

PLC *Professional Loss Control, Inc.*

STRUCTURAL STEEL ANALYSIS
for
LIMERICK GENERATING STATION

Control Structure El. 304'

Fan Room

Fire Zone 27

December 20, 1983

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LIMERICK GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the Fan Room on the 304' elevation of the Control Structure (Fire Area 27). The bounding walls in the area are of reinforced concrete with an average thickness of 2 ft. The total surface area for heat transfer is 17,071 ft² (see Attachment A for sketch and calculation of areas).

2. COMBUSTIBLE LOADING

Combustible loading in the area consists of cable insulation located in cable trays. Total cable tray surface area is 748 ft². The average combustible loading of the cable trays is 3.6 lbs/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

Five doors serve this area, four measuring 3' x 7' and one measuring 9' x 10'. Two 3' x 7' doors are located in the north wall, one is located in the east wall while the fourth door is located in the west wall. The 9' x 10' door is also located in the west wall.

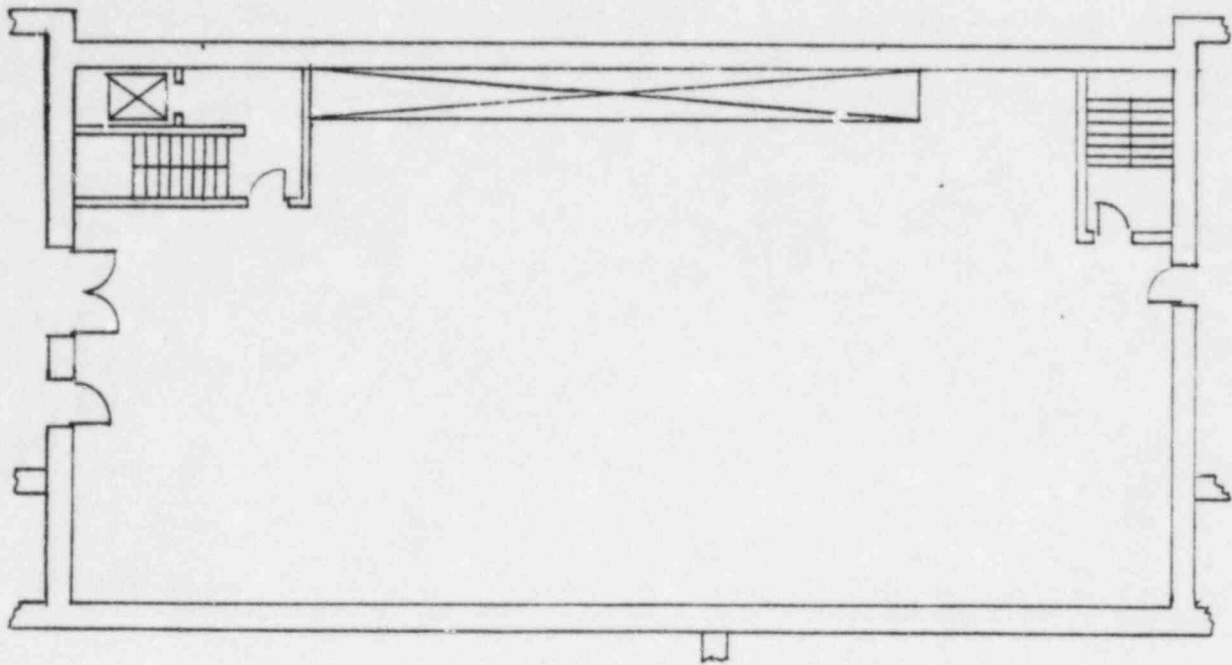
4. CASES EXAMINED

With the light combustible loading in this area, the assumption that all cables are burning simultaneously would present the worst case. With all cable trays burning, a surface area of 748 ft² would be involved (see Attachment B for a list of trays). Three cases were examined; the first case involving a ventilation opening of 21 ft², one 3' x 7' door open. The second case examined involved a ventilation opening of 42 ft², two 3' x 7' doors open. The third case examined involved a ventilation opening of 63 ft², three 3' x 7' doors open.

5. RESULTS

For the three cases examined, all cable trays in the area are burning simultaneously. In the first case, a gas temperature of 374°F was achieved after 105 minutes. In the second case, a gas temperature of 506°F was achieved after 54 minutes. In the third case, a gas temperature of 591°F

was achieved after 36 minutes (see Attachment C for results of all three analysis). All three temperatures are below the critical temperature for the structural steel. The cable trays in the area were positioned so as to not present a localized heating exposure to the structural steel.



Control Structure El. 304'
Fan Room Fire Zone 27

Surface Area Calculation

Walls

North wall	(27' x 129')	3483 ft ²
East wall	(27' x 58')	1566 ft ²
South wall	(27' x 129')	3483 ft ²
West wall	(27' x 58')	1566 ft ²
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		10,098 ft ²

Ceiling

Area 1	(58' x 129') - [(21' x 17') + (8' x 19')]	<hr/> 6973 ft ²
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Total Surface Area for Heat Transfer		17,071 ft ²
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The following cable trays are assumed to be burning simultaneously.

Tray No.	Width (in.)	Length (ft.)	Surface Area (ft ²)
1DCKM01	24	2	4
1DCKM02	24	5	10
1DCKM03	24	17	34
1DCKM04	24	13	26
1DCKM05	24	13	26
1DCKM06	24	25	50
1DCKM07	24	37	74
1DCKM08	24	23	46
1DCKM09	24	9	18
1CCKM02	24	4	8
1CCKM03	24	10	20
1CCKM04	24	13	26
1CCKM05	24	9	18
1CCKM06	24	12	24
1CCKM07	24	9	18
1CCKM08	24	7	14
1CCKM09	24	23	46
1CCKM10	24	5	10
1OCGF01	24	17	34
1OCGF03	24	10	20
1OCGF04	24	12	24
1OCGF05	24	2	4
1OCGF06	24	17	34
1OCGF07	24	17	34
1OCGF08	24	24	48
1OCGF09	24	31	62
1OCGF10	24	8	16
			<u>748 ft²</u>

Average combustible loading per tray surface area = 3.6 lbs/ft²

Fire duration for free burning tray fires = $3.6 \text{ lbs/ft}^2 \div \frac{.1 \text{ lb}}{\text{ft}^2/\text{min}} = 36 \text{ mins.}$

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

$$\frac{748 \text{ ft}^2}{10.76 \text{ ft}^2/\text{m}^2} \times 190 \text{ kW/m}^2 = 13,208 \text{ kW}$$

ATTACHMENT B

CASE NUMBER: 1
 BUILDING: CONTROL STRUCTURE
 ELEVATION AND AREA DESCRIPTION: FAN ROOM EL 304'
 CASE DESCRIPTION: ONE 3'x7' DOOR OPEN ALL CABLES BURNING

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Ho (ft)	Aw (ft2)	Q (kW)
2.0	CONCRETE	21.0	7.0	17071	4504

FIRE IS VENTILATION CONTROLLED

FIRE DURATION
(min)

GAS TEMPERATURE
(deg.F)

5	138
10	166
15	186
20	204
25	220
30	234
35	247
40	259
45	270
50	281
55	291
60	301
65	310
70	319
75	327
80	336
85	344
90	352
95	360
100	367
105	374

CASE NUMBER: 2
 BUILDING: CONTROL STRUCTURE
 ELEVATION AND AREA DESCRIPTION: FAN ROOM EL 304'
 CASE DESCRIPTION: TWO 3'x7' DOORS OPEN ALL CABLES BURNING

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Ho (ft)	Aw (ft2)	Q (kw)
2.0	CONCRETE	42.0	7.0	17071	9008

FIRE IS VENTILATION CONTROLLED

FIRE DURATION
(min)

GAS TEMPERATURE
(deg.F)

2	156
4	191
6	217
8	239
10	259
12	277
14	293
16	308
18	323
20	336
22	349
24	361
26	373
28	384
30	395
32	406
34	416
36	426
38	436
40	445
42	454
44	463
46	472
48	481
50	489
52	498
54	506

CASE NUMBER: 3
 BUILDING: CONTROL STRUCTURE
 ELEVATION AND AREA DESCRIPTION: FAN ROOM EL 304'
 CASE DESCRIPTION: THREE 3'x7' DOORS OPEN ALL CABLES BURNING

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Ho (ft)	Aw (ft2)	Q (kW)
2.0	CONCRETE	63.0	7.0	17071	13208

FIRE IS FUEL CONTROLLED

FIRE DURATION
(min)

GAS TEMPERATURE
(deg.F)

2	196
4	246
6	285
8	317
10	346
12	372
14	396
16	418
18	439
20	459
22	478
24	496
26	513
28	530
30	546
32	562
34	577
36	591