PLC *Professional Loss Control, Inc.*

STRUCTURAL STEEL ANALYSIS

for

LIMERICK GENERATING STATION

Unit 1 Reactor Building El. 177'

RHR Heat Exchanger and Pump Room - Room 102

Fire Area 32

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LIMERICK GENERATING STATION

1. AREA DESCRIPTION

The area under consideration is the RHR Heat Exchanger and Pump Room, Room 102, on the 177' elevation of the Unit 1 Reactor Building (Fire Area 32) (see Attachment A for sketch of area). The bounding walls of the area are of reinforced concrete construction with an average thickness of 3 ft. The total surface area for heat transfer is 7848 ft^2 (see Attachment A for calculation of areas).

2. COMBUSTIBLE LOADING

Combustible loading in the area consists of 72 gallons of lubricating oil contained in the RHR pump motors. For the analysis this quantity was doubled to account for possible maintenace activities in the area. There are two cable trays in the room - one located along the east wall, the other along the west wall. The total surface area of the cable trays is 52 ft^2 with an average combustible loading of 1.5 lbs/ft^2 of cable tray surface.

3. VENTILATION PARAMETERS

There are four doors which enter the area. Two watertight doors measuring 3' wide by 5'10" high enter the area on the 177' elevation and two steamtight doors measuring 3' wide by 7' high enter the area on the 201' elevation.

4. CASES EXAMINED

Two cases were examined, each assuming a lube oil fire involving 144 gallons of lubricating oil. Case number one assumed the lube oil fire with one steamtight door open and case number two assumed both steamtight doors open.

5. RESULTS

Case number one considered only one 3' x 7' door open which corresponds to a ventilation controlled heat output of 4504 kW. At this heat output the fire would consume the 144 gallons of lube oil in 85 minutes. The gas temperature at this time would be 664°F, which is below the critical temperature of the structural steel (see Attachment B).

The ventilation controlled burning rate of 4504 kW is equivalent to the heat output from a pool fire with an area of 14 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 supporting the intermediate grating at the 201' elevation, Hesketad's relations will be used:

Virtual point source determination:

$Z_o = -1.02D + .083\ Q^{.4} = 1.09$ m

Plume temperature at bottom of structural steel supporting intermediate grating.

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

$\Delta T_o = 348°K$ temperature use

$T = 695°F$ temperature of fire plume

The plume temperature is below the critical temperature of the structural steel.

Case number two considered both 3' x 7' doors open which corresponds to a ventilation controlled burning rate of 9008 kW. At this heat output the fire would consume the 144 gallons of lube oil in 44 minutes. The gas temperature at this time would be 923°F which is below the critical temperature of the structural steel (see Attachment B).

The ventilation controlled burning rate of 9008 kW is equivalent to the heat output from a pool fire with an area of 28 ft^2 (pool diameter of approximately 6 ft). In order to assess the effect of the plume of heated gases above the pool fire on the structural steel supporting the intermediate grating at the 201' elevation, Hesketad's relations will be used:

Virtual point source determination:

$Z_o = -1.02D + .083\ Q^{.4} = 1.32$ m

Plume temperature at bottom of structural steel supporting intermediate grating.

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

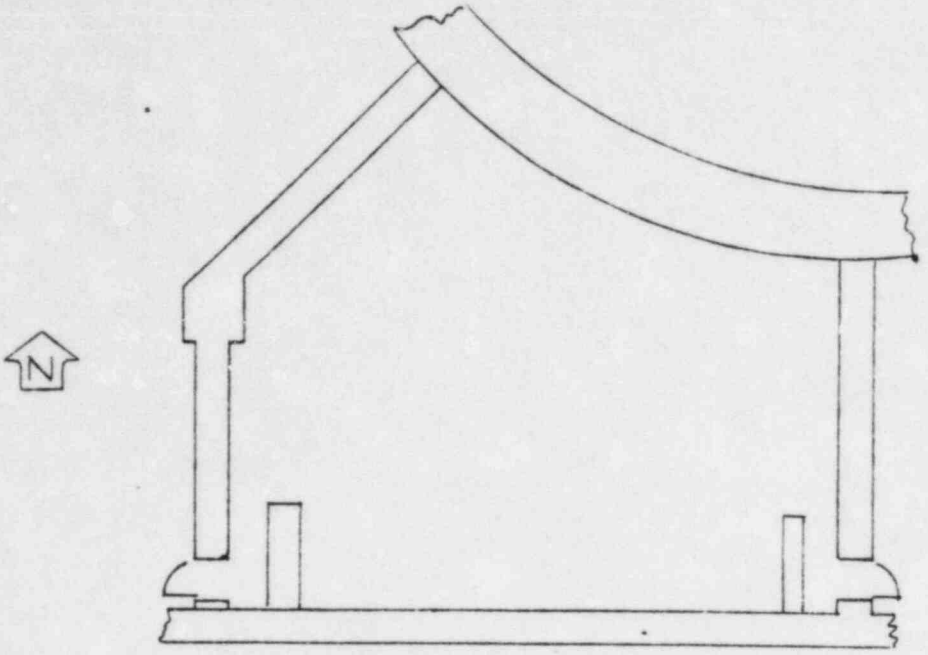
ΔT_o = 597°K temperature rise

T = 1194°F temperature of fire plume

The plume temperature is below the critical temperature of the structural steel.

The plume temperature is below the critical temperature of the structural steel for both cases. 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 airflow into the room through two open doors.

The cable trays in this area were positioned such that they did not present a localized heating exposure to the structural steel.



Unit 1 Reactor Building El. 177'
RHR Heat Exchanger and Pump Room 102

Surface Area Calculation

Walls		
North wall	(32' x 40')	1280 ft^2
South wall	(52' x 40')	2080 ft^2
East wall	(29' x 40')	1160 ft^2
West wall	(52' x 40')	2080 ft^2
		6600 ft^2

Ceiling for area is at elevation 217'

Ceiling	(24' x 52')	1248 ft^2
Total Surface Area for Heat Transfer		7848 ft^2

ATTACHMENT A

CASE NUMBER: 1
BUILDING: UNIT 1 REACTOR BUILDING
ELEVATION AND AREA DESCRIPTION: 177' RHR HX & PUMP ROOM 102
CASE DESCRIPTION: ONE 3'x7' DOOR OPEN LUBE OIL FIRE

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Ho (ft)	Aw (ft2)	Q (kW)
3.0	CONCRETE	21.0	7.0	7848	4504

FIRE IS VENTILATION CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
5	216
10	275
15	321
20	359
25	393
30	424
35	452
40	478
45	503
50	526
55	548
60	569
65	589
70	609
75	628
80	646
85	664

CASE NUMBER: 2
BUILDING: UNIT 1 REACTOR BUILDING
ELEVATION AND AREA DESCRIPTION: 177' RHR HX & PUMP ROOM 102
CASE DESCRIPTION: TWO 3'x7' DOORS OPEN LUBE OIL FIRE

CEILING/WALL THICKNESS (ft)	CEILING/ WALL MATERIAL	Ao (ft2)	Hs (ft)	Aw (ft2)	Q (kW)
3.0	CONCRETE	42.0	7.0	7848	9008

FIRE IS VENTILATION CONTROLLED

FIRE DURATION (min)	GAS TEMPERATURE (deg.F)
4	330
8	436
12	517
16	586
20	646
24	701
28	751
32	798
36	842
40	884
44	923