

PLC Professional Loss Control, Inc.

STRUCTURAL STEEL ANALYSIS
for
LIMERICK GENERATING STATION

Unit 1
Reactor Building El. 217'
General Floor Area
Fire Area 44

November 1, 1983

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LIMERICK GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the general floor area on the 217' elevation of the Unit 1 Reactor Building (Fire Area 44). The heaviest combustible loading encountered on this elevation is found in the northeast corner. The area of heaviest combustible loading is bounded by column lines 19.4 & 23 and J & Fb (see Attachment A for a sketch of the area under consideration). The bounding walls in the area are of reinforced concrete with an average thickness of 3 ft. The total surface area for heat transfer is 11,309 ft² (see Attachment A for calculation of areas).

2. COMBUSTIBLE LOADING

The heaviest concentration of cabling found within this area was centered along column line 21.5. The average combustible loading of the cable trays in this area is 3.2 lb/ft² of tray surface area. There are no combustible liquids in this area. Enclosed combustibles are not included in the combustible loading.

3. VENTILATION PARAMETERS

The area under consideration is open to the remainder of this elevation on its south side. This opening is approximately 13 ft. wide by 35 ft. high.

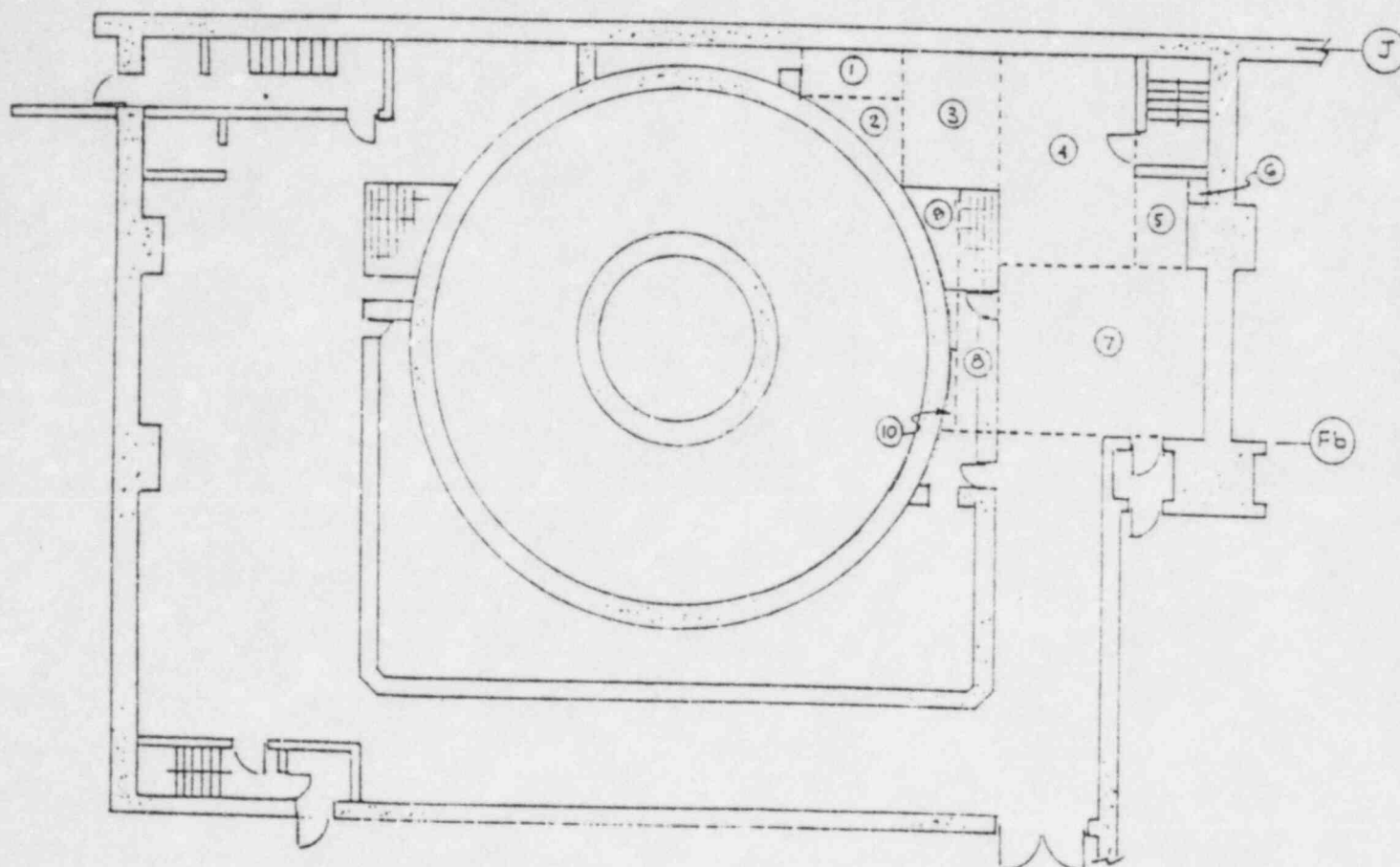
4. CASES EXAMINED

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. The fire will spread along all of the horizontal cable trays intersecting the point source for a distance of 5 feet in each direction before the original point source dies out after 32 minutes. A maximum surface area of 186 ft² 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 3284 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 that would be involved at any one time would be less.

5. RESULTS

The fire duration was taken to be 180 minutes and the fire temperature reached after 3 hours was 508°F which is below the critical temperature for the structural steel (see Attachment C for results of analysis). Since the fire was assumed to occur in the area of heaviest combustible loading, the results are considered to be representative for the entire general floor area on the 217' elevation of the Reactor Building.

The location of cable trays relative to structural steel members were examined throughout the 217' elevation of the Reactor Building in order to assess the potential for localized heating. No cable trays were positioned so as to present a localized heating exposure to structural steel.



Unit 1 Safeguard Systems El. 217' Northeast Corner

Surface Area Calculation

<u>Walls</u>		
North wall	(51' x 34.5')	1759.5 ft ²
North wall stairway	(8' x 34.5')	276 ft ²
East wall stairway	(18' x 34.5') - (3' x 7' door)	600 ft ²
West wall (H to Fb)	(51' x 24')	1224 ft ²
East wall (stairway to Fb)	(55' + 2' x 3') x 34.5'	2104.5 ft ²
South wall at H	(13' x 24')	312 ft ²
South wall at Fb	(10.5' x 34.5') - (3' x 7' door)	341 ft ²
Drywell to Fb	(30.5' x 34.5') + (51' x 24')	2276 ft ²
		<u>8893 ft²</u>

<u>Ceiling</u>		
Area 1	(5' x 24')	120 ft ²
Area 2	$1/2 (24' \times 19') - 42 \text{ ft}^2$	186 ft ²
Area 3	(24' x 13')	312 ft ²
Area 4	(31' x 16')	496 ft ²
Area 5	(13' x 5')	65 ft ²
Area 6	(4' x 3')	12 ft ²
Area 7	(21' x 42')	882 ft ²
Area 8	(49' x 5')	245 ft ²
Area 9	$1/2(28' \times 8') - 42 \text{ ft}^2$	70 ft ²
Area 10	$1/2(21' \times 4') - 14 \text{ ft}^2$	28 ft ²
		<hr/>
		2416 ft ²
Total Surface Area for Heat Transfer		11,309 ft ²

The following cable trays are present in the area defined for the source fire and all of the trays are assumed to be burning simultaneously:

Tray No.	Width (in)	Length (ft)	Surface Area (ft ²)
1BCTA70	24"	17'	34
1BCVA70	24"	17'	34
1BCVA70	24"	17'	34
1BCWA70	24"	10'	20
10CRA63	24"	6'	12
10CRA62	24"	4'	8
10IWA63	24"	8'	16
10IXA62	24"	2'	4
10IWA62	24"	2'	4
10IXA70	24"	10'	20
			186 ft ²

Average Combustible Loading per Tray Surface Area = 3.2 lb/ft²

Fire Duration for Free Burning Tray Fires =

$$3.2 \text{ lb/ft}^2 \div \frac{0.1 \text{ lb}}{\text{ft}^2/\text{min}} = 32 \text{ minutes}$$

Heat output with all trays in source fire area (above) burning simultaneously:

$$\frac{186 \text{ ft}^2}{10.76 \text{ ft}^2/\text{m}^2} \times 190 \text{ kW/m}^2 = 3284 \text{ kW}$$

CASE NUMBER: 1
 BUILDING: UNIT 1 REACTOR BUILDING
 ELEVATION AND AREA DESCRIPTION: 217' GENERAL FLOOR AREA
 CASE DESCRIPTION: SPREADING CABLE FIRE

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	A ₀ (ft ²)	H ₀ (ft)	A ₄ (ft ²)	Q (kW)
3.0	CONCRETE	452	35	11309	3284

FIRE IS FUEL CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
10	175
20	217
30	250
40	277
50	302
60	324
70	344
80	362
90	380
100	397
110	412
120	428
130	442
140	456
150	470
160	483
170	495
180	508