PLC Professional Loss Control, Inc.

STRUCTURAL STEEL ANALYSIS

for

LIMERICK GENERATING STATION

Unit 1 Reactor Building El. 177'

Core Spray Pump Room 113

Fire Area 36

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 113, on the 177' elevation of the Unit 1 Reactor Building (Fire Area 36) (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 2976 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 34 ft^2 of surface area with an average combustible loading of .5 lbs/ft^2 of tray surface area is located along the north wall.

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 3424 kW.

5. RESULTS

With one door open, the resulting ventilation controlled heat output of 3424 kW will consume the 48 gallons of lube oil in 37 minutes. The gas temperature at this time would 853°F which is below the critical temperature of the structural steel (see Attachment B).

The ventilation controlled burning rate of 3424 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:

$Z_0 = -1.02D + .083\ Q^{.4} = 1.01$ m

Plume temperature at bottom of steel supporting the room ceiling:

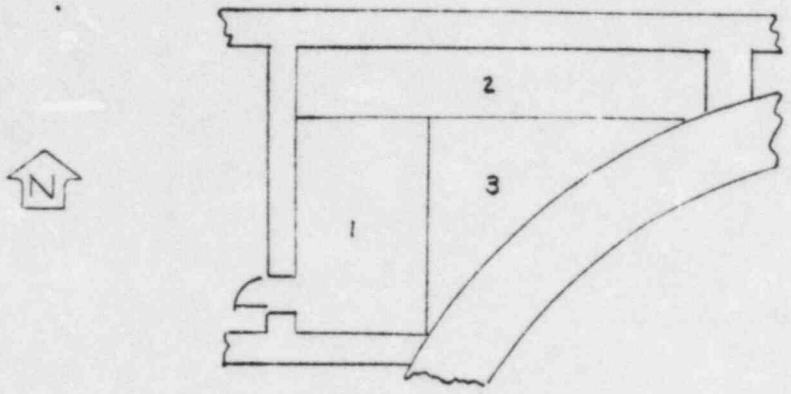
$\Delta T_0 = 9.1[T_\infty / (gc_p^2 \rho_\infty^2)]^{.333}\ Q_c^{.667}\ (Z - Z_0)^{-1.67}$

$\Delta T_0 = 282°K$ 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 113

Surface Area Calculation

Walls		
North wall	(34' x 23')	782 ft^2
South wall	(40' x 23')	920 ft^2
East wall	(5' x 23')	115 ft^2
West wall	(24' x 23')	552 ft^2
		2369 ft^2
Ceiling		
Area 1	(11' x 19')	209 ft^2
Area 2	(34' x 5')	170 ft^2
Area 3	1/2(24' x 19')	228 ft^2
Total Surface Area for Heat Transfer		2976 ft^2

ATTACHMENT A

CASE NUMBER: 1
BUILDING: UNIT 1 REACTOR BUILDING
ELEVATION AND AREA DESCRIPTION: 177' CORE SPRAY ROOM 113 FIRE AREA 36
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	2976	3417

FIRE IS VENTILATION CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
1	202
2	255
3	295
4	330
5	360
6	387
7	412
8	436
9	458
10	478
11	498
12	517
13	535
14	553
15	570
16	586
17	602
18	617
19	632
20	646
21	661
22	674
23	688
24	701
25	714
26	727
27	739
28	751
29	763
30	775
31	787
32	798
33	810
34	821
35	832
36	842
37	853