Analysis of Electray Hanger Rods
In Unit 2 Auxiliary Feedwater Pump Room
At
McGuire Nuclear Station

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1.0 Area Description

The area under consideration is the southeast corner of the Unit 2 Motor Driven Auxiliary Feedwater Pump Room on the 716+0 ft. elevation of the Auxiliary Building. The bounding walls are constructed of reinforced concrete. The ceiling height is approximately 16 feet. The area under consideration is a small portion of a large room, therefore build up of a significant hot layer is not anticipated. (See Attachment A for a sketch of the area). Automatic sprinklers, portable fire extinguishers and small hose stations are available for fire suppression. Smoke detectors are provided for early warning.

2.0 Problem Statement

The problem is to determine if electray hanger rods will lose their support strengh due to elongation and possible subsequent failure of the rods due to the temperature developed as result of the fire below the rods. In the area is one electray which contains power and control cables for certain motor operated valves. These valves may be required during certain shutdown operations. A one-hour fire resistive barrier wrap is installed on the electray to prevent an exposure fire from damaging the cables in the electray. The exposing cable trays are not wrapped. The postulated fire scenarios of concern are a fire in either of the two cable trays above the electray or floor level fires involving transient combustibles.

3.0 Combustible Loading

The presence of combustibles in the area is limited due to the presence of two large CCW pipes. Combustible material present, is cable insulation material in the two cable trays noted in Attachment B. Transient combustibles were considered, however station directives and housekeeping requirements limit the likelihood of accumulated transient combustibles.

The total loading in the two (2) cable trays shown on Attachment A is 871 lbs. of cable insulation and the average tray loading is 6.60 lbs/ft^2 of tray surface area. (See Attachments C1 and C2 for cable insulation calculations). Enclosed combustibles such as cabling in conduit and in wrapped electray have not been considered in this analysis.

4.0 Analysis

The analysis for this area was conducted identical to that noted in the report developed by Professional Loss Control Inc. (PLC) pertaining to the Mechanical Pipe Chase. The same values were utilized regarding hanger rod strength, loading, yield strength and maximum temperature to reach yield point under loaded conditions.

The first scenario examined considered a cable fire in cable trays 1 or 2 approximately 5 feet above the electray.

From information derived in the PLC report:

- Hanger rod working stress of 503 psi or 0.5 ksi
- Hanger rod yield point at 1597°F
- Surface controlled burning rate of 0.1 (lb/min)/ft^2
- Heat release rate of 16.67 (BTU/sec)/ft^2
- Equivalent point source - Tray 1 or 2: 8 ft^2

$\dot{Q}$ = 8 ft^2 x 16.67 (BTU/sec)/ft^2 = 133.36 BTU/sec
H = 3 ft. (Distance to ceiling above fuel source at which point electray support is attached)

This yeilds a maximum temperature at the ceiling of:

$$\Delta T = \frac{300\ (K\dot{Q})^{2/3}}{H^{5/3}} \qquad K = 1$$

Substituting in the values

$$\Delta T = \frac{300\ (133.36\ \text{BTU/sec})^{2/3}}{(3)^{5/3}} = 1255°$$

$T \approx 1330°$ (ambient = 75°)

The second scenario examined is a floor level fire involving transient combustibles below the electray at the 724 ft. elevation. The electray supports are a minimum of 8 ft above the floor.

Substituting known values in the following equation

$$\Delta T = \frac{300\ (K\dot{Q})}{H^{5/3}}^{2/3}$$

and solving for $\dot{Q}$

$$1522° = \frac{300\ (\dot{Q})^{2/3}}{(8)^{5/3}}$$

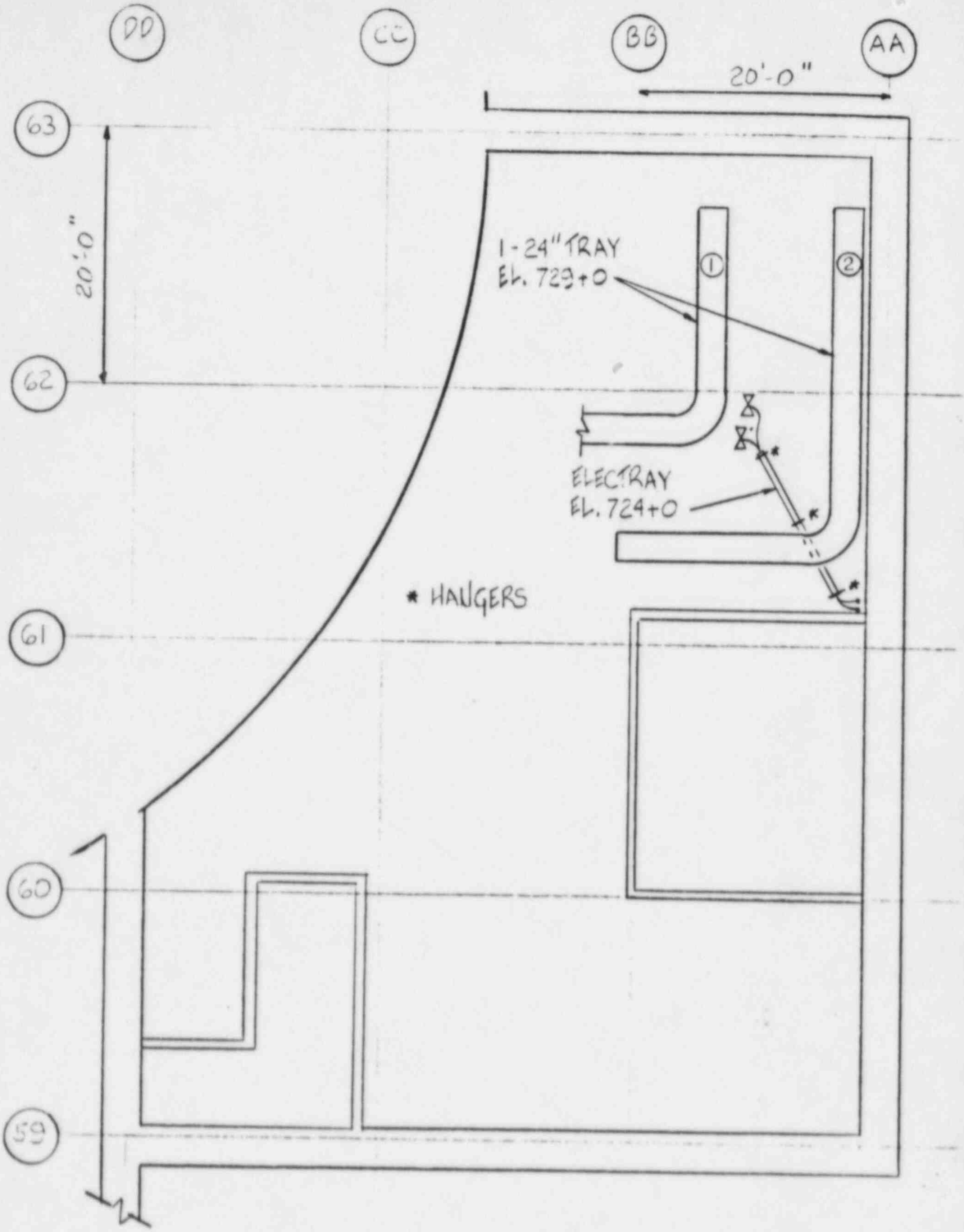
$\dot{Q}$ = 2069 BTU/sec

Using a heat release rate of 290(BTU/sec)/ft^2 (Reference #6 in the PLC report), this is equivalent to a 3 ft diameter flammable liquid pool fire, or 14 ft^2 of compartmented cartons stacked 15 ft. high. With housekeeping requirements and automatic suppression capability, such is not considered a credible event.

5.0 Conclusion

1) Cable exposure creates a ceiling temperature around the electray supports of approximately 1330°F. This worst case exposure is less than the failure temperature of the supports. Therefore, the fire endurance of the electray supports is assured in the event of a cable fire. Automatic sprinkler actuation provides an additional margin of safety.

2) The size of a floor level transient fire capable of failing the electray supports at the 724 ft elevation is 2069 BTU/sec. This is equivalent to a flammable liquid pool fire of 3 ft diameter or 14 ft^2 of compartmented cartons stacked 15 ft high. This transient fire exposure, because of housekeeping reuqirements and station directives, is not a credible event. Automatic sprinkler actuation also provides an additional margin of safety.



UNIT 2 AUX. FEEDWATER PUMP ROOM
PLAN

ATTACHMENT A

Cable Information
Auxiliary Feedwater Pump Room (Unit 2)

1. 24", 26', max fill 97 cables
2. 24", 40', max fill 93 cables

Most typical cables are:

3XJ12G1	- 3 conductor 12 Ga.	60 mil PVC
12XJ12G1	- 12 conductor	80 mil PVC
4SPA16G.3	- 4 shielded pair (ie) 8 conductors	

Each conductor 30 mil EPR, 15 mil Hypalon, Cables have PVC jackets

30 mil EPR = 10 lb/1000 LF
15 mil Hypalon = 6 lb/1000 LF
15 mil PVC = 6 lb/1000 LF

Each conductor of shielded pairs 15 mil PVC & 20 mil Hypalon,
30 mil PVC jacket

Suggest that cables be considered equally distributed among the trays.

Attachment B

Cable Insulation Calculations

A No. of Conductors	B Conductor Insulation		C Jacket Insulation (PCV)	(AB)+C Total
	EPR	Hypalon		
3	$\frac{10\ lbs}{1000\ LF}$	$\frac{6\ lbs}{1000\ LF}$	$\frac{4 \times 6\ lbs}{1000\ LF}$	$\frac{72\ lbs}{1000\ LF}$
12	$\frac{10\ lbs}{1000\ LF}$	$\frac{6\ lbs}{1000\ LF}$	$\frac{5.3 \times 6\ lbs}{1000\ LF}$	$\frac{224\ lbs}{1000\ LF}$
	PVC	Hypalon		
8	$\frac{6\ lbs}{1000\ LF}$	$\frac{1.3 \times 6\ lbs}{1000\ LF}$	$\frac{2 \times 6\ lbs}{1000\ LF}$	$\frac{122.4\ lbs}{1000\ LF}$
			TOTAL	$\frac{418.4\ lbs}{1000\ LF}$

Cables are considered to be equally distributed among trays:

$$\frac{418.4\ lbs}{1000\ LF} \div 3\ \text{cables (type)} = \frac{139.5\ lbs}{1000\ LF - cable}$$

$$= \frac{0.1395\ lbs}{ft\text{- }cable}$$

Cable Insulation Calculations (Cont'd)

Tray 1: $(26 \text{ ft.})(97 \text{ cables}) \dfrac{0.1395 \text{ lbs}}{\text{ft-cable}} = 351.82 \text{ lbs.}$

Tray 2: $(40 \text{ ft.})(93 \text{ cables}) \dfrac{0.1395 \text{ lbs}}{\text{ft-cable}} = 518.94 \text{ lbs.}$

TOTAL 870.76 lbs.

<u>Area of Trays</u>

Tray 1: $(2 \text{ ft.})(26 \text{ ft.}) = 52 \text{ ft.}^2$

Tray 2: $(2 \text{ ft.})(40 \text{ ft.}) = 80 \text{ ft.}^2$

TOTAL 132 ft.^2 cable tray surface area

$$\text{Average Tray Loading} = \frac{870.76 \text{ lbs}}{132 \text{ ft}^2}$$

$$= \frac{6.60 \text{ lbs}}{\text{ft}^2}$$