

PLC *Professional Loss Control, Inc.*

STRUCTURAL STEEL ANALYSIS

for

LIMERICK GENERATING STATION

Unit 1 Turbine Building El. 239'

Feedwater Heater Room Room 441

Fire Area 88B

January 4, 1984

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LIMERICK GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the Feedwater Heater Room, Room 441, on the 239' elevation of the Unit 1 Turbine Building (Fire Area 88B). The bounding walls of the area are of reinforced concrete and concrete masonry unit construction with an average thickness of 2 ft. The total surface area for heat transfer is 5048 ft² (see Attachment A for sketch and calculation of surface areas).

2. COMBUSTIBLE LOADING

Combustible loading in the area consists of five vertical cable trays located along the west wall of the room. The total surface area of the cable trays is 208 ft² with an average combustible loading of 3 lbs/ft² of cable tray surface area. There are no combustible liquids in this area.

3. VENTILATION PARAMETERS

There are two doors which enter this area, both measuring 3' wide by 7' high. One door is located in the south wall, the other in the north wall.

4. CASES EXAMINED

With the light combustible loading in the area, the assumption that all cables are burning simultaneously would present the worst case. With all cable trays burning, a surface area of 208 ft² would be involved. This corresponds to a heat output of approximately 3765 kW. With all cables assumed to burning simultaneously, the duration of the fire would be

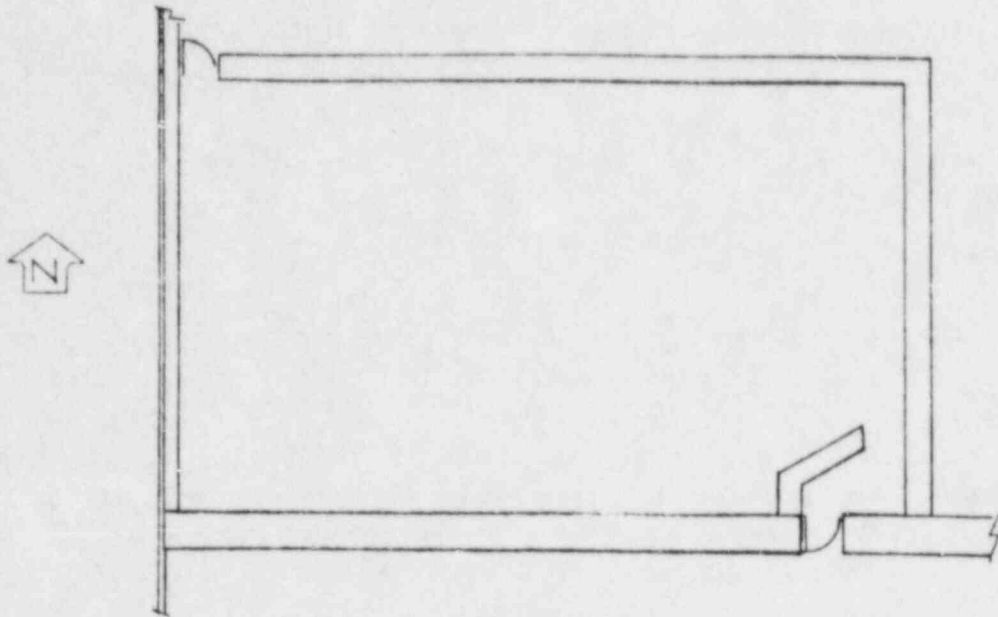
$$3 \text{ lbs/ft}^2 \div \frac{.1 \text{ lbs}}{\text{min/ft}^2} = 30 \text{ minutes}$$

5. RESULTS

With all cable trays in the area burning simultaneously and one door open, the resulting fire was fuel controlled. A gas temperature of 529°F would be achieved after 30 minutes which is below the critical temperature of the structural steel members (see Attachment B).

The position of cable trays relative to structural members was examined throughout the area to assess the potential for localized heating. Cable trays were located within 12 inches of member types W24X68 and G1(W24X293).

Attachment C contains the results of the calculations performed to determine the response of the structural steel members to localized heating. These calculations are conservative because they assume that the entire length of the structural steel members is subjected to a temperature of 1300°F when in actuality only a small section of the steel would be subjected to localized heating. As can be seen from the results, none of the members exceeded the single point failure temperature of 1300°F during the 30 minute exposure period (time required for tray to burn to completion).



Unit 1 Turbine Building El. 239'
Feedwater Heater Room 441

Surface Area Calculation

<u>Walls</u>		
North wall	(60' x 16')	960 ft ²
South wall	(60' x 16')	960 ft ²
East wall	(34' x 16')	544 ft ²
West wall	(34' x 16')	544 ft ²
		<u>3008 ft²</u>
<u>Ceiling</u>	(34' x 60')	<u>2040 ft²</u>
Total Surface Area for Heat Transfer		5048 ft ²

CASE NUMBER: 1
 BUILDING: UNIT 1 TURBINE BUILDING
 ELEVATION AND AREA DESCRIPTION: 239' FEEDWATER HEATER ROOM 441
 CASE DESCRIPTION: ONE 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	5048	3765

FIRE IS FUEL CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
2	191
4	240
6	277
8	308
10	336
12	361
14	384
16	406
18	426
20	445
22	463
24	481
26	497
28	513
30	529

CASE NUMBER: 1
BUILDING: UNIT 1 TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 239' FEEDWATER HEATER ROOM 441
CASE DESCRIPTION: LOCALIZED HEATING OF MEMBER TYPE W24x68

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (deg. F): 1300
WEIGHT OF STEEL MEMBER (lbs./ft): 68
SURFACE OF STEEL MEMBER HEATED (sq.ft./ft): 6.06

TIME (min.)	STEEL TEMPERATURE (deg.F)
5.00	502
10.00	783
15.00	965
20.00	1083
25.00	1159
30.00	1209

CASE NUMBER: 2
BUILDING: UNIT 1 TURBINE BUILDING
ELEVATION AND AREA DESCRIPTION: 239' FEEDWATER HEATER ROOM 441
CASE DESCRIPTION: LOCALIZED HEATING OF MEMBER TYPE G1(W24x293)

EFFECTS OF LOCAL HEATING ON STRUCTURAL STEEL

FIRE TEMPERATURE (deg. F): 1300
WEIGHT OF STEEL MEMBER (lbs./ft): 293
SURFACE OF STEEL MEMBER HEATED (sq.ft./ft): 7.37

TIME (min)	STEEL TEMPERATURE (deg.F)
5.00	190
10.00	301
15.00	400
20.00	489
25.00	570
30.00	642