PLC Professional Loss Control, Inc.

STRUCTURAL STEEL ANALYSIS

for

LIMERICK GENERATING STATION

Unit 1 Reactor Building El. 177'

Core Spray Pump Room 110

Fire Area 35

December 20, 1983

P. O. Box 446 • Oak Ridge, Tennessee 37830 • (615) 482-3541

LIMERICK GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the Core Spray Pump Room, Room 110, on the 177' elevation of the Unit 1 Reactor Building (Fire Area 35) (see Attachment A for sketch of area). The bounding walls in the area are of reinforced concrete construction with an average thickness of 3 ft. The total surface area for heat transfer is 2749 ft^2 (see Attachment A for calculation of areas).

2. COMBUSTIBLE LOADING

Combustible loading in the area consists of 24 gallons of lubricating oil contained in the core spray pump. For the analysis this quantity was doubled to account for possible maintenance activities in the area. A single cable tray having 37 ft^2 of surface area with an average combustible loading of .5 lbs/ft^2 of tray surface area.

3. VENTILATION PARAMETERS

A single watertight door measuring 3' wide by 5'10" high is located in the west wall of the room.

4. CASES EXAMINED

A lube oil fire was assumed in the area involving 48 gallons of lubricating oil. The door entering the area was assumed to be open. This is an opening area of 17.5 ft^2 which results in a ventilation controlled maximum heat output of 3426 kW.

5. RESULTS

With one door open, the resulting ventilation controlled heat output of 3426 kW will consume the 48 gallons of lube oil in 37 minutes. The gas temperature at this time would be 920°F which is below the critical temperature of the structural steel (see Attachment B).

The ventilation controlled burning rate of 3426 kW is equivalent to the heat output from a pool fire with an area of 11 ft^2 (pool diameter of approximately 4 ft). In order to assess the effect of the plume of heated

gases above the pool fire on the structural steel located above the fire, Hesketad's (1) relation will be used:

Virtual point source determination:

$Z_o = -1.02D + .083\ Q^{.4} = 1.01$ m

Plume temperature at bottom of steel supporting the room ceiling:

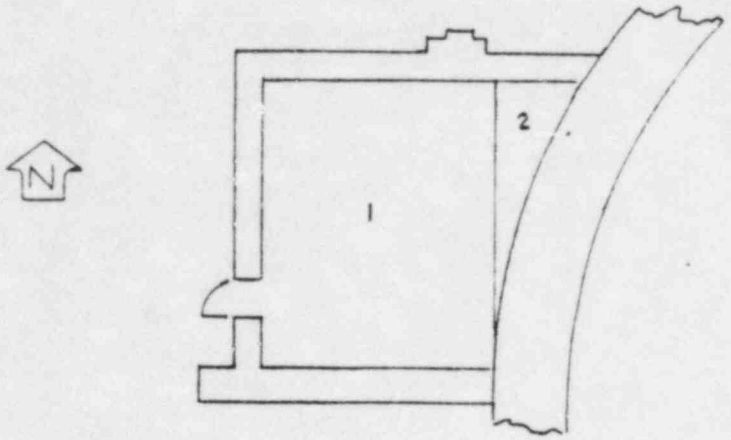
$\Delta T_o = 9.1[T_\infty/(gc_p^2\rho_\infty^2)]^{.333}\ Q_c^{.667}\ (Z - Z_o)^{-1.67}$

$\Delta T_o = 282°K$ temperature rise

$T = 576°F$ temperature of fire plume

The plume temperature is below the critical temperature of the structural steel. It is concluded that there is no problem due to localized heating of the structural steel as a result of the maximum pool fire that can be supported by the available air flow into the room.

The cable tray in the area was positioned such that it did not present a localized heating exposure to the structural steel.



Unit 1 Reactor Building
Core Spray Pump Room 110

Surface Area Calculation

Walls		
North wall	(27' x 23')	621 ft^2
South wall	(20' x 23')	460 ft^2
East wall	(24' x 23')	552 ft^2
West wall	(24' x 23')	552 ft^2
		2185 ft^2
Ceiling		
Area 1	(20' x 24')	480 ft^2
Area 2	1/2(24' x 7')	84 ft^2
Total Surface Area for Heat Transfer		2749 ft^2

ATTACHMENT A

CASE NUMBER: 1
BUILDING: UNIT 1 REACTOR BUILDING
ELEVATION AND AREA DESCRIPTION: 177' CORE SPRAY ROOM 110
CASE DESCRIPTION: ONE DOOR OPEN LUBE OIL FIRE

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Ho (ft)	Aw (ft2)	Q (kW)
3.0	CONCRETE	17.5	5.8	2749	3426

FIRE IS VENTILATION CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
1	213
2	270
3	314
4	352
5	384
6	414
7	441
8	467
9	491
10	513
11	535
12	555
13	575
14	594
15	612
16	630
17	647
18	663
19	680
20	695
21	711
22	726
23	740
24	755
25	769
26	783
27	796
28	809
29	822
30	835
31	848
32	860
33	873
34	885
35	896
36	908
37	920