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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

November 6, 1978

Docket No. 50-29

Yankee Atomic Electric Company
ATTN: Mr. Robert H. Groce
Licensing Engineer
20 Turnpike Road
Westborough, Massachusetts 01581

Gentlemen:

The enclosed IE Circular No. 78-18 is forwarded to you for information. No specific action is requested and no written response is required. If you desire additional information regarding this matter, please contact this office.

Sincerely,

Robert T. Carlson for
Boyce H. Grier
Director

Enclosures:
1. IE Circular No. 78-18
2. List of IE Circulars Issued in 1978

cc w/encls:
H. Autio, Plant Superintendent
L. E. Minnick, President

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D. C. 20555

IE Circular 78-18
Date: November 6, 1978

UL FIRE TEST

Background

On September 15, 1978, a fire test of a full-scale vertical cable tray array was conducted at the Underwriters Laboratory (UL) near Chicago, Illinois. It was part of the fire protection research program managed by Sandia Laboratories under NRC contract. The purpose of the test was to demonstrate the effectiveness of area sprinklers and cable tray fire barriers constructed of ceramic fiber blankets in preventing damage to cables as a result of an exposure to a flammable liquid fire. The test resulted in damage to some electrical cables.

Discussion

The configuration of the fire test was selected to simulate a section of a plant area with vertical cable trays containing redundant safety divisions arranged such that the redundant divisions could be simultaneously exposed to a potential fire resulting from an inadvertent spill of flammable liquid in the area. The arrangement of the cable trays and the designation of the redundant tray divisions is shown in Figure 1. Figure 2 shows the location of the fire detectors and the three groups of sprinklers. Each of the five cable trays contained cable insulated with polyvinyl chloride and was enclosed in a separated ceramic fiber blanket fire barrier from floor to ceiling in accordance with the manufacturer's recommendations. The sprinkler and detector arrangement was as permitted by NFPA Code. However, no water was actually used at any time during this test due to the failure of some sprinkler heads to actuate, as explained below.

Each sprinkler location in the test arrangement contained three nominally identical temperature sensing sprinkler heads with fusible links adjacent to an open sprinkler head which was connected to a manual water supply valve. The temperature sensing heads were wired to signal when their links fused. After all three temperature sensing heads at a given location activated, then the water supply for the open head was to be manually admitted. The sprinklers were of a type which actuate at the slow end of acceptance for reaction time. The test procedure required that all three temperature sensing heads had to activate before water would be turned on. In this way, it was expected to get some data on variability in the response time of identical sprinklers.

Test Details

The test was started by igniting the two gallons of heptane that was poured into the floor pan. A fully developed fire occurred almost immediately. The ceiling smoke detector alarmed in about 15 seconds. In about 50-60 seconds, two of the three temperature sensing sprinklers located between the wall and cable trays 1 and 2 activated. The fire between cable trays 1, 2, 3, and 4 appeared most intense, apparently because of a chimney effect between the four trays. The flames between cable trays 3 and 5 did not appear to be so intense. The ceramic fiber blanket absorbed some of the heptane so that after the heptane in the pan burned, most of the flame seemed to come from the bottom outside surface of the ceramic fiber blanket. No additional temperature sensing sprinkler heads at any location activated; thus, the sprinkler water supply was not turned on for any of the three sprinkler locations. The apparent slow response of the third temperature sensing sprinkler is being investigated, since this was not intended to be a slow response sprinkler.

At about 3 minutes into the test there was an indication of a short circuit in cable tray 3, which was probably caused by the fire. After 5-7 minutes the height of the flames appeared to subside; however, residual flames continued for about 40 minutes.

Preliminary Results and Analyses

Preliminary information indicates that the flammable liquid or flames penetrated the protective barriers at the bottom of the vertical trays and caused fire damage to the polyvinyl chloride insulation on cables in four of the five trays.

On subsequent 500-volt megger tests, it was found that another cable in tray 2 had also experienced some damage, as evidenced by a conductor to ground short.

The most probable cause of the fire damage in certain cable trays appears to be related to the absorption or seepage of heptane under the ceramic fiber blanket at the juncture with the floor. Once the heptane entered the interior regions of the cable tray, then ignition apparently occurred via the small opening at the floor or through a vapor/air path within the joints. There is some indication that some cable damage was caused by absorption of heptane on the inside of the barrier (wicking effect) and its ignition which heated a cable tray ladder rung, causing damage to a cable in contact with the rung. The ingress of the heptane into the ceramic fiber needs to be further evaluated since this appears to be the most significant failure mode.

Tentative Conclusions

The test results are still being analyzed, and it would be premature to establish firm conclusions at this time; however, the results now available indicate that the following areas of the fire protection program need close consideration:

1. To protect against spills of flammable liquids, barriers or curbs may be needed to prevent entry of the flammable liquid behind fire barriers. A wick effect may also need to be considered in the design of fire barriers.

2. Some small fires may not actuate sprinkler heads. To reduce this possibility in sprinkler systems to be installed, fast response sprinkler heads should be considered (less than approximately 3 minutes in the UL Standard 199 "Automatic Sprinklers for Fire Protection Service").

3. The location of the fire detection devices and the sprinkler heads relative to the fire and components being protected is of great importance. The path of the air movement in the area influences the actuation of such devices and should be considered in the system layout.

The final results of this test will be issued when the analysis of the test is complete.

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Attachments:
1. Figure 1
2. Figure 2

ENCLOSURE 2

LIST OF IE CIRCULARS ISSUED IN 1978

Circular No.	Subject	First Date of Issue	Issued To
78-01	Loss of Well Logging Source	4/14/78	All Holders of Well Logging Source Licenses
78-02	Proper Lubricating Oil for Terry Turbines	4/20/78	All Power Reactor Facilities with an Operating License (OL) or Construction Permit (CP)
78-03	Packaging Greater Than Type A Quantities of Low Specific Activity Radioactive Material for Transport	5/12/78	All Power Reactor Facilities with an OL or CP; and all Fuel Cycle, Priority I Materials and Waste Disposal Licensees
78-04	Installation Errors That Could Prevent Closing of Fire Doors	5/18/78	All Power Reactor Facilities with an OL or CP
78-05	Inadvertent Safety Injection During Cooldown	5/26/78	All PWR Power Reactor Facilities with an OL or CP
78-06	Potential Common Mode Flooding of ECCS Equipment Rooms at BWR Facilities	5/31/78	All Power Reactor Facilities with an OL or CP
78-07	Damaged Components on a Bergen-Paterson Series 25000 Hydraulic Test Stand	5/31/78	All Power Reactor Facilities with an OL or CP
78-08	Environmental Qualification of Safety-Related Electrical Equipment at Nuclear Power Plants	5/31/78	All Power Reactor Facilities with an OL or CP

ENCLOSURE 2 (Continued)

LIST OF IE CIRCULARS ISSUED IN 1978

Circular No.	Subject	First Date of Issue	Issued To
78-09	Arcing of General Electric Company NEMA Size 2 Contactors	6/8/78	All Power Reactor Facilities with an OL or CP
78-10	Control of Sealed Sources Used in Radiation Therapy	6/14/78	All Institutional Medical Licensees
78-11	Recirulation M-G Set Overspeed Stops	6/15/78	All BWR Power Reactor Facilities with an OL or CP
78-12	HPCI Turbine Control Valve Lift Rod Bending	6/30/78	All Power Reactor Facilities with an OL or CP having a HPCI Terry Turbine
78-13	Inoperability of Multiple Service Water Pumps	7/10/78	All Power Reactor Facilities with an OL or CP
78-14	HPCI Turbine Reversing Chamber Hold Down Bolting	7/17/78	All Power Reactor Facilities with an OL or CP having a HPCI Terry Turbine excepting Duane Arnold and Monticello
78-15	Tilting Disk Check Valves Fail to Close with Gravity in Vertical Position	7/24/78	All Power Reactor Facilities with an OL or CP
78-16	Limitorque Valve Actuators	7/26/78	All Power Reactor Facilities with an OL or CP
78-17	Inadequate Guard Training/Qualification and Falsified Training Records	10/13/78	All Power Reactor Facilities with an OL; Susquehanna 1 & 2, Shorenam, and Salem 2

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