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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
SUITE 202, WALNUT CREEK PLAZA
1990 N. CALIFORNIA BOULEVARD
WALNUT CREEK, CALIFORNIA 94596

March 20, 1979

Docket No. 50-344

Portland General Electric Company
121 S. W. Salmon Street
Portland, Oregon 97204

Attention: Mr. Charles Goodwin, Jr.
Assistant Vice President

Gentlemen:

The enclosed IE Circular No. 79-05 is forwarded to you for information. If there are any questions related to your understanding of the suggested actions, please contact this office.

Sincerely,

R. H. Engelken
Director

Enclosures:
1. IE Circular No. 79-05
2. List of IE Circulars Issued in 1979

cc w/enclosures:
B. Withers, PGE
F. C. Gaidos, PGE

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

March 20, 1979

IE Circular No. 79-05

MOISTURE LEAKAGE IN STRANDED WIRE CONDUCTORS

Description of Circumstances:

During a staff review of the results of environmental qualification test of certain electrical equipment, the phenomenon of water penetration between an electrical conductor and its loosely fitting insulation sleeve was identified. The staff determined it to be prudent to investigate this phenomenon and initiated an equipment checkout test at Sandia Laboratories using a few typical conductors used in nuclear plants.

The equipment checkout test for cable leaks performed at Sandia Laboratories in August 1978, has shown that most stranded wire conductors, when subjected to a differential pressure across the conductor ends, will leak steam or moisture through the interstices of the strands of wire. The test has also shown that solid conductors, under similar conditions, do not leak.

Steam/moisture leakage through stranded conductors can occur during a Loss of Coolant Accident/Main Steam Line Break (LOCA/MSLB), if a differential pressure were to develop across the conductor ends; e.g., one end of the conductor is exposed to the accident environment (typically, in an unsealed junction box) and the other end is isolated from the environment (typically, inside a sealed component such as a sensor/transmitter).

In order to determine whether as-installed configurations exist in nuclear power plants which may result in degradation of safety-related functions due to moisture leakage in stranded wire conductors, inspection visits by NRC personnel were made in October to two nuclear plants, (one under construction, and the other operating). During the inspections the detailed configuration of stranded conductor cables, and their terminations at splices, penetrations, junction boxes, transmitters, motors, motor operated valves, and valve limit switches were reviewed. Special attention was given to termination details of stranded conductors at the terminal blocks installed inside junction boxes and at the connections to the various equipment. Additional information was provided by both licensees of the power plants visited and by the Architect-Engineer regarding design and construction details of such equipment. Based on observations made during these site visits and information obtained, the following items have been identified as areas where the possibility of the steam/moisture incursion phenomenon exists:



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1. Terminal Blocks/Junction Boxes - Junction boxes in containment that are used to house terminal blocks where cables were terminated, usually have dust tight and drip proof housings with vent and drain holes. Cables terminated in this fashion are generally stranded conductor type. The terminal blocks and cable terminations inside these boxes will be exposed to the containment environment during normal operation and a LOCA. No special provisions are generally made in the termination of stranded conductors in terminal blocks/junction boxes to prevent moisture or steam incursion.

2. Sensor Transmitters - Sensor transmitters such as Foxboro, Fisher and Porter, Barton, etc. are typically contained in sealed housings that are designed and constructed to maintain their internals isolated from the environment during a LOCA. The electrical connection to the transmitter is generally made with solid conductors which pass through qualified pressure seal connectors. However, if stranded conductors are used to make such connections, moisture incursion is a possibility. With this configuration, a differential pressure can develop between the exposed end of a cable in a terminal block or junction box and the end terminated in a sensor transmitter.

3. Motors - The cable terminations at motors are normally housed in terminal boxes which are not sealed and cables are brought into them by conduits which are open at the other end. Hence, no differential pressure will exist across the cable. However, if the cable terminations at the motor are sealed and stranded conductors are used to make such connections, then moisture incursion is a possibility.

4. Electric Motor Operated Valves (MOV's) and Limit Switches - The cables are brought into the housing of these components through open conduits which were not designed to keep out the environment. Since these components were qualified with the housings vented, steam/moisture incursion does not appear to be of concern.

These items were observed and no potential for steam/moisture incursion was found:

1. Splices - Qualified heat-shrink butt splices are used on terminations in place of terminal blocks or connectors in several nuclear plants. Where there are no interposing junction boxes or other possible moisture entry points in a cable run between the penetration and the equipment (and only splices are used), then moisture incursion into the splice is not possible; i.e., if no differential pressure can exist then moisture incursion is not possible.

2. Penetrations - The containment end and the end outside the containment will experience a differential pressure during a LOCA event. However, no leakage will occur across the conductor associated with the penetration since the penetrations are designed, constructed, and installed to prevent leakage. (The containment intergrated leak test with all penetrations installed verifies this satisfactorily.)

Based on the above observations, it is our view that qualification of Class IE equipment is generally done on a component basis. The "as-installed" configuration of the equipment and its interface connections have not been fully considered. In the case of sensor transmitters and connectors, the possible incursions of steam/moisture through the interstices of stranded conductors of a cable has not been specifically considered during LOCA qualification. However, NRC is only concerned if the steam/moisture incursion could affect the operation of the equipment.

All holders of operating licenses or construction permits should be aware of the potential problems of the types discussed above. Because cable termination details are plant specific, it is recommended that both licensees of operating facilities and holders of construction permits conduct a detailed review and analyses of their "as-installed" safety-related transmitters and connectors to ascertain the possibility of steam/moisture incursion through stranded conductors which could adversely affect the operability of safety-related equipment during a LOCA. If the possibility exists, then the facility should verify the qualification of the affected equipment for the service intended.

No written response to this Circular is required. If you require additional information regarding these matters, contact the Director of the appropriate NRC Regional Office.

Enclosure:
List of IE Circulars
Issued in 1979

# LISTING OF IE CIRCULARS ISSUED IN 1979

| Circular No. | Subject | Date of Issue | Issued To |
|---|---|---|---|
| 79-01 | Administration of Unauthorized Byproduct Material to Humans | 1/12/79 | All Medical Licensees except Teletherapy Medical Licensees and each Radiopharmaceutical Suppliers |
| 79-02 | Failure of 120 Volt Vital AC Power Supplies | 2/16/79 | All Holders of Reactor Ols and CPs |
| 79-03 | Inadequate Guard Training - Qualification and Falsified Training Records | 2/23/79 | All Holders of and applicants for Special Nuclear Material Licenses in Safeguards Group I |
| 79-04 | Loose Locking Nut on Limitorque Valve Operators | 3/16/79 | All Holders of Reactor Ols and CPs |
| 79-05 | Moisure Leakage in Stranded Wire Conductors | 3/20/79 | All Holders of Reactor Ols and CPs |