

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
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February 17, 1998

NRC INFORMATION NOTICE 97-45, SUPPLEMENT 1: ENVIRONMENTAL QUALIFICATION DEFICIENCY
FOR CABLES AND CONTAINMENT PENETRATION
PIGTAILS

Addressees

All holders of operating licenses for nuclear power reactors except those licensees who have permanently ceased operations and have certified that the fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing a Supplement to Information Notice (IN) 97-45 to alert the licensees of erratic indications from high-range radiation monitors (HRRMs) as result of a problem with their associated coaxial cables. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response to this notice is required.

Description of Circumstances

IN 97-45 addressed issues relating to a potential environmental qualification (EQ) deficiency for cables and containment penetration pigtailed for HRRMs. After IN-45 was issued, the staff became aware of an additional issue that could result in misleading the operators in assessing the radiation levels in the containment during an accident scenario. This issue was identified as a [temperature-induced phenomenon](#).

During a periodic test of the containment emergency coolers at the San Onofre Nuclear Generating Station (SONGS), Unit 3, the HRRM indicated a "fail" alarm for periods of up to 15 minutes. After completion of the cooler test, an upscale reading of approximately 1 R/hr occurred, decaying back to zero in about 15 minutes. Southern California Edison Company's (SCE's) follow up provided more detailed information and evaluation on the transient response of all channels of the HRRM under postulated accident conditions.

The licensee documented the transient response evaluation and EQ testing results in two internal memorandums that were provided to the NRC in an SCE letter (Accession No. 9708250123) dated August 20, 1997.

In one of these memorandums, the licensee concluded that Rockbestos RSS-6-104/LE coaxial cable used previously with the SONGS Units 2 and 3 HRRMs would undergo significant positive and negative current flow when exposed to transient temperature conditions. The induced current is the result of temperature stress, specifically the rate of temperature change. Another conclusion was that the detector "keep alive" signal of 1R/hr would provide a false high radiation reading, for approximately 15 minutes, when exposed to extreme temperature transient conditions inside containment, such as those postulated during a loss-of-coolant accident (LOCA) or a main steamline break (MSLB). The magnitude of the false reading may be in the range of the low thousands of R/hr. The low thousands of R/hr indication spike would last less than 1 minute, drop down to hundreds of R/hr, then return to below the alarm setpoint (less than 10 R/hr) in approximately 15 minutes.

Discussion

The licensee concluded from EQ testing that the magnitude and direction of the spurious signal is a function of the temperature gradient across the cable insulation. When the cable is heated, the induced current signal is positive and when the cable is cooled, the induced current signal is negative. A negative current signal could cause the HRRM to alarm "fail." Consequently, when the cable begins to cool following the initial accident temperature transient, the effect on the HRRM system could be to indicate a false fail signal in the control room if the cooling transient induces a current of sufficient magnitude to overcome the "keep alive" and/or detector dose rate signal.

A comparison of steam environment test results for 250-foot coaxial cable lengths indicated that cable routed completely in conduit does not provide relief from thermally induced currents. The test

specimens routed completely in conduit demonstrated a time delay of approximately 60 seconds. The cable samples completely in conduit and partially in conduit experienced spurious signals of equal magnitude that ranged up to thousands of R/hr.

The results of the testing program performed for the temperature-induced signal phenomena demonstrated that both false high and fail indications could mislead the operators during LOCA and MSLB environmental conditions inside containment. The licensee made the following conclusions from the Wyle Laboratory test results:

- (1) The duration of the spurious signal would be approximately 15 minutes and may range into thousands of R/hr
- (2) The spurious high R/hr signal would return to normal, and, as the containment environment cools, a spurious fail signal may also occur as the thermally induced signal changes from positive to negative, thereby masking any actual low-level dose rate.
- (3) When accident temperature conditions stabilize and/or a significant dose rate exists, indicated radiation dose rates would be more accurate.

Operators could be misled in the required actions during an accident scenario if they are not sensitized to the potential spurious signals from HRRMs. As previously reported IN 97-45, SCE replaced the Rockbestos coaxial cables with stainless steel jacketed mineral-insulated (MI) cables. SCE concluded that the MI cables are not significantly sensitive to thermal transients, moisture intrusion, or sudden air flow across the cable. SCE believes that the stainless steel jacketed MI cable is of a more robust design and will provide a significantly more stable signal than the previously installed Rockbestos RSS-6-104/LE coaxial cable during LOCA environmental conditions. However, the MI cable does not completely eliminate the temperature-induced signal phenomena in that erroneous signals up to 100 R/hr could exist during severe temperature transients. SCE revised its operator training to ensure that operators were aware of the MI cable response for this phenomena.

This information notice requires no specific action or written response. If you have any questions about the information notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/s/ d by
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