UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

June 23, 1987

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MEMORANDUM FOR: C. E. Rossi, Director
Division of Operational Events Assessment

FROM: Dennis F. Kirsch, Director
Division of Reactor Safety and Projects

SUBJECT: POTENTIALLY GENERIC ISSUE RV-87-04, DETERIORATION OF INSULATION ON CONAX CONTAINMENT PENETRATIONS AT SAN ONOFRE UNIT.1

On June 15, 1987, Southern California Edison (SCE) advised Region V of a potentially significant problem involving the deterioration of insulation on containment penetration electrical circuits in Unit 1. The licensee is still attempting to determine the magnitude of this problem but the Region has been informed of the current developments and the following is the extent of our understanding of this issue.

During the current outage, SCE performed megger testing of the control rod drive mechanism (CRDM) coil stacks to determine if any damage resulted from previous cooling fan malfunctions. During this testing, although the CRDM coils tested satisfactorily, unacceptably low resistance readings were found on 11 CRDM cables. Troubleshooting determined that the low megger readings were the result of insulation damage on "pigtails" associated with new containment electrical penetrations that were recently installed during the last refueling outage (about 1 year of operation). These new penetrations were installed as part of committed EQ upgrading. The new penetrations are manufactured to include pigtails on either end, which are field spliced onto existing plant cabling. The pigtails are multi-conductor cables that are factory spliced to the single conductor of the penetration. The pigtails are insulated by a very thin dielectric called DuPont "Kapton" (about 1 mil thick) with an additional thin teflon coating (about 0.5 mil thick). The insulation is installed as a double wrapping of Kapton tape, which is installed by the vendor, CONAX. The entire insulation is about 8 mils thick. Since the insulation is so thin, the pigtails are also protected by a polyolefin sheathing.

To date, SCE has visually inspected about 800 of approximately 7000 cables and discovered about 30 defects. It is our understanding that these inspections have been somewhat limited in their degree of detail. Many of the involved cable trays contain energized cables and inspections only covered those portions of cables that were immediately visible without any repositioning. Other than the initial CRDM cable meggering, all inspection has been visual. All of the damaged cables appear to involve cables for which the polyolefin sheathing was cut back to facilitate field splicing at the cable trays (e.g. all of the damage has been observed at the field splice end, not the factory spliced end). The cables with the most severe insulation damage (e.g. the CRDM cables) are located outside of containment. SCE has performed laboratory evaluation of portions of these cables which appears to confirm salt water attack of the Kapton. The mechanism appears to involve salt water infusion

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through what appear to be knife cuts in the Kapton/Teflon coating. Once the salt water gets to the copper conductor, copper chloride and sodium hydroxide are produced. The sodium hydroxide has been shown to easily dissolve the Kapton tape. This mechanism seems to be confirmed by the fact that none of the cut Kapton observed inside of containment appears to involve Kapton deterioration.

Although SCE has yet to confirm their evaluation of the cause and correction of this problem, it is our understanding that the leading theory involves accidental cutting of the Kapton during removal of the polyolefin sheathing. SCE has agreed to perform a thorough visual inspection of every bare Kapton wire associated with all the containment penetrations and provide the results to Region V.

This potential generic issue has been discussed with Messrs. Lanning and Merschoff. Region V is not aware of other potential uses or users of the subject coating material and recommends that NRR evaluate whether other nuclear applications of the coating material may be subject to similar degradation or environmental conditions inducing degradation.

D F. Kirsch

Dennis F. Kirsch, Director
Division of Reactor Safety and
Projects

cc: E. L. Jordan, AEOD
C. H. Berlinger, NRR
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July 10, 1987

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Docket No. 50-206
Information LER
Licensee Event Report No. 87-008
San Onofre Nuclear Generating Station, Unit 1

The attached Licensee Event Report (LER) provides information regarding damage to the insulation of conductors which connect field cabling to containment electrical penetrations. Neither the health and safety of plant personnel nor the health and safety of the public was affected by this event.

If you require any additional information, please so advise.

Sincerely,

HEM

H. E. MORGAN
STATION MANAGER

RCDouglas
Enclosure: LER No. 87-008

cc: F. R. Huey (USNRC Senior Resident Inspector, Units 1, 2 and 3)

J. B. Martin (Regional Administrator, USNRC Region V)

Institute of Nuclear Power Operations (INPO)

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NRC Form 366 (5/83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1	0 5 0 0 0 2 0 6	1 OF 0 3

TITLE (4)

KAPTON INSULATION DAMAGE ON CONTAINMENT PENETRATION CABLES

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQ NUMBER	REV NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
										0 5 0 0 0
0 6	0 2	8 7	8 7	– 0 0 8	– 0 0	0 7	1 0	8 7		0 5 0 0 0

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	INFORMATION
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
H. E. MORGAN, STATION MANAGER	7 1 4 3 6 8 – 6 2 4 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

Abstract (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

On June 2, 1987 with Unit 1 in Mode 5, meggering of Control Rod Drive Mechanism (CRDM) coil circuits revealed low insulation resistance in 22 circuits. The source of the low resistance was later found in Conax containment electrical penetration "pigtails" which connect the field cables to the penetration conductors.

Laboratory analysis and subsequent evaluation of the damaged CRDM pigtails revealed that the Kapton insulation appeared to have been cut or punctured through to the conductor. The analysis further determined the insulation damage did not result from electrical causes. Subsequent visual inspection of those portions of approximately 5,000 penetration pigtails which are not protected with a polyolefin jacket, revealed that less than 2 per cent were damaged (including the CRDM cables). Damaged pigtails in circuits which are safety related or which are important to safety have been repaired.

Investigation of the cause of the insulation damage indicates that most of the damage occurred during initial installation of the Conax penetrations in 1985/1986. Corrective action will be developed and implemented to prevent recurrence of insulation damage.

The Units 2 and 3 electrical penetrations are of a different design and thus are not similarly affected.

On June 2, 1987 with Unit 1 in Mode 5, meggering of Control Rod Drive Mechanism (CRDM) coil circuits revealed low insulation resistance in 22 circuits. The source of the low resistance was later found in Conax containment electrical penetration "pigtails", ranging in length from four to twenty feet, which connect field cables to the solid copper penetration feed throughs. These pigtails are insulated with a double wrap of Kapton insulation approximately 9 mils thick. A Teflon-based adhesive is used to bind the Kapton wrap and to provide a moisture barrier. As provided by the manufacturer, the pigtails originating from each feed through are grouped together and jacketed with a loose fitting polyolefin sleeve which protects the insulation from mechanical damage.

Visual examination of the CRDM pigtails outside containment, which are in an outside marine air environment, identified points at which the insulation was damaged and the copper conductor displayed signs of corrosion. Laboratory analysis and subsequent evaluation of two samples of damaged cable revealed that the insulation appeared to have been cut or punctured through to the conductor.

Subsequent visual inspection of those portions of approximately 5,000 penetration pigtails which are not protected with the polyolefin sleeve, revealed that less than 2 per cent were damaged (including the CRDM cables). The inspection further revealed a pattern of physical damage (i.e., cuts, punctures, or abrasion) to the exposed portion of the pigtail insulation where the pigtails are connected to the field cables. None of the damaged pigtails located inside containment revealed evidence of conductor corrosion.

One laboratory analysis further determined that the failures did not result from electrical causes. The postulated corrosion mechanism was intrusion of moisture and NaCl from the marine air environment outside of containment, through a cut in the insulation. Reaction with the conductor formed $CuCl_2$ and NaOH. The NaOH, in a saturated water solution, degraded the Kapton insulation around the cut.

Investigation of the cause of the insulation damage indicates that most of the damage occurred during initial installation of the Conax penetrations in 1985/1986. The balance of the damage appears to be from other causes such as dropping or placing objects on the cables, and stepping on the cables during subsequent construction, maintenance and inspection activities.

A sample of exposed polyolefin jacketing was also visually surveyed. The survey revealed three instances of jacketing damage extending through to the conductor insulation. The damage to the jacketing appears to be random and unrelated to the Kapton insulation damage described above.

Damaged pigtails in circuits which are safety related or which are important to safety were repaired by cutting out the damaged section and reconnecting the field cable to the remaining portion of the pigtail, or by covering the damaged section with an approved heat shrink insulating tube. The remaining damaged pigtails are part of non-essential lighting and communication circuits, which will be repaired during the next refueling outage.

Corrective action to prevent recurrence will include providing cable tray covers where appropriate, and administrative controls on activities which could potentially damage conductor insulation. Additionally, appropriate procedures will be revised to address protection and handling of Kapton insulated cable. Implementation of corrective action will be completed by the end of the next refueling outage.

These instances of installation damage to Kapton insulation are similar to the installation damage reported by Gulf States Utilities Company for the River Bend Station Unit 1 (Docket 50-458) in January, 1985.

The Units 2 and 3 electrical penetrations are of a different design and thus are not similarly affected.