PLC Professional Loss Control, Inc.

STRUCTURAL STEEL ANALYSIS

for

PEACH BOTTOM GENERATING STATION

Calculation No.24

Unit 2,3

Turbine Building El. 116'

Common Equipment Area

(Beneath Switchgear Rooms)

Fire Area 78B

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PEACH BOTTOM GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the Common Equipment Area on the 116'elevation of the Turbine Building (Fire Area 78B). The bounding walls are constructed of reinforced concrete with an average thickness of 3 ft. The total surface area for heat transfer is 9,552 ft^2 (see Attachment A for a sketch of the area under consideration).

2. COMBUSTIBLE LOADING

This area contains cable trays. The average loading in the cable trays is 8.93 lbs/ft^2 of cable tray surface area. The total surface area of cable trays in this area is 1,964 ft^2.

There are no combustible liquids in this area. Enclosed combustibles such as cabling in conduit have not been considered in this analysis.

3. VENTILATION PARAMETERS

There are 3 doors which enter this area.

Door Number	Size	Location
73	6'-4 1/2 x 3'-0"	West wall
134	6'-4 1/2 x 3'-0"	West wall
149	6'-4 1/2 x 3'-0"	West wall

There is an opening on the east side of this area which measures 117'-0" wide by 18'-0 1/2". In addition, there is a 6'-0" wide by 18'-0 1/2" opening in the north and south wall.

4. CASES EXAMNED

A spreading cable fire was assumed to originate in the area of heaviest cable concentration in order to present the worst case. The fire is assumed to start at a point source and spread horizontally along the cable trays in each direction at a rate of 10 ft. per hour and instantaneously up any vertical trays encountered. The fire will spread a distance of 15 feet in each direction along the cable trays before the original point source dies out after 89 minutes. A maximum surface area of 184 ft^2 of cable trays (see Attachment B for a list of trays) will be involved at any one time, which corresponds to a heat output of 3,235 kW. This heat output is assumed constant throughout the fire duration. The actual heat output as the fire spreads out of the area originally involved would be less since the quantity of cabling involved at any one time would be less.

5. RESULTS

The only case examined was that of a spreading cable fire occurring when one personnel door was open. The fire duration was taken to be 180 minutes. The maximum temperature reached was 717 ^{o}F, which is below the critical temperature for the structural steel (see Attachment for results of analysis.) Since the resulting fire was fuel controlled with one door open, it will also be fuel controlled if any additional doors are open.

The positions of cable trays relative to structural steel members were examined throughout the area in order to assess the potential for localized heating. Attachment D contains the results of calculations performed to determine the response of the affected structural members to localized heating. These calculations are conservative because they assume that the entire length of the member is subjected to the exposure temperature, whereas, in reality only a short section would be. The duration of each cable tray fire is taken to be 90 minutes which is the time required for a cable tray to burn to completion. The cable tray exposures and beam responses are tabulated as follows:

Case No.	Member Type	Exposure Temp. (°F)	Final Beam Temp. (°F)
1	W16x36	1500°F	1500
2	W12x27	1500°F	1500
3	W12x27	1300°F	1300
4	W16x36	1300°F	1300
5	Same as Case 1		
6	Same as Case 2		
7	Same as Case 2		
8	Same as Case 1		
9	Same as Case 3		
10	Same as Case 4		
11	Same as Case 3		
12	Same as Case 3		

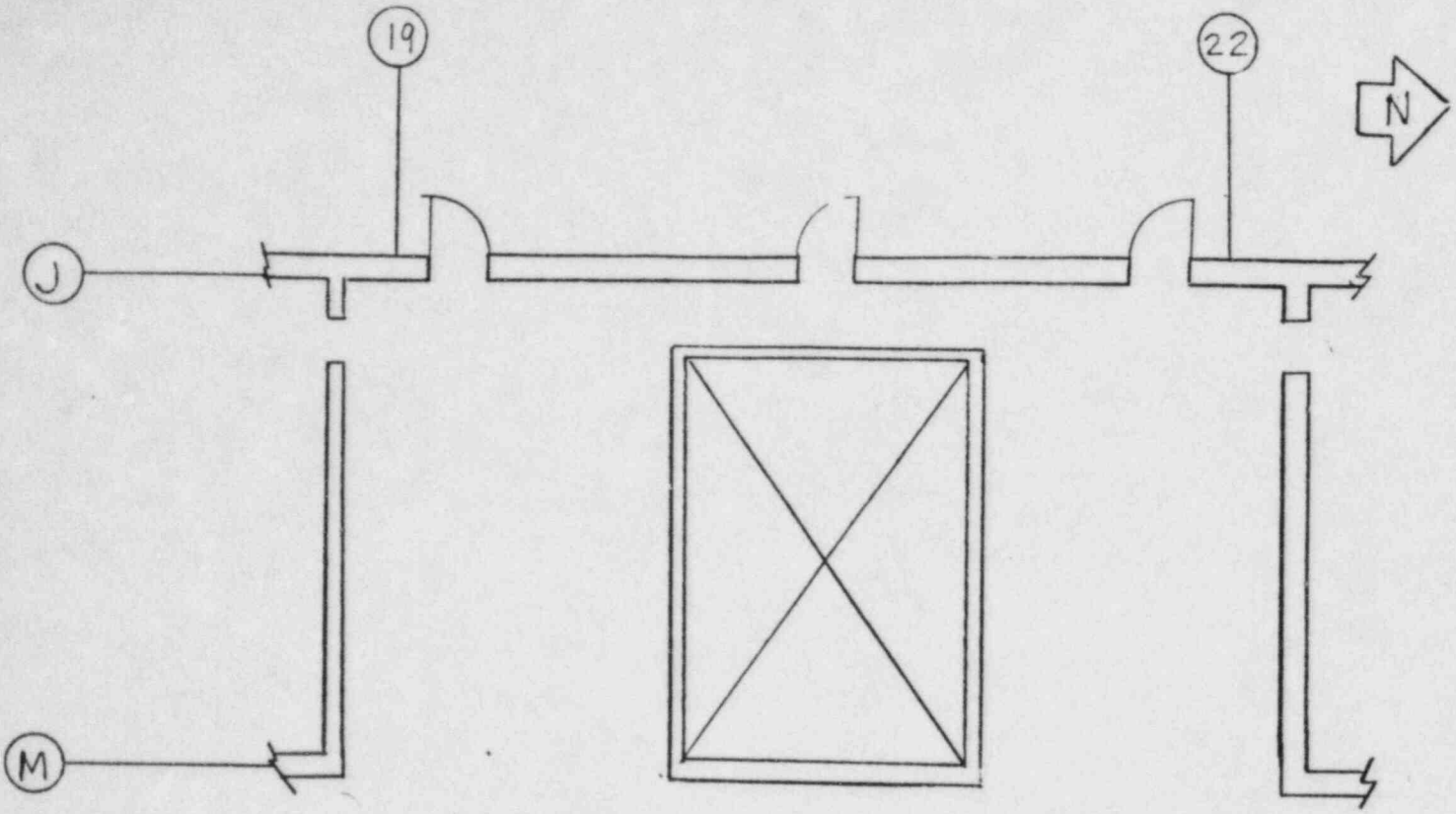
6. EFFECTS OF TRANSIENT COMBUSTIBLES

The worst case fire examined was fuel controlled with a duration of 180 minutes. The maximum additional heat release rate due to transient materials in the area which will result in an area temperature less than 1100°F is listed below.

Fire Duration	Q/A (kW/m^2)	Q(kW)
180	6.5	2,533

The distance between the floor and the deepest beams supporting the ceiling is 16'-8 1/2". The heat release rates required of floor level transient combustible fires to produce plume temperatures of 1100°F, 1300°F and 1500°F at the bottom flange of the beam have been determined and tabulated below. For the temperatures greater than 1100°F the time required to heat the sizes of the beams supporting the ceiling have also been determined.

		Time to 1100°F(min)		
T(°)	(kW)	W12 x 27	W16 x 36	W16 x 96
1100	7,257	-	-	-
1300	9,549	13	14	38
1500	12,042	9	10	26



Unit 2,3 Turbine Building, Elevation 116'-0"
Common Equipment Area

Surface Area Calculation

Walls		
North wall	(57' x 18')	1,026 ft^2
South wall	(57' x 18')	1,026 ft^2
West wall	(128' x 18')	2,304 ft^2
		4,356 ft^2
Ceiling	(128' x 57') - (50' x 42')	5,196 ft^2
Total Surface Area for Heat Transfer		9,552 ft^2

ATTACHMENT A

SPREADING CABLE FIRE TRAYS

Tray	Section	Width (Inches)	Length (Feet)	Surf. Area (Sq. Ft.)
2CH	010	12	24	24
2RH	040	6	24	12
2CK	010	14	24	28
2CH	030	18	12	18
2CF	057 & 058	30	6	15
2CJ	050	13	24	26
2RF	050	18	24	36
2CH	058	18	6	9
2CK	010	4	24	8
2CJ	050	4	24	8
				184 sq. ft.

ATTACHMENT B

CASE NO.: 1
BUILDING: PEACH BOTTOM TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 116' COMMON EQ. AREA (BENEATH SWGR. RM)
CASE DESCRIPTION: SPREADING CABLE FIRE

CEILING/WALL THICKNESS (FT.)	CEILING/WALL MATERIAL	Ao SQ. FT.	Ho FT.	Aw SQ. FT.	Q KW
3.0	CONCRETE	19.1	6.4	9552	3235

FIRE IS FUEL CONTROLLED

FIRE DURATION (MIN.)	GAS TEMPERATURE (DEG. F)
10	522
20	538
30	552
40	565
50	578
60	590
70	601
80	613
90	624
100	635
110	646
120	656
130	667
140	677
150	687
160	697
170	707
180	717

FIRE NO.: 1
BUILDING: PEACH BOTTOM TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 116' COMMON EQ. AREA (BENEATH SWGR. RM)
CASE DESCRIPTION: W12X27

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (DEG. F): 1300
WEIGHT OF STEEL MEMBER (LBS./FT.): 27
SURFACE OF STEEL MEMBER HEATED (SQ. FT./FT): 4.12

TIME (MIN.)	STEEL TEMPERATURE (DEG. F)
5	811
10	1106
15	1223
20	1269
25	1288
30	1295
35	1298
40	1299
45	1300
50	1300
55	1300
60	1300
65	1300
70	1300
75	1300
80	1300
85	1300
90	1300

CASE NO.: 2
BUILDING: PEACH BOTTOM TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 116' COMMON EQ. AREA
CASE DESCRIPTION: W12X27

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (DEG. F): 1500
WEIGHT OF STEEL MEMBER (LBS./FT.): 27
SURFACE OF STEEL MEMBER HEATED (SQ. FT./FT): 4.12

TIME (MIN.)	STEEL TEMPERATURE (DEG. F)
5	932
10	1275
15	1411
20	1465
25	1486
30	1494
35	1498
40	1499
45	1500
50	1500
55	1500
60	1500
65	1500
70	1500
75	1500
80	1500
85	1500
90	1500

CASE NO.: 3
BUILDING: PEACH BOTTOM TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 116' COMMON EQ. AREA
CASE DESCRIPTION: W16X36

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (DEG. F): 1300
WEIGHT OF STEEL MEMBER (LBS./FT.): 36
SURFACE OF STEEL MEMBER HEATED (SQ. FT./FT): 4.28

TIME (MIN.)	STEEL TEMPERATURE (DEG. F)
5	647
10	954
15	1117
20	1203
25	1248
30	1273
35	1286
40	1292
45	1296
50	1298
55	1299
60	1299
65	1300
70	1300
75	1300
80	1300
85	1300
90	1300

CASE NO.: 4
BUILDING: PEACH BOTTOM TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 116' COMMON EQ. AREA
CASE DESCRIPTION: W16X36

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (DEG. F): 1500
WEIGHT OF STEEL MEMBER (LBS./FT.): 36
SURFACE OF STEEL MEMBER HEATED (SQ. FT./FT): 4.28

TIME (MIN.)	STEEL TEMPERATURE (DEG. F)
5	741
10	1098
15	1287
20	1387
25	1440
30	1468
35	1483
40	1491
45	1495
50	1497
55	1499
60	1499
65	1500
70	1500
75	1500
80	1500
85	1500
90	1500