PLC *Professional Loss Control, Inc.*

STRUCTURAL STEEL ANALYSIS

for

LIMERICK GENERATING STATION

Unit 1 Reactor Building El. 177'

Core Spray Pump Room 114

Fire Area 37

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 114, on the 177' elevation of the Unit 1 Reactor Building (Fire Area 37) (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 2784 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 is located along the east wall.

3. VENTILATION PARAMETERS

A single watertight door measuring 3' wide by 5'10" high is located in the east 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 909°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) relations 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:

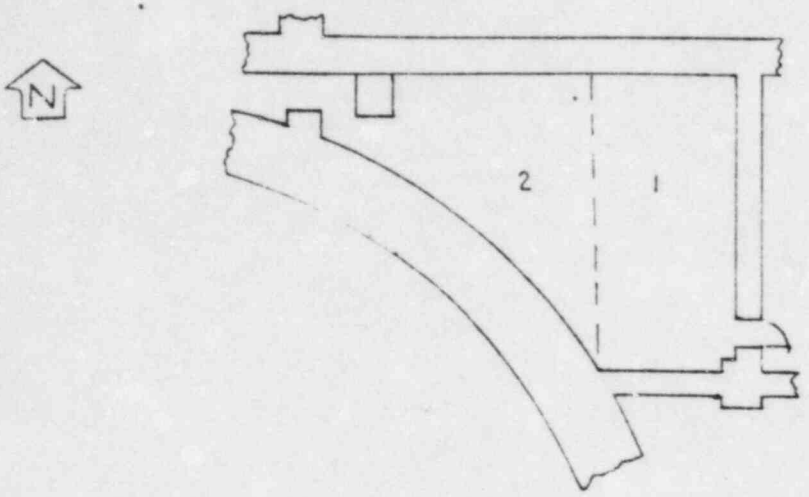
$\Delta T_o = 9.1[T_\infty / (gc_p^2 \rho_\infty^2)]^{.333}\ Q_c^{.667}\ (Z - Z_o)^{-1.67}$

$\Delta T_o = 282°K$ 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 114

Surface Area Calculation

Walls		
North wall	(29' x 23')	667 ft^2
South wall	(12' x 23')	276 ft^2
East wall	(25' x 23')	575 ft^2
West wall	(30' x 23')	690 ft^2
		2208 ft^2
Ceiling		
Area 1	(10' x 24')	240 ft^2
Area 2	1/2(24' x 28')	336 ft^2
Total Surface Area for Heat Transfer		2784 ft^2

ATTACHMENT A

CASE NUMBER: 1
BUILDING: UNIT 1 REACTOR BUILDING
ELEVATION AND AREA DESCRIPTION: 177' CORE SPRAY PUMP ROOM ROOM 114
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	2784	3426

FIRE IS VENTILATION CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
1	211
2	268
3	311
4	348
5	380
6	410
7	437
8	462
9	485
10	508
11	529
12	549
13	568
14	587
15	605
16	623
17	640
18	656
19	672
20	688
21	703
22	718
23	732
24	746
25	760
26	774
27	787
28	800
29	813
30	826
31	838
32	850
33	862
34	874
35	886
36	898
37	909