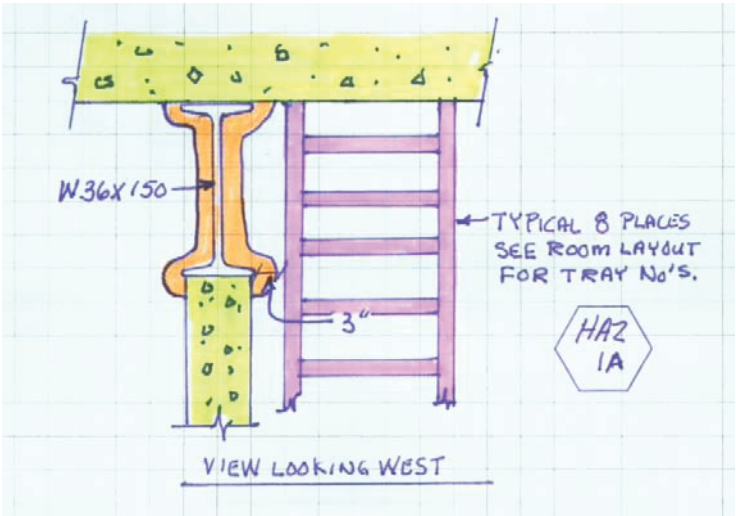
Room-Elevation: **3605-2047** **Building:** Control **Fire Area:** C-27

Description: Equipment Cabinet Area

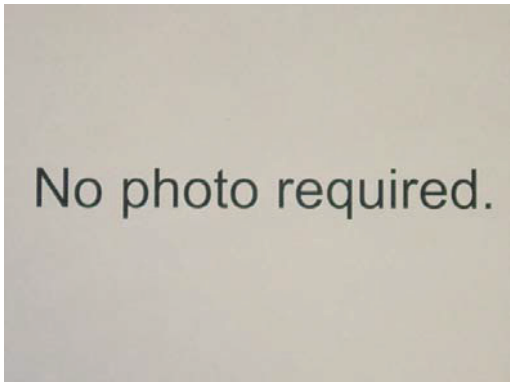
Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo



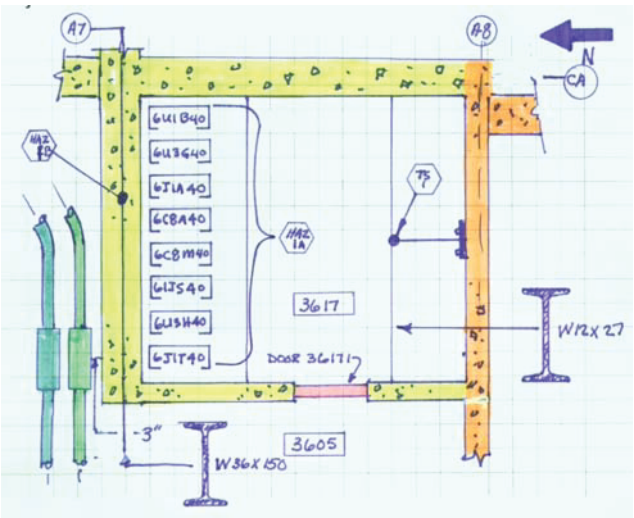
Structural Steel Fireproofing Data

Appendix G5A

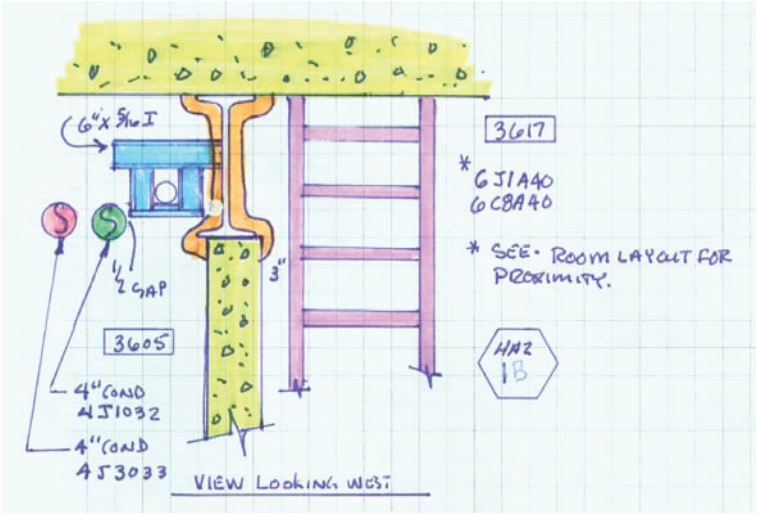
Room-Elevation: **3617-2047** **Building:** Control **Fire Area:** C-30

Description: Electrical Chase

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

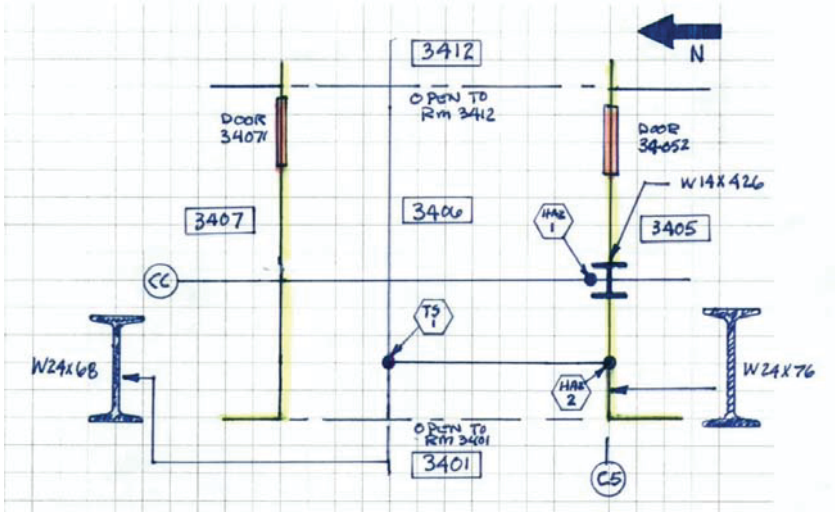
Structural Steel Fireproofing Data

Appendix G5A

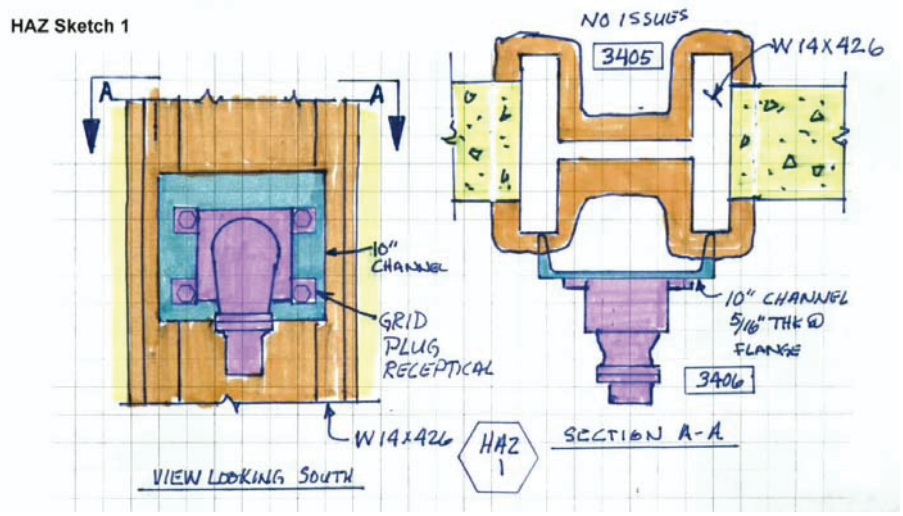
Room-Elevation: **3406-2016** **Building:** Control **Fire Area:** C-35

Description: Corridor No. 2

Room Sketch:



HAZ #1 Sketch



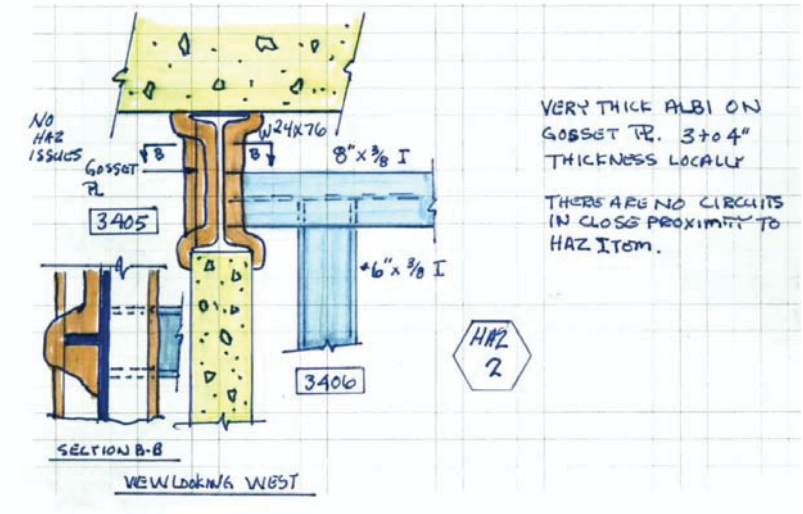
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3406-2016

HAZ #2 Sketch



HAZ #2 Photo

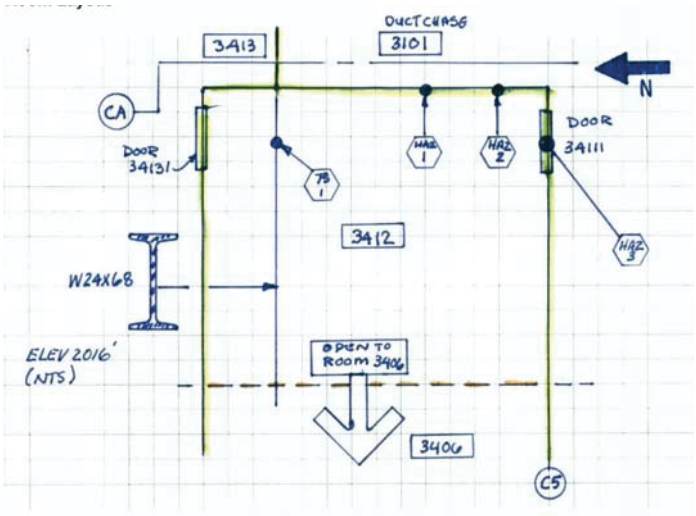
Structural Steel Fireproofing Data

Appendix G5A

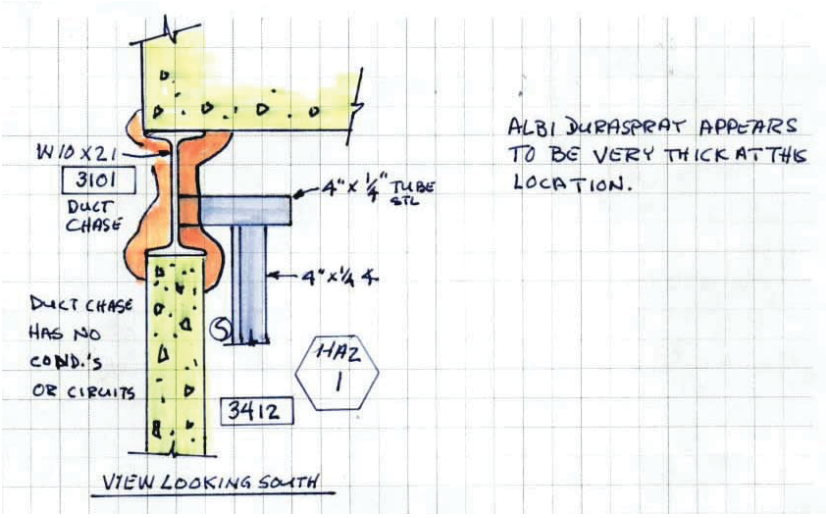
Room-Elevation: **3412-2016** **Building:** Control **Fire Area:** C-35

Description: Emergency Shower & Eyewash Area

Room Sketch:



HAZ #1 Sketch



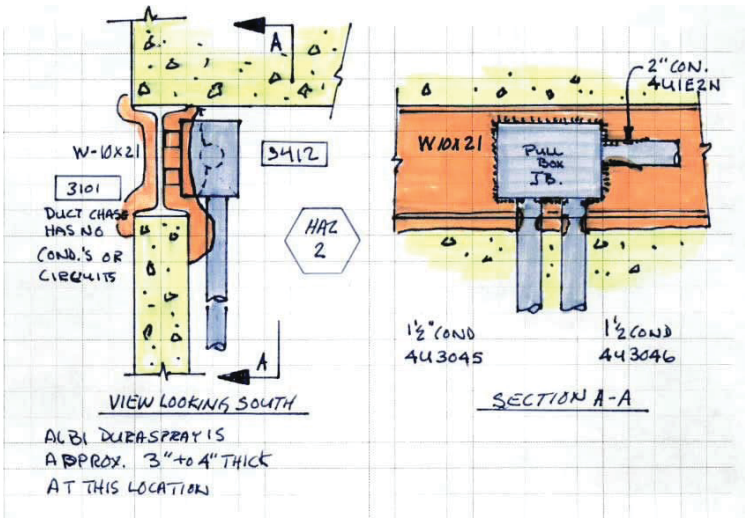
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

3412-2016

HAZ #2 Sketch



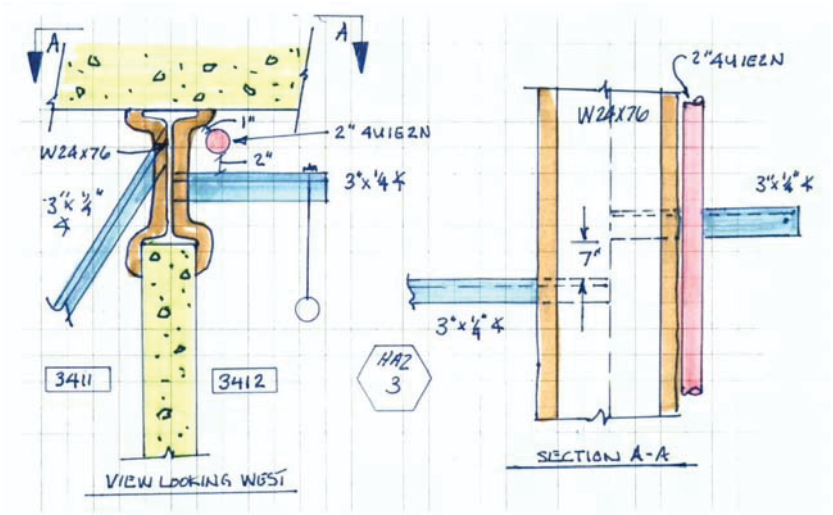
HAZ #2 Photo

Structural Steel Fireproofing Data

Appendix G5A

3412-2016

HAZ #3 Sketch



HAZ #3 Photo

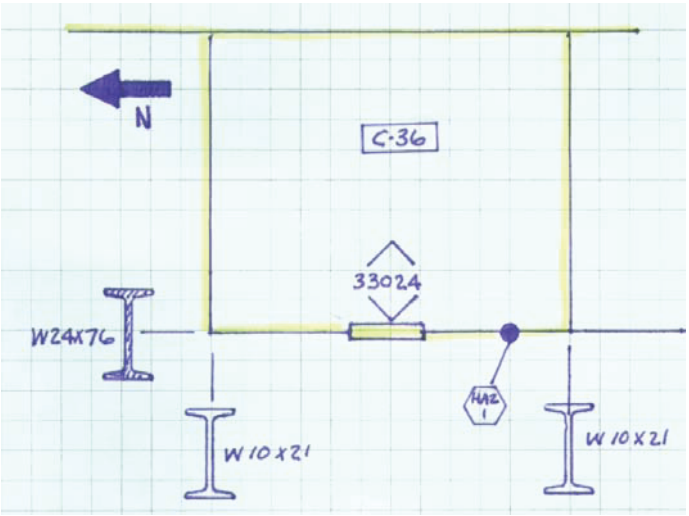
Structural Steel Fireproofing Data

Appendix G5A

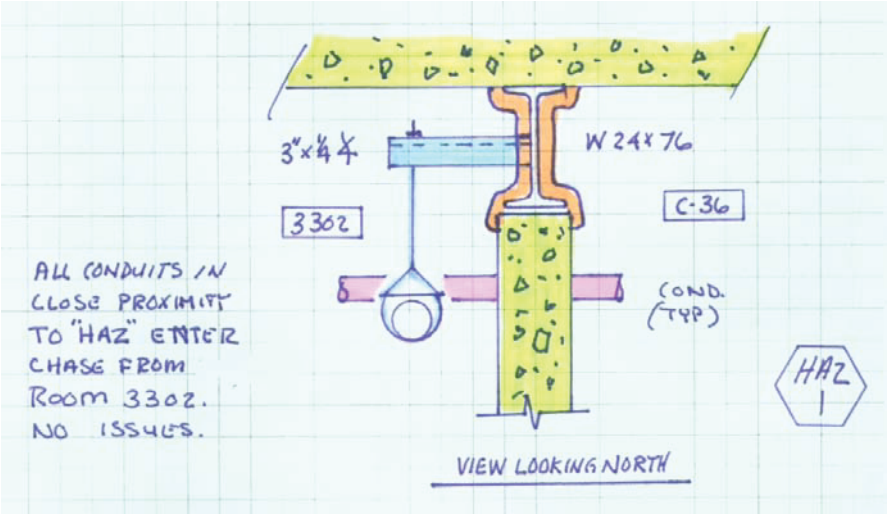
Room-Elevation: **C036-2000** **Building:** Control **Fire Area:** C-36

Description: Cable Chase @ CA-C6, 2000-0 to 2016-0,

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

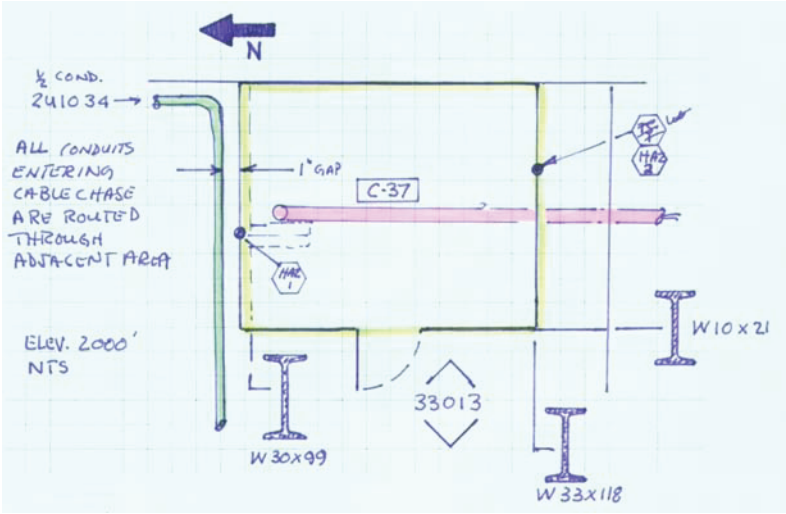
Structural Steel Fireproofing Data

Appendix G5A

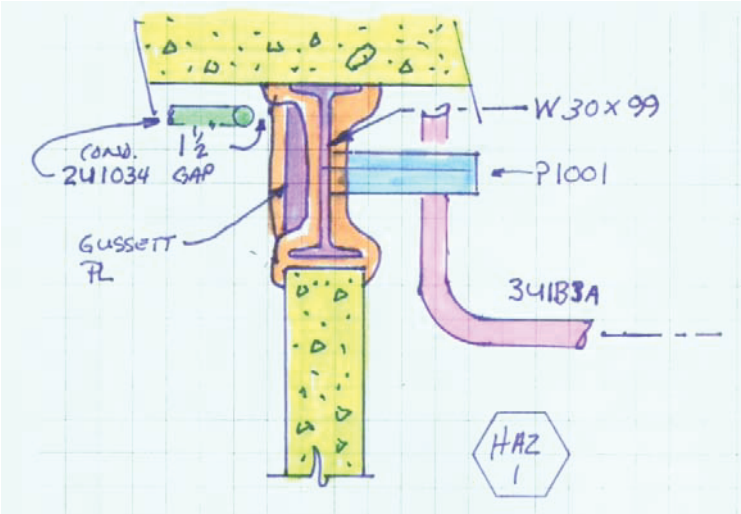
Room-Elevation: **C037-2000** **Building:** Control **Fire Area:** C-37

Description: Cable Chase @ CA-C3, 2000-0 to 2016-0

Room Sketch:



HAZ #1 Sketch



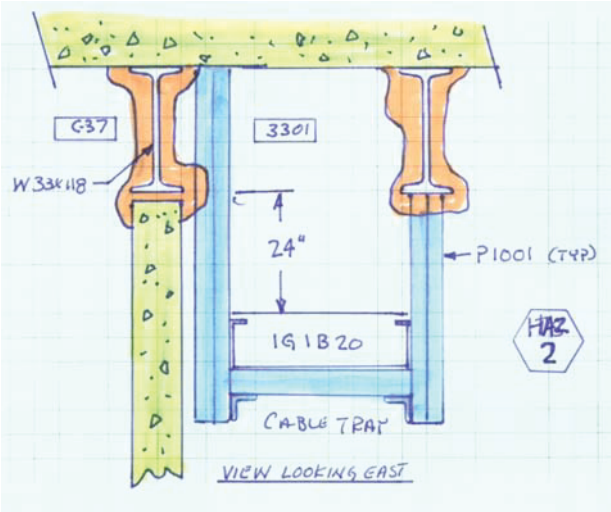
HAZ #1 Photo

Structural Steel Fireproofing Data

Appendix G5A

C037-2000

HAZ #2 Sketch



HAZ #2 Photo

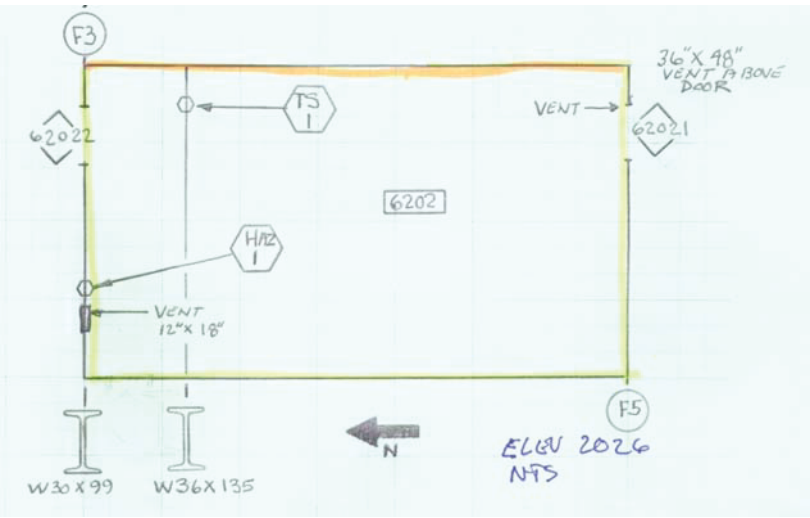
Structural Steel Fireproofing Data

Appendix G5A

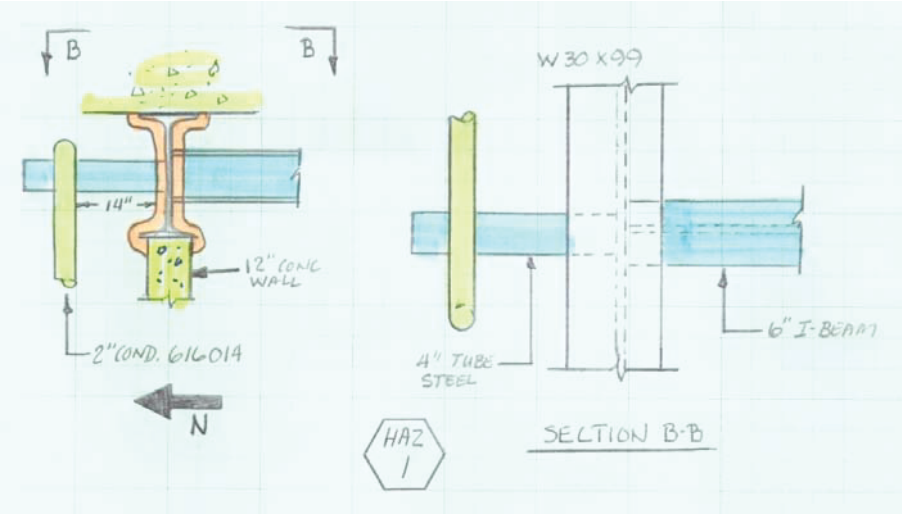
Room-Elevation: **6202-2026** **Building:** Fuel **Fire Area:** F-05

Description: Electrical Equipment Room

Room Sketch:



HAZ #1 Sketch



HAZ #1 Photo

Attachment H

Fire Protection Evaluations for Unique or
Unbounded Firestop and Cable Tray Cover Configurations

(There are currently no evaluations in this attachment)