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SUBJECT: Responds to concerns raised during 891113-1204 insp re environmental qualification-terminal boxes & splices.

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Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
ENVIRONMENTAL QUALIFICATION-TERMINAL BOXES AND SPLICES

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

Attn: A. B. Davis

December 20, 1989

Dear Mr. Davis

This letter responds to concerns raised by your staff during an inspection of the environmental qualification program at the Donald C. Cook Nuclear Plant. During the inspection, which was conducted the weeks of November 13, 1989 and December 4, 1989, the following items were categorized as unresolved issues:

1) Applicability to terminal block qualification reports to the installed configuration at the Cook Nuclear Plant. The specific issue was the use of top entry conduits and the need for weep holes in the terminal boxes.

2) A review of anomaly number 6 in the Wyle Test Report NEQ-45603-1 and an assessment of its affect on the Cook Nuclear Plant MOV control circuits.

3) Review of the use of Scotch 70 tape on Raychem splices.

4) Review of the use of Okonite, Okoprene tape on motor termination splices.

These issues are addressed below.

<u>Terminal Box Qualification</u>

The qualification tests for the Marathon 1600 series terminal blocks (Wyle Test Report, Reference 1) and the Penn Union 6000 series terminal blocks (Conax Test Report, Reference 2) have been reviewed, and compared with the conditions that would exist at the

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Cook Nuclear Plant following a postulated steam line break outside of containment. The test conditions for the Marathon test are given in Table 1, the test conditions for the Penn Union test are given in Table 2, and the profile for the postulated accident is given in Table 3. A comparison of the Marathon test configuration with the Cook Nuclear Plant configuration is given in Table 4. Figures 1 through 3 provide a temperature history for the test and the postulated accident.

Based on the comparisons in Table 4, it can be seen that where there are differences between the Cook Nuclear Plant configuration and the Wyle test configuration they are counter balanced by the peculiarity of the application. The Wyle test needed a Nema 4 enclosure to qualify the terminal block for 30 days of chemical spray. At the same time the weep holes were necessary for the proper drainage of a NEMA 4 enclosure. The Cook Nuclear Plant configuration uses a non watertight terminal box which was used in the testing of the Penn Union terminal blocks.

The open conduit (top entry) and the weep holes used in the Marathon test configuration guaranteed steam intrusion and condensation of the steam on the terminal blocks. There is no difference from the Cook Nuclear Plant configuration since for an outside containment application (no chemical spray), no NEMA 4 enclosure is required and proper drainage without weep holes is assured as proved by the Penn Union terminal block test.

The question has been asked whether the conduit opening into a cable tray in a HELB area could serve as a channel for water running down through the conduit to the terminal box and shorting the terminal blocks.

The Cook Nuclear Plant design standards specify that "all Engineered Safeguards System and Reactor Protection System troughs require covers with the exception of the troughs installed in the Control Room Cable Vault" (Specification DCC-EE-605-QCN). PDS-1175 (Figure 4) requires one-inch holes every 2 ft. in the bottom of the cable trays for drainage purposes. Holes are stamped from inside out to eliminate any rough edges projecting inside the tray, and eliminating the possibility of water pooling in the tray. Further PDS-1183 (Figure 5) specifies conduit the cable tray horizontally at the top of the tray (the cables must be brought up from the tray and into the horizontal conduit).

From these specifications and standards, it can be seen that only steam (a gas) will be able to enter the conduit, but only during the 10 minutes outside containment DBE (Reference 3). On the

contrary, during the Wyle test, the steam environment was present for 30 days. Chemical spray was also present but its effect may have been minimized by the NEMA 4 enclosure. However, during the 118-hour Conax test, both steam and chemical spray were able to enter the unsealed Cook Nuclear Plant terminal box configuration.

It seems evident that during the 118 hours of the Conax test, more water spray and steam entered the terminal boxes and impacted the terminal blocks than is likely to happen following a 10-minute high energy line break (HELB) outside containment at Cook. Likewise, during the 30-day Wyle test, despite the use of a NEMA 4 enclosure, the weep holes in the enclosure and the open top entry conduit would allow steam and water spray to enter the enclosure. It is our opinion that the 30-day test subjected the terminal blocks to conditions more severe than would occur during a short duration (10-minute) steam line break.

The levels of margin present during these tests as compared with the postulated environments where the terminal blocks need to remain functional plus the foregoing discussion between the tested and installed configuration leads to the conclusion that the Cook Nuclear Plant terminal block installation, with top entry conduit and without terminal box weep holes, will remain functional following an outside containment HELB at Cook Nuclear Plant.

<u>Wyle Test Report - Anomaly Number 6</u>

<u>Description of Anomaly</u>

"On December 31, 1981 the fuses in the leakage current circuit of both remaining boxes were blown. The cause of the blown fuses was a voltage spike resulting from an abrupt reapplication of facility power, which had been off for approximately 15 minutes."

<u>Evaluation</u>

In reviewing this anomaly for applicability to the Cook Nuclear Plant configuration one should consider the following:

1. The valve actuator control circuits at Cook Nuclear Plant (Figure 6) (the EQ application for Marathon 1600 series) are not fused.

The control circuit (220 VAC) is fed from a 600 VAC power circuit through a low power control transformer (see attached control circuit schematic, typical). A momentary disturbance (voltage spike) in the control circuit will not generate enough current to trip the 600 VAC circuit protective device (circuit breaker).

In our experience, for the 600 VAC circuit breaker to trip on a secondary side fault, this needs to be a relatively long lasting, bolted (low resistance) fault that would cause the control transformer to fail. It is for this reason (momentary spikes, faults, etc.), that AEPSC does not fuse control circuit secondaries and instead elects to sacrifice the control transformer.

Due to Appendix R concerns, a testing program was carried out in 1985 at AEPSC Electrical Engineering Laboratory to determine if a fault that developed in the secondary side of a control transformer would take the MCC out once the control transformer blew up. To find out what would happen, each size of starter and control transformer was tested by bolting a fault to the secondary side of the control transformer. The results of the tests were reported in Test Report #CL-552 (July 29, 1985). The required modifications (metal barriers for size 1 FVR starters only) were installed under design change #RFC-DC-12-2882. For the purposes of this analysis the relevant fact is that it took approximately 50 seconds (from 41.5 seconds to 55.8 seconds) for a bolted fault on the secondary side of the transformer (220 VAC) to damage the transformer.

Clearly, a bolted fault of 50 seconds duration cannot be characterized as a "voltage spike." These tests, therefore, proved that a voltage transient in the control circuit will not instantaneously trip the power circuit and prevent valve operation.

2. Anomaly #6 happened on December 31, 1981, at least 12 days into the LOCA test. However, we are claiming terminal block qualification for survival in a 10-minute HELB outside containment environment only.

   For both the above reasons, we consider this anomaly (#6) to have no impact on the environmental qualification of the Marathon 1600 series terminal blocks for outside containment control circuit applications at Cook Nuclear Plant.

Scotch 70 Tape

The Cook Nuclear Plant splicing procedure (Specification DCC-EE-176-QCN) contains directions to abraid the cable outer jacket to produce a dull surface for at least three inches from the end of the wire. It also has directions to slide a piece of tubing previously installed on the cable conductor over the splice such that at least two inches extends beyond the edge of the conductor. It appeared to the inspector that this would leave one inch of wire unprotected. Also, the inspector questioned our use of Scotch 70 tape as it had not been included in the environmental qualification tests.

The one inch difference provided in the specification is to make sure that the splice is not shrunk over the asbestos braid jacket but rather over the smooth insulation material to guarantee a water tight connection. At the same time, Scotch #70 silicone tape is used to prevent the now loose jacket from unravelling. The Raychem splice qualification, successfully tested without this added protection, can only be enhanced by the tape addition.

We believe there is not question of material incompatibility between the Raychem heat shrink tubing and the Scotch #70 silicone tape. Also, Raychem "Nuclear Products Compatibility Statement" (Reference 3) states that "Raychem knows of no incompatibility of its nuclear compounds and adhesives on typical polymeric cable insulating materials currently sold into the nuclear power industry."

We, therefore, conclude that the Cook Nuclear Plant splicing procedure is sound and our Raychem splices environmentally qualified.

Okonite Okoprene Qualification

Standard power cable motor terminations at Cook Nuclear Plant were environmentally tested during the spring of 1978 at Westinghouse, Ontario, Canada test facilities. The test reports specifies that motor terminations were constructed in accordance with AEP Electrical Design Standards 1-2-EDS-613-2. Tested samples were E3 and E4 utilizing splicing compound tape Scotch #23, and F3 and F4 utilizing splicing compound tape Bishop W962 (AEP Bill of Materials 1788, item #692).

Although the test report makes no mention of the Neoprene tape, the following consideration are nevertheless relevant:

1) The test program was undertaken specifically for AEP, to test AEP standard connections.

2) The test report specifically states that motor connections were made in accordance with AEP standard drawing 1-2-EDS-613-2.

3) 1-2-EDS-613 Revisions 1 and 3, (Figures 7 and 8), clearly indicate that the fourth step in the construction of the motor connection is the application of "3 half-lapped layers of Neoprene tape" (AEP Bill of Material 1788 item #695).

4) A letter written to D. V. Shaller (Cook Nuclear Plant manager at the ti dated May 19, 1978 (Attachment 1) from the AEP electrical engineer responsible for the test clearly states: "The 'E' series of test samples used Scotch #23 tape for B/M item 692 and the 'F' series of test samples used Bishop W962 for B/M item 692. Both samples used Okonite "Okoprene" Neoprene tape for B/M item 695."

We have not been able to locate Revision 2 of the standard, however, from the text of the letter and a review of Revisions 1 and 3 it can be ascertained that Revision 2 was the same as Revision 3 except for the following:

a. In Step 3 of the procedure, Revision 2 simply read: "Apply half-lapped splicing compound tape (M. E. #________)".

b. In Step 4 of the procedure, Revision 2 simply read: "Apply 3 half-lapped layers of Neoprene tape (M. E. #__________)".

Thus the instructions in the Revision 2 of the standard, refer to the use of generic materials for the motor connections. After the Westinghouse-Canada test qualified the Scotch 23, Bishop W962 and Okoprene tapes, the standard was revised to eliminate the generic instruction and direct that specific manufacturers be used for EQ reasons. The 1-2-EDS-613-3 version is therefore the exact description of what was tested at the Westinghouse Ontario labs.

There may be several reasons why the test report makes no mention of the Neoprene tape. For one, reports written at that early period were not very good at documenting the details of the test.

In addition, it may have been felt that the "Splicing" compound was what needed qualification. The Neoprene tape in this view may be considered to play a structural rather than an electrical role in building the motor connection.

Whatever the reasons may have been for neglecting to mention the inclusion of the Neoprene tape in the test, the records of 1-2-EDS-613 Revisions 1 and 3 plus Mr. T. E. King letter previously quoted leaves no room for doubt that the Okonite-Okoprene Neoprene tape was environmentally tested and qualified together with the Scotch and Bishop tapes.

Conclusion

Based on our evaluation of the environmental qualification documentation, we believe that our terminal blocks and splices are qualified for their intended use.

References

1. Wyle Test Report NEQ-45603-1

2. Conax Test Report IPS-339

3. IMPELL Report 01-0120-1524

This document has been prepared following Corporate procedures that incorporate a reasonable set of controls to ensure its accuracy and completeness prior to signature by the undersigned.

Sincerely,

M. P. Alexich
Vice President

MPA/eh

Attachment

cc: D. H. Williams, Jr.
A. A. Blind, Jr. - Bridgman
R. C. Callen
G. Charnoff
M. Kopp - Region III
NFEM Section Chief
NRC Resident Inspector - Bridgman

Table 1

Marathon Terminal Block Qualification Parameters

<u>Temperature Profile</u>

$345^{o}F$	3 hours
$325^{o}F$	50 hours
$290^{o}F$	28 Days

<u>Pressure</u>

97.7 psia peak

<u>Chemical Spray Duration</u>

30 Days

<u>Radiation Exposure</u>

200 Mrads

<u>Tested Configuration</u>

Inside NEMA 4 enclosure
top conduit entry
conduit opened inside test chamber
two 1/4-inch weep holes diagonally

<u>Results</u>: The specimens which were powered with applied voltages of 132 VAC and 264 VAC complied with all requirements.

Table 2

Penn Union Terminal Block Test Parameters

<u>Temperature Profile</u>

340°F	1 hour
250°F	117 hours

<u>Chemical Spray Duration</u>

118 hours

<u>Pressure</u>

26.7 psia

<u>Radiation</u>

None Required

<u>Tested Configuration</u>

Cook Nuclear Plant installation standards (except one may also find top entry conduit terminal boxes at Cook).

Terminal Boxes:	1 hinged cover
	1 bolted cover
	No Weep Holes

<u>Results</u>

Specimens powered with applied voltage of 600 volts. Test items performed satisfactorily under test conditions and passed the requirements of this test.

Table 3

Postulated Accident Parameters

<u>Temperature Profile</u>

400°F (430°F Spike)	15 seconds
340°F	10 minutes

<u>Pressure</u>

15 psia (20 psia spike)	50 seconds

<u>Installed Configuration</u>

Hinged Cover Terminal Boxes
Bolted Cover Terminal Boxes

Table 4

Comparison of Marathon Test Configuration and Cook Nuclear Plant Configuration

Wyle (Marathon) Test Configuration	Cook Nuclear Plant Configuration
1. Top entry conduit	1. Top entry conduit
2. NEMA 4 enclosure; conduit opening into chamber; two 1/4-inch weep holes.	2. Non-Watertight enclosure; conduit opening into HELB area; No weep holes.
3. Tested for inside containment environment including 30 days of chemical spray.	3. Outside containment application only; No chemical spray; 10 minute steam environment.

FIG. 1: Wyle Test Report NEQ-45603-1

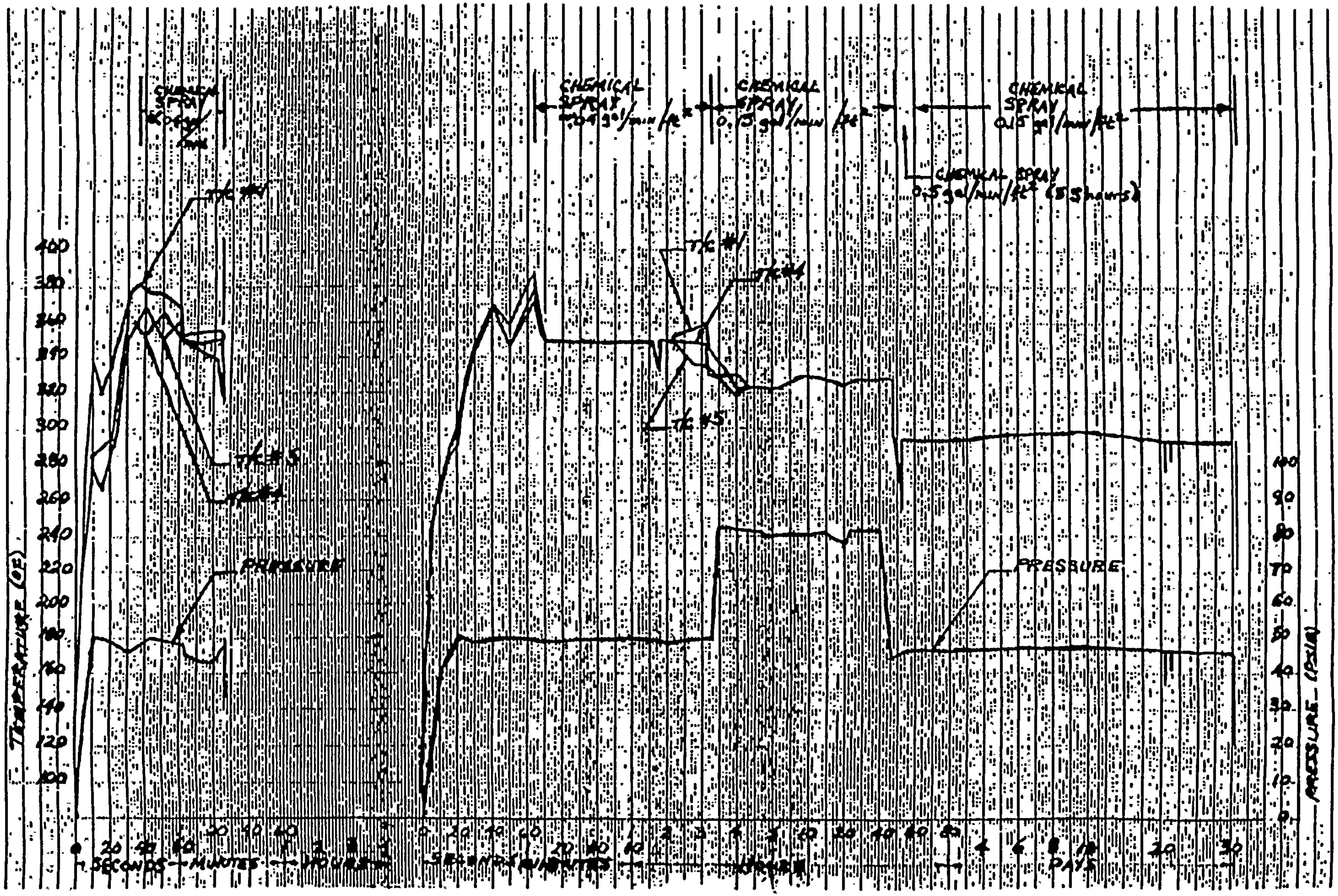


FIG. 2: Conas Test Report IPS-339

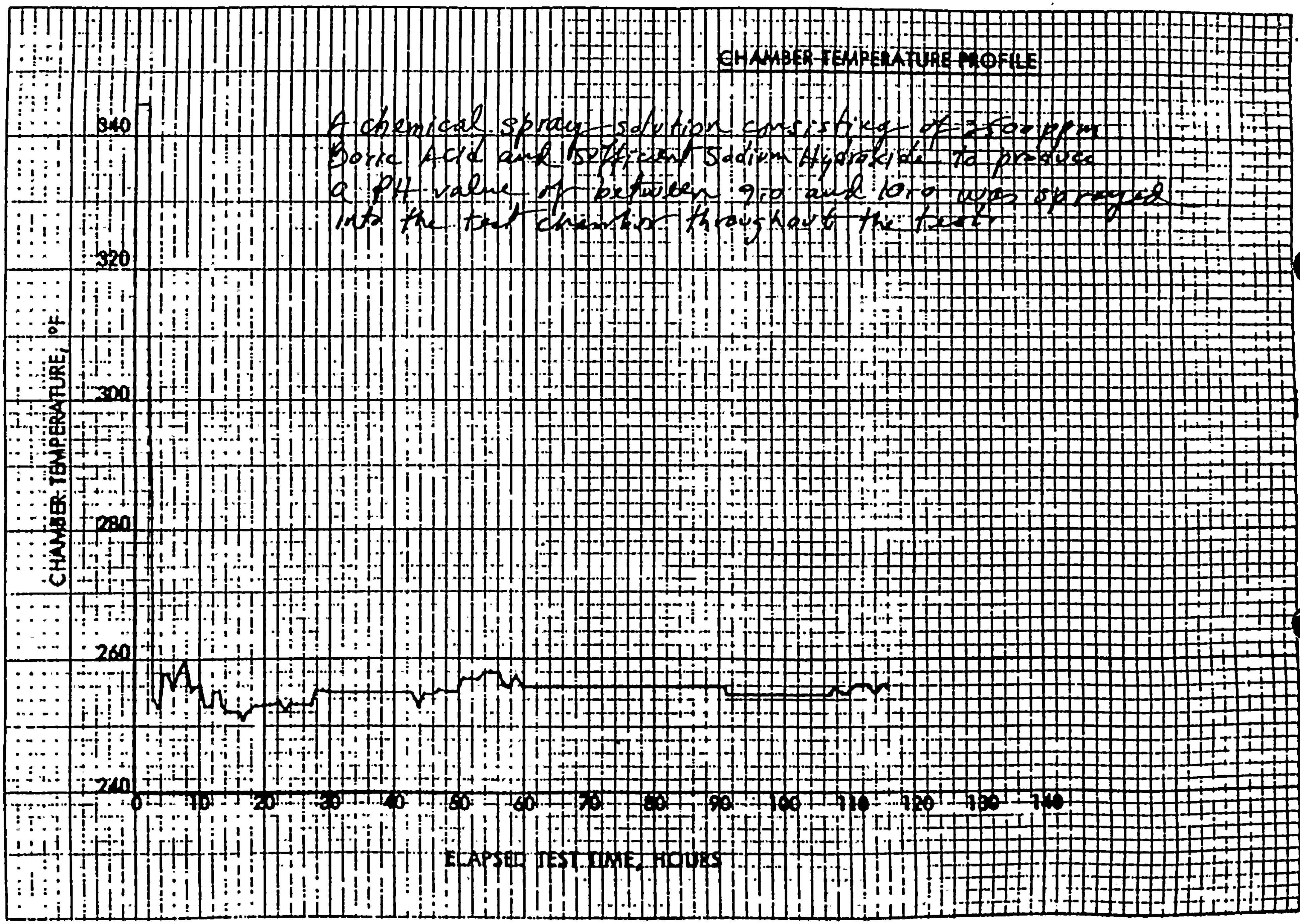
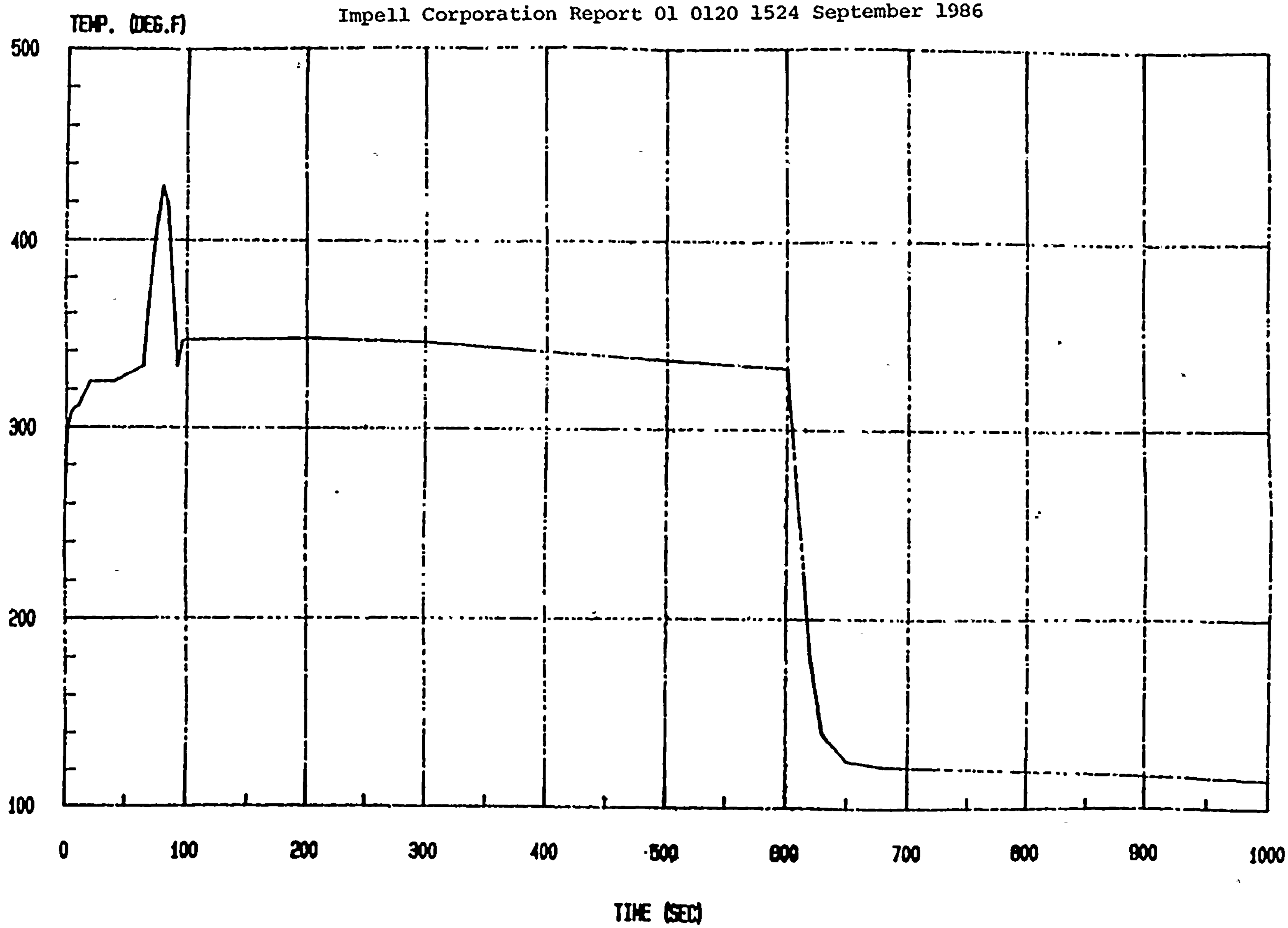


FIG. 3

AEP:NRC:0775AQ

AEPSC/DC COOK UNITS 1&2

MSLB Environmental Analysis
Impell Corporation Report 01 0120 1524 September 1986



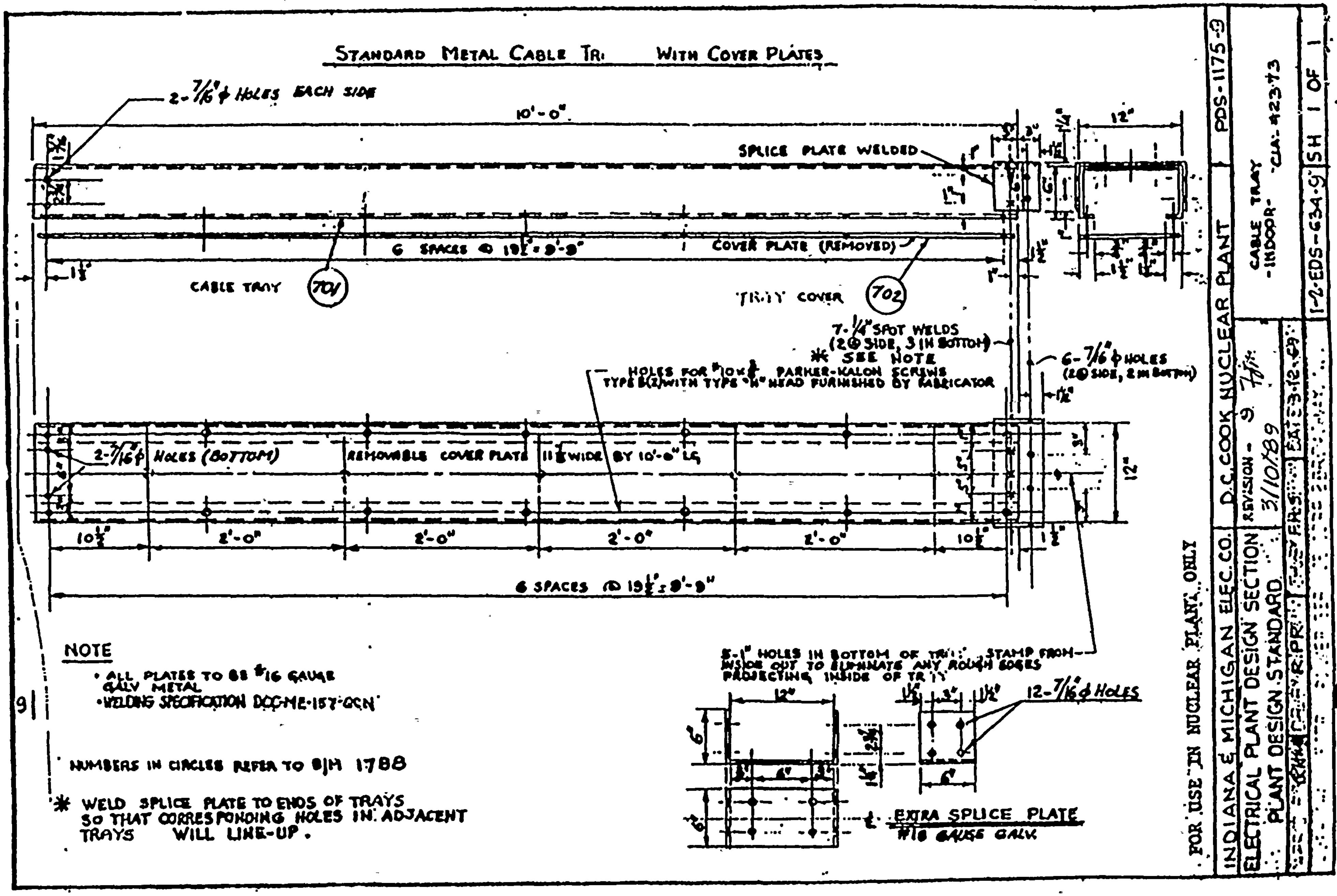
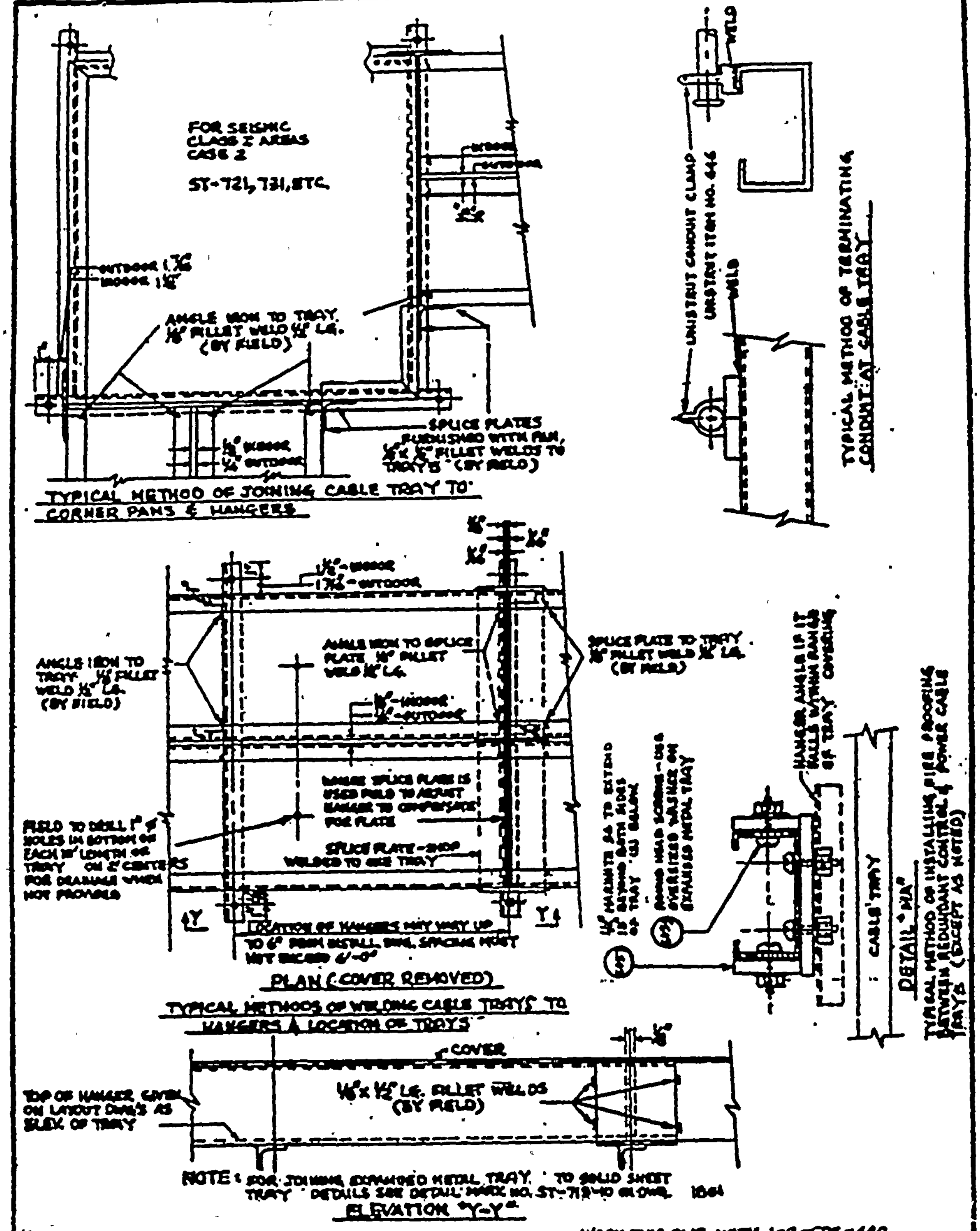

STANDARD METAL CABLE TR[illegible] WITH COVER PLATES
2-7/16"φ HOLES EACH SIDE
10'-0"
SPLICE PLATE WELDED
12"
6 SPACES @ 19½" = 9'-9"
COVER PLATE (REMOVED)
CABLE TRAY 701
TRAY COVER 702
7-¼" SPOT WELDS (2 @ SIDE, 3 IN BOTTOM)
✱ SEE NOTE
6-7/16"φ HOLES (2 @ SIDE, 2 IN BOTTOM)
HOLES FOR #10×⅝ PARKER-KALON SCREWS TYPE B(Z) WITH TYPE "H" HEAD FURNISHED BY FABRICATOR
2-7/16"φ HOLES (BOTTOM)
REMOVABLE COVER PLATE 11⅞" WIDE BY 10'-0" LG.
10½"
2'-0"
2'-0"
2'-0"
2'-0"
10½"
6 SPACES @ 19½" = 9'-9"
NOTE
• ALL PLATES TO BE #16 GAUGE GALV METAL
• WELDING SPECIFICATION DCC-ME-157-QCN
NUMBERS IN CIRCLES REFER TO B|M 1788
✱ WELD SPLICE PLATE TO ENDS OF TRAYS SO THAT CORRESPONDING HOLES IN ADJACENT TRAYS WILL LINE-UP.
5-1" HOLES IN BOTTOM OF TRAY. STAMP FROM INSIDE OUT TO ELIMINATE ANY ROUGH EDGES PROJECTING INSIDE OF TRAY
12-7/16"φ HOLES
EXTRA SPLICE PLATE
#16 GAUGE GALV.
FOR USE IN NUCLEAR PLANT ONLY
INDIANA & MICHIGAN ELEC. CO.
D.C. COOK NUCLEAR PLANT
ELECTRICAL PLANT DESIGN SECTION
PLANT DESIGN STANDARD
REVISION - 9
3/10/89
CABLE TRAY -INDOOR-
CIA. 42373
PDS-1175-9
1-2-EDS-634-9
SH 1 OF 1

FIG. 4

AEP:NRC:0775AQ



NOTE: FOR JOINING EXPANDED METAL TRAY TO SOLID SHEET TRAY DETAILS SEE DETAIL MARK NO. ST-713-10 ON DWG. 1061

WORK THIS DWG. WITH 1-2-EDS-640 ITEM NO'S. REFER TO B/M #1788

NUMBERS IN ◯ REFER TO B/M 1788

FOR USE IN NUCLEAR PLANT ONLY

INDIANA & MICHIGAN ELEC. CO.	D.C. COOK NUCLEAR PLANT	PDS-1183-13
ELECTRICAL PLANT DESIGN SECTION PLANT DESIGN STANDARD	REVISION 13 5-5-89	CABLE TRAY ASSEMBLY DETAILS - INDOOR -
APP'D BY ... DR. BY R.P.R. CH. BY F.H.S.	DATE 3-12-69	OM-42373
AMERICAN ELECTRIC POWER SERVICE CORP. 2 BROADWAY, N.Y.	1-2-EDS-633-13	SH 2 OF 2

FIG. 5

DWG# OP-2-98214-20

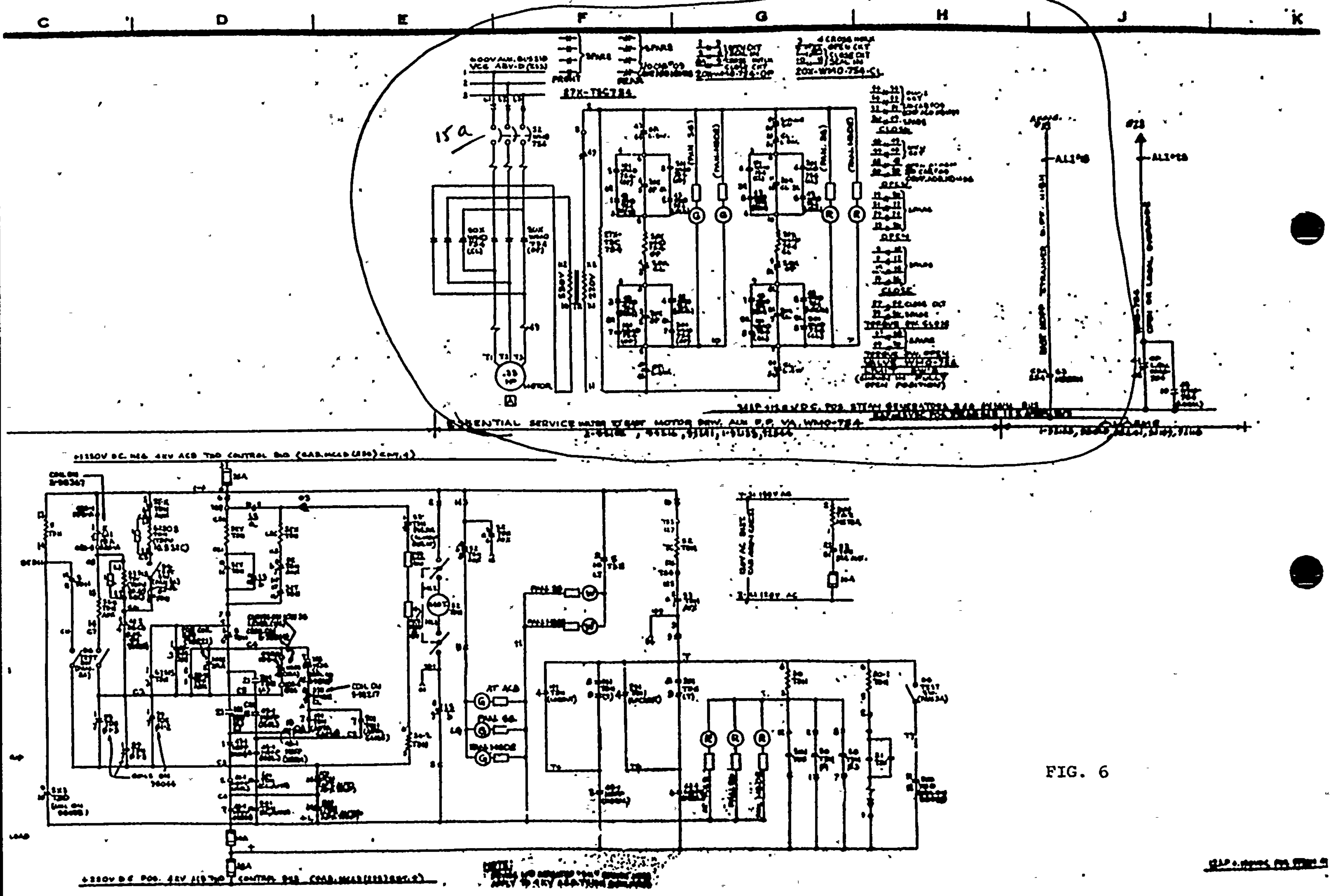
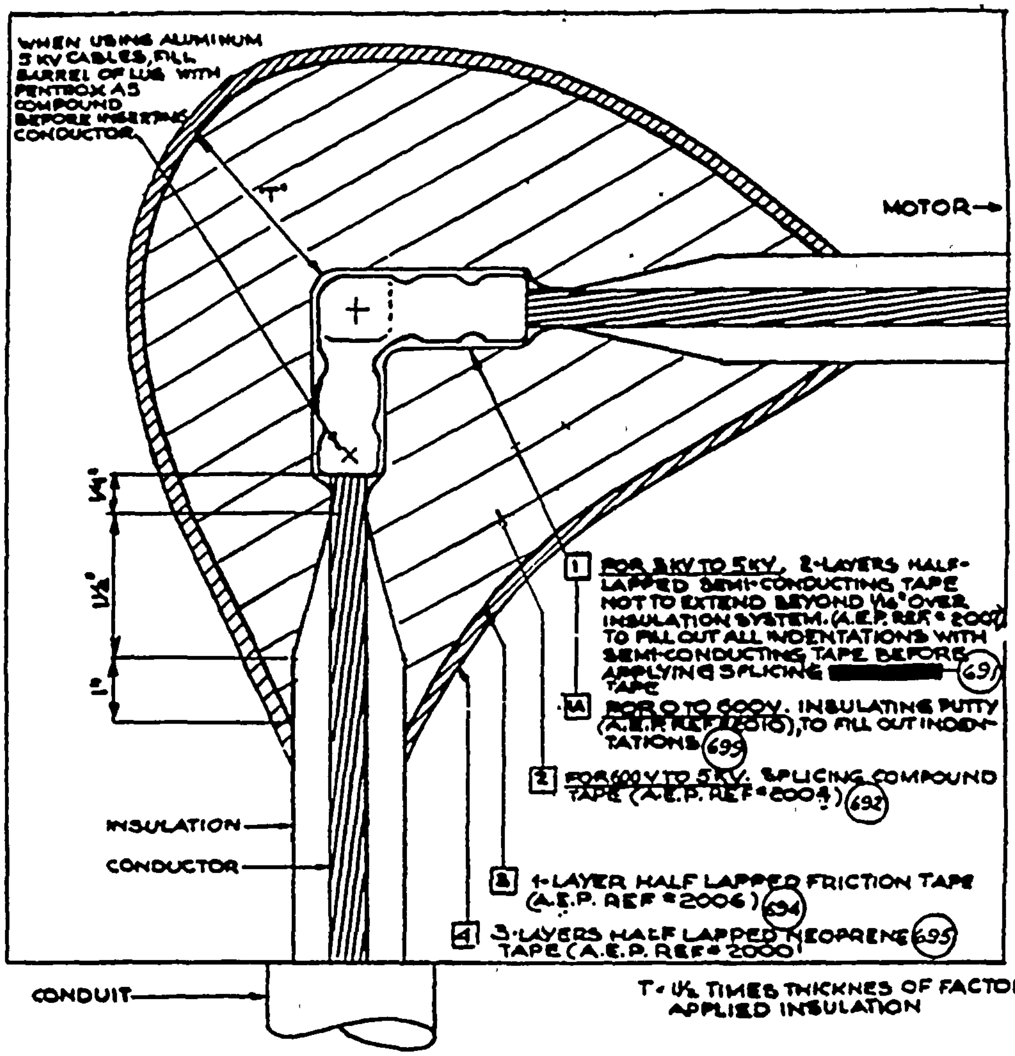


FIG. 6

REV.#1- GVS-11/24/69



T = 1½ TIMES THICKNES OF FACTORY APPLIED INSULATION

FIG. 7

TERMINATION OF RUBBER-LIKE & CROSS-LINKED POLYETHYLENE CABLE

DETAIL OF ONLY ONE LEG SHOWN ALL THREE LEGS TO BE MADE AS SHOWN

SUPERSEDED - SEE REV # 2

○ NUMBERS IN CIRCLES REFER TO ITEMS IN B/M #1788

[redacted]. C/A 42373

INDIANA & MICHIGAN ELECTRIC CO.	DONALD C. COOK NUCLEAR PLANT	5KV & 600V MOTOR TERMINATIONS FOR NON-SHIELDED RUBBER & XL INSULATION
APP'D BY	DR. BY RAR	CH. BY FHS	DATE 3-12-69
AMERICAN ELECTRIC POWER SERVICE CORP. 2 BROADWAY, NEW YORK		DWG. 12-EDS-613-1

AEP:NRC:0775AQ

REV. 3 - PER T. E. KING LETTER - 5-18-78 - 8-4-78

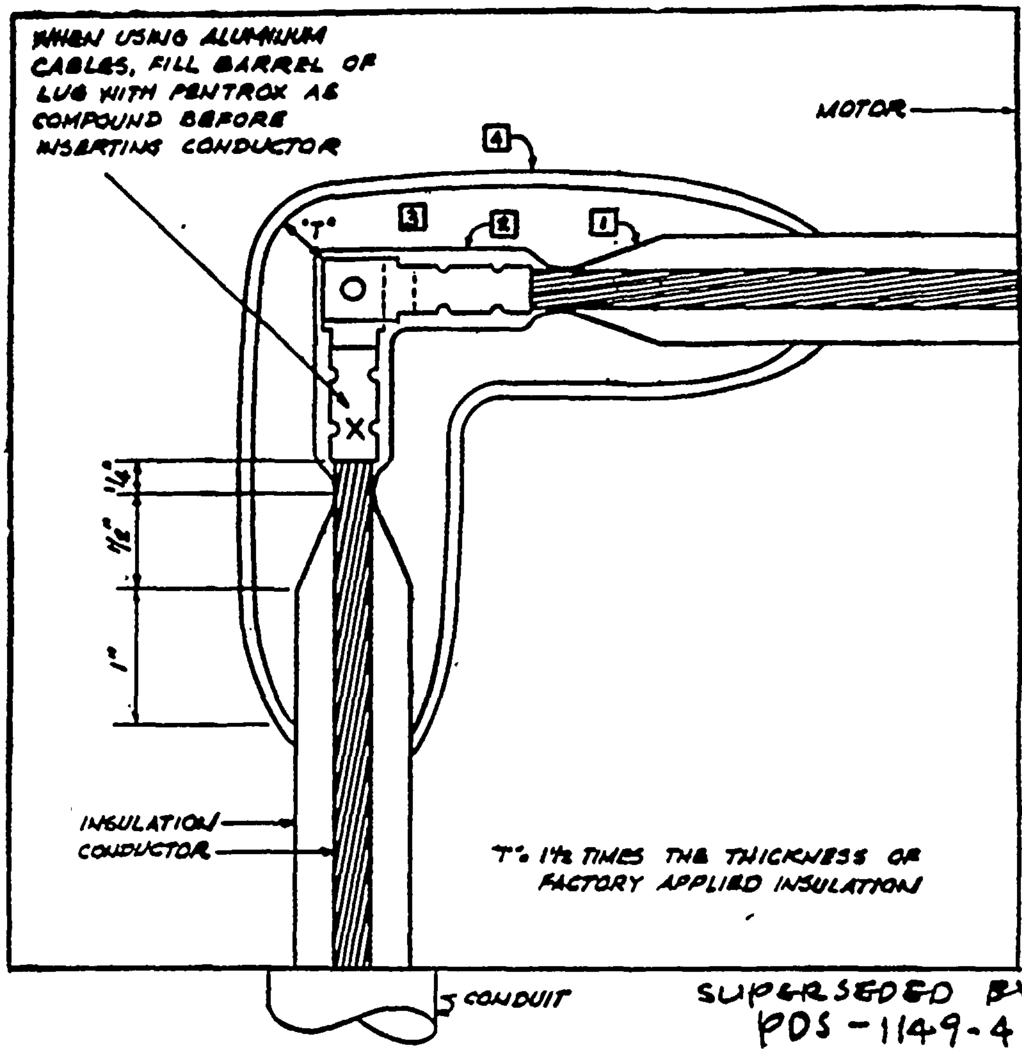


FIG. 8

SUPERSEDED BY
PDS-1149-4
8-9-82
RH Bozgo

TERMINATION OF RUBBER-LIKE & CROSS-LINKED POLYETHYLENE CABLE (NON SHIELDED)

1. TAPER CABLE INSULATION
2. ROUND OUT ALL IRREGULARITIES WITH INSULATING PUTTY (M.E. #63-100500) (694)
3. APPLY HALF-LAPPED SPLICING COMPOUND TAPE (SCOTCH #23 OR BISHOP-W962) (692)
4. APPLY 3 HALF-LAPPED LAYERS OF NEOPRENE TAPE OVERALL (OKONITE-OKOPRENE NEOPRENE) (693)

DETAIL OF ONLY ONE LEG SHOWN ALL THREE LEGS TO BE MADE AS SHOWN

FOR USE INSIDE AND OUTSIDE OF CONTAINMENT AREA

NUMBERS IN CIRCLES REFER TO COOK PLANT B/M.

INDIANA & MICHIGAN ELECTRIC CO.		DONALD C. COOK NUCLEAR PLANT	600V MOTOR TERMINATIONS RUBBER & XL INSULATION
APP'D BY	DR. BY JVC	CH. BY F.H.S.	DATE 3-12-69
AMERICAN ELECTRIC POWER SERVICE CORP. 2 BROADWAY, NEW YORK			1-2-8D5-613-3

ATTACHMENT TO AEP:NRC: 0775AQ

H. N. SCHERER, JR.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AMERICAN ELECTRIC AEP POWER SYSTEM

DATE: May 19, 1978

SUBJECT: D. C. Cook Plant
Material Control of Insulating Tapes

FROM: T. E. King

TO: D. V. Shaller - Bridgman

Qualification tests of electrical connections made inside the containment on safety related motor terminal connections have been performed at the Westinghouse-Canada test facility at Hamilton, Ontario, Canada and will be reported on test reports CWAPD-326 and CWAPD-348. The tested samples are identified as E1, E2, E3, E4, F1, F2, F3 and F4 and consist of a connection made in accordance with drawing 1-2-EDS-613-2, "600 V Motor Terminations". The "E" series of test samples used Scotch #23 tape for B/M Item 692 and the "F" series of test samples used Bishop W962 for B/M Item 692. Both samples used Okonite "Okoprene" neoprene tape for B/M Item 695. Both the Bishop W962 and Scotch #23 tapes were used on 600 volt motor connections in the Unit 1 and 2 reactor containments.

We must assure ourselves that any remake of the motor connections of safety related motors inside the containment use only materials which have been qualified by the above test. To accomplish the above objectives, may I suggest the following:

1. The stock material cards for the subject tapes use the item numbers for Bill of Material 1788 for identification. TKC 11/28/89
2. The reference to the system M and E number be deleted from the stock cards since this number includes tapes which have not been qualified for nuclear containments.
3. Identify Scotch #23 and Bishop W962 as the only acceptable replacement tape for Item 692.
4. Identify Okonite Okoprene neoprene tape as the only acceptable replacement tape for Item 695.
5. Obtain suitable quantities of the acceptable tapes for stores requirements.
6. Return all non conforming material to I and M central stores for reissue and use outside D. C. Cook Plant.

INTRA-SYSTEM

By copy of this letter I am requesting the Electrical Design Section to revise 1-2-EDS-613 to delete the references to the M and E Number for B/M Items 692 and 695 and insert a note identifying Scotch #23 or Bishop W962 tape for Item 692 and Okonite Okporene tape for Item 695. In addition, a similar revision is requested for B/M Items 692 and 695 in B/M 1788W. 11/28/79

Approved ______________
M. I. Olken

T. E. King

TEK/jal

cc: H. N. Scherer, Jr.
R. A. Byron
S. H. Horowitz
R. W. Jurgensen
R. F. Kroeger
J. D. Gore - Bridgman
C. Crow - Bridgman
S. J. Trippy - Bridgman
J. F. Steitzel - Bridgman
R. L. Dudding - Bridgman