Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

JUN 25 1994

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

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - THERMO-LAG FIRE BARRIER ISSUES - CABLE TRAY AND UNIQUE CONFIGURATION TEST PROGRAM

TVA has previously described a program for qualifying Thermo-Lag 330 for use as a one-hour barrier on electrical raceways at WBN. This program has included the conducting of fire exposure and ampacity tests for conduits protected by Thermo-Lag. NRC letter dated February 2, 1994, documented preliminary review of this test program.

TVA has planned to protect cable trays, where necessary, with one-hour Thermo-Lag designs qualified by tests performed by Texas Utilities (TU), and reviewed by NRC for Comanche Peak Unit 2. This is still TVA's intent. Engineering performed to date in support of installation of Thermo-Lag on cable trays at WBN has identified that additional testing could provide a benefit by reducing the scope of effort required to install the fire barrier material. These benefits include:

1. The TU tests were performed using a nominal cable fill in protected trays. Ensuring that the thermal mass in cable trays to be protected at WBN is at least as great as the configuration tested by TU will require additional mass (i.e., more cables) in some trays. Testing cable trays with no, or minimal, cable fill is expected to eliminate the need to install additional cables in these trays.

2. Electrical raceways to be protected at WBN include configurations in which cable trays or conduits are grouped together. Qualification

A029

of enclosures for protection of multiple raceways (e.g., stacked or parallel cable trays, ganged conduits) can reduce the scope of effort required to install the fire barrier material.

3. Reviews at other TVA facilities (i.e., Browns Ferry and Sequoyah Nuclear Power Plants) have identified Thermo-Lag installations not bounded by tests previously performed by TVA or TU. In many cases, these configurations involve grouped raceways. Qualifications of those installations, by test, can result in resolving the Thermo-Lag issue at those plants more quickly and with less effort than removing those installations and replacing them with previously tested configurations. (Results of tests of these configurations will be submitted on the WBN docket since any configurations so qualified will be used at WBN, as appropriate. Reliance upon the test results for other TVA plants will be addressed separately and will be consistent with the requirements for resolving this issue for plants already licensed to operate).

TVA and Thermal Science, Inc. (TSI) have agreed to a joint effort for this testing program. TVA will be technically responsible for the design and installation of the fire barrier systems. Additional responsibilities are described in Enclosure 1. Arrangements are presently being made to conduct these tests at Omega Point Laboratories. Ampacity tests will be performed, in addition to fire endurance tests, for those cases in which tested configurations are not bounded by the ampacity tests conducted to date. These additional ampacity tests will also be conducted at Omega Point Laboratories. Raceway materials to be used in constructing the test decks will be supplied by TVA and will be representative of materials installed at WBN. Installation of the Thermo-Lag fire barriers onto the test decks will be performed by TVA personnel. TVA will keep NRC informed of the schedule for these activities so that NRC may arrange for its personnel to observe any aspects of this test program.

The test plan for conducting the additional fire exposure tests is provided in Enclosure 1. It is fully consistent with the criteria provided in Generic Letter 86-10, Supplement 1. In particular, thermocouples will be installed at six-inch spacing on the outside of tray side rails and on bare #8 AWG stranded cables within the trays. Cable trays to be tested with cable fill will include bare cables both below the tray rungs and on top of installed cables. Any cables installed in test specimens will be examined for fire damage following the test regardless of the temperatures recorded inside the enclosure. Measured internal temperature rises of less that 250°F average (averaged as described in the Generic Letter) and 325°F maximum will be considered to qualify a tested installation regardless of cable type. Cables may be qualified for

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temperatures which may be experienced above these limits consistent with the "Test Plan for Circuit Functionality Testing" submitted as part of TVA's February 10, 1993 letter to NRC.

The test plan for conducting additional ampacity tests is provided as Enclosure 2.

Test reports for all tests conducted as part of this program will be submitted to NRC.

Commitments made as a result of this submittal are listed in Enclosure 3.

If you should have any questions, contact P. L. Pace at (615)-365-1824.

Sincerely,

Dwight E. Nunn
Vice President
New Plant Completion
Watts Bar Nuclear Plant

Enclosures
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50-390 TVA WATTS BAR 1

THERMO-LAG FIRE BARRIER ISSUES - CABLE TRAY AND UNIQUE CONFIGURATION TEST PROGRAM

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ENCLOSURE 1

ONE HOUR FIRE ENDURANCE TESTS OF ARTICLES PROTECTED WITH THE TSI THERMO-LAG FIRE BARRIER SYSTEM

1.0 SCOPE

This test plan describes the methods and guidelines for seven fire endurance tests. This test plan includes the preparation of the test decks and specimens, installation of the Thermo-Lag, performance of fire endurance and hose stream tests, temperature monitoring, and applicable documentation of these tasks and test results.

2.0 OBJECTIVE

The objective of these tests is to qualify a protective generic fire barrier system for redundant essential cables at Tennessee Valley Authority's (TVA) nuclear power plants. Successful results of this test program will provide documented evidence that the electrical raceway fire barrier systems (ERFBS) will satisfactorily withstand an ASTM E-119-88 fire exposure for a period of one hour, followed by a hose stream test. These tests shall satisfy the requirements for fire testing the ERFBS as detailed in Underwriter's Laboratories, Inc. (UL) Subject 1724, "Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems," Issue Number 2, August 1991, and NRC Generic Letter 86-10, Supplement 1, except where clarified, and in the absence of other standards for these specific types of tests, standard practice shall be invoked.

3.0 ACCEPTANCE CRITERIA

3.1 The exterior surface temperature of each electrical raceway shall be recorded (cold side of the barrier). If the average temperature recorded by the exterior raceway thermocouples does not exceed 250°F (139°C) above their initial temperature and no individual thermocouple is in excess of 325°F (181°C) above its initial temperature, the ERFBS shall be acceptable for use with any type cable.

3.2 The thermocouples located on the bare copper cable (#8 AWG) installed inside the electrical raceway shall be recorded. The highest thermocouple temperature rise above its initial temperature and the average temperature rise above their initial temperature shall be recorded for each ERFBS. These results WILL be analyzed, if required, at a later date to determine the unique electrical applications.

3.3 A hose stream test as described in Section 8.2 shall be performed at the end of the fire endurance test. If the hose stream test does not

cause any openings through which the electrical raceway is visible, the ERFBS shall be acceptable.

4.0 REFERENCES

4.1 10CFR50, Appendix R - Fire Protection Program for Operating Nuclear Power Plants.

4.2 American Society for Testing and Materials (ASTM) E119-88 - Standard Test Methods for Fire Tests of Building Construction and Materials.

4.3 Underwriters Laboratories, Inc. (UL) Subject 1724-91 - Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems.

4.4 TVA Position on Fire Testing Criteria for Fire Barrier Systems used to Protect Electrical Cables Required for 10CFR50, Appendix R Compliance.

5.0 RESPONSIBILITIES

5.1 TENNESSEE VALLEY AUTHORITY (TVA)

5.1.1 Establish the criteria, guidelines, drawings (draft quality), recommendations, etc., to govern the configuration of the test items.

5.1.2 Establish the criteria, guidelines, drawings (draft quality), recommendations, etc., to govern the installation of the fire penetration seal systems, if any (other than deck through-penetration seals).

5.1.3 Establish the criteria, guidelines, drawings (final), recommendations, hold points, etc., to govern the installation of the Thermo-Lag ERFBS to the test articles.

5.1.4 Provide specific Thermo-Lag installation procedures and work package documentation for each test.

5.1.5 Provide the electrical raceway materials (e.g., cable trays, fittings, conduits, junction boxes, cables).

5.1.6 Personnel to install the fire barrier systems.

5.1.7 Supply personnel to witness assembly and test article raceway configurations and Thermo-Lag installation at TVA's discretion.

5.2 THERMAL SCIENCE, INC. (TSI)

5.2.1 Provide the Thermo-Lag materials (5/8" and 3/8" thick ribbed and flat board, preformed conduit sections, trowel grade material), stress skin, stainless steel tie wire and bands.

5.2.2 Make the necessary arrangements with, and provide adequate funding for Omega Point Laboratories to perform the tests.

5.3 OMEGA POINT LABORATORIES, INC. (OPL)

5.3.1 Prepare the test furnace, deck and slab assemblies, and provide all required test instrumentation in accordance with its Appendix B Quality Assurance and Quality Control Program and other applicable procedures.

5.3.2 Provide thermocouple calibration and instrumentation, storage temperature records, surface temperature probe and relative humidity instrumentation.

5.3.3 Provide, assemble, install and document the installation of the electrical raceways (i.e., trays, conduits, cables, junction boxes, etc.) Provide computer generated drawings of the electrical raceways which clearly indicate critical dimensions, thermocouple locations, etc.

5.3.4 Coordinate all phases of the fire test preparation.

5.3.5 Supply QC personnel to witness and document assembly and test article raceway configurations.

5.3.6 Provide all applicable quality control documentation for the ERFBS materials to the test articles and attendant instrumentation on each test article.

5.3.7 Observe and document the installation of the Thermo-Lag ERFBS materials to the test articles and attendant instrumentation on each test article.

5.3.8 Conduct the fire endurance and water hose stream tests.

5.3.9 Document the test parameters and provide a formal, detailed written report of the test program and test results.

5.3.10 Notify TVA and TSI within three (3) working days of completion of each test specimen.

5.4 OPL QUALITY ASSURANCE/QUALITY CONTROL

5.4.1 Verify the quality control documentation of the ERFBS materials used in the test program.

5.4.2 Perform and document inspections of the ERFBS materials at various points during the installation process.

5.4.3 Verify and document that TVA's installation procedures are used in the installation of the ERFBS.

5.4.4 Inspect and document the construction and instrumentation of the test articles.

5.4.5 Provide written calibration documentation of all thermocouples, measurement devices and data acquisition systems used in this test program.

6.0 SPECIAL PRECAUTION

6.1 PRECAUTIONS FOR INSTALLATION OF THE ERFBS

6.1.1 Observe specific precautions recommended by TSI and other's material safety data sheets.

6.2 PRECAUTIONS FOR CONDUCTING THE FIRE ENDURANCE TEST

6.2.1 Proper safety precautions shall be exercised to preclude personnel from direct exposure to the flame environment, hot object, hazardous gases, and other related hazards.

7.0 PREREQUISITES

7.1 GENERAL TEST CONFIGURATION REQUIREMENTS

The electrical raceway installation configurations for the tests shall be shown on drawings in Appendix A.

7.2 TRACEABILITY REQUIREMENTS

To ensure that the materials used in these tests are representative of those in actual use, or to be used at TVA facilities, all aspects of traceability as required by the OPL QA Program shall be applied.

All thermocouples used in these tests shall be traceable to the respective thermocouple manufacturer, with calibration certification.

7.3 DIMENSIONED DRAWINGS

All test articles shall conform to the draft dimensioned drawings (see Appendix A). Final dimensioned drawings shall be prepared by OPL.

7.4 SHIPPING, RECEIVING, MATERIAL INSPECTIONS

Make a visual inspection of all materials for damage.

Record lot numbers and expiration dates of materials as applicable.

Thermo-Lag bulk grade materials are shipped under "protective service" with an in-transit temperature chart recorder included with each shipment in an identifiable container. That container reads "RECORDER IN HERE." The chart tape produced by this recorder shall be inspected by OPL personnel upon arrival of the shipment to ensure that the temperature limitations of 32°F to 100°F were not exceeded.

Thermo-Lag fire barrier materials shall be stored off the ground when not in use. The materials shall be stored in a totally enclosed and weather protected area when not in use (ANSI N45.2.2, level B or better). The bulk grade (trowel grade) material shall be maintained within the temperature limits of 32°F to 100°F.

Prior to application of the bulk grade material, check that the expiration date of the products have not passed. All bulk product expiration dates are good through the end of the expiration date month.

7.5 TEST CONFIGURATIONS

7.5.1 General

The test articles shall be sufficiently secured to the test deck by OPL personnel and sealed in accordance with written instructions and drawings.

7.5.2 Cable Trays and Conduit

One deck will consist of three (3) 18" wide, standard weight steel cable trays with 4" side rails and rungs spaced on 6" centers. Cable tray configurations for this program will consist of "L" shaped assemblies which penetrate the steel deck, extend downwards into the furnace for a minimum of 36", turn horizontally and extend for a minimum of 68" and through the side of the furnace. The deck will also contain a 3" rigid steel conduit that penetrates the steel deck, extends downwards into the furnace for a minimum of 36", turn horizontally and extend for a minimum of 68" and through the side of the furnace (see drawing in Appendix A).

7.5.3 Special Tray Fitting

One deck will consist of a special tray fitting and two sections four feet in length of 18" wide, standard weight steel cable trays with 4" side rails and rungs spaced on 6" centers. The special fitting and two section of cable trays shall be suspended below the steel deck a minimum of 36" into the furnace.

7.5.4 Stacked Trays and Raised Cover Tray

One deck will consist of three 18" wide, standard weight steel cable trays with 4" side rails and rungs spaced on 6" centers. The trays will be spaced 12" apart (bottom of tray to bottom of next tray) and extend vertically into the furnace 34" to 56", turn horizontally for approximately 84" to 108", turn back up and extend through the deck. Another 18" wide tray will be located approximately 15" beside the tray stack and extend through the deck approximately 36", turn horizontally for 96", turn back up and extend up through the deck. A solid cover with stand-off extensions will be mounted on this tray.

7.5.5 Conduits Enclosed in a Two-Sided Thermo-Lag Enclosure

One slab will consist of arrays of conduit installed in the corner of a horizontal concrete slab. The slab will simulate a wall meeting a ceiling (two sides of the enclosure). The Thermo-Lag will be installed to a steel support frame to form the other two sides to enclose the raceways. Both a large enclosure and a small enclosure shall be tested to provide bounding conditions. Space permitting, additional unique configurations may be added to the test slab.

7.5.6 Conduits Enclosed in a Three-Sided Thermo-Lag Enclosure

A wall assembly will consist of arrays of conduit installed on a vertical concrete wall. This test shall be performed using the vertical furnace. The concrete wall forms one side of the ERFBS enclosure and the Thermo-Lag forms the other three sides of the enclosure. The Thermo-Lag will be fastened to the wall, but is otherwise self-supporting. Both a large and small enclosure shall be tested to provide bounding conditions. Space permitting, additional unique configurations may be added to the test slab.

7.5.7 Ganged Conduits Enclosed in Thermo-Lag

One slab will consist of an array of seven steel conduits installed on a concrete horizontal slab. The conduits will be running parallel to each other on 6½" centers. The Thermo-Lag will be installed as follows:

- Preformed conduit sections will be installed on the outside half of the outside conduits
- Ribbed flat sections will be used to complete the enclosure around the conduits
- All-thread rod will be used to hold the flat sections together.

Space permitting, additional unique configurations may be added to the test slab.

7.5.8 Conduits Enclosed in a Four-Sided Thermo-Lag Enclosure

One test shall consist of an array of free standing conduits enclosed on all four sides with ribbed Thermo-Lag panels. This will resemble a column and will be similar to a column fire test. This test shall be run in the vertical furnace. Both a large and small enclosure shall be tested to provide bounding conditions. Space permitting, additional unique configurations may be added to the test slab.

7.5.9 Three hour fire endurance testing for TSI. Three hour fire rated configurations are not anticipated to be used at WBN. Details for the test plans of these configurations shall be provided by TSI at a later date.

7.6 CABLE LOADING REQUIREMENTS

7.6.1 The cable trays identified in 7.5.2 will be used to bound cable fill attributes of the ERFBS.

One tray will contain a single #8 AWG bare stranded copper conductor within the ERFBS and is to be in accordance with section 4.4 of reference 4.3 (UL Subject 1724). The bare copper conductor shall be instrumented along the entire length of the cable tray being protected.

One tray will contain a single layer of insulated cable within the ERFBS. A bare copper conductor will be routed on top of these cables and another bare copper conductor will be routed under the tray (attached to the bottom of the rungs) and will be instrumented along the entire length of the cable tray.

One tray will contain sufficient insulated cables to fill the tray up to the top of the side rails. A bare copper conductor will be routed on top of these cables and another bare copper conductor will be routed under the tray (attached to the bottom of the rungs). These bare conductors will be instrumented along the entire length of the tray.

7.6.2 The cable tray identified in 7.5.4 will be used to bound cable tray configurations where cables are above the side rail and have a raised cover. The tray will be loaded with insulated cables in a manner to be above the side rails. Thermocouples will be mounted down the top center of the tray cover rather than on a bare copper conductor routed on top of the cables. A bare copper conductor will be routed along the bottom of the tray (attached to the bottom of the rungs) and instrumented its entire length.

7.6.3 All other ERFBS will contain a single #8 AWG bare stranded copper conductor within the ERFBS and are to be in accordance with section 4.4 of reference 4.3. The bare copper conductor shall be instrumented along the entire length of the raceway being protected.

7.7 THERMOCOUPLE INSTALLATION

All thermocouples used in this test program shall be provided and installed by OPL, with QC surveillance by OPL personnel. The thermocouple wires shall be calibrated (by Lot Number) prior to installation and/or use, and applicable quality control documentation records generated. All thermocouples will consist of 24 GA, type K, Chromel-Alumel Teflon PFA insulation (Special Limits of error $\pm$1.1°C) electrically welded thermojunctions. Calibration will consist of manufacturer supplied (and audited) certifications of calibrations at fire temperatures of thermocouples taken from both ends of each purchased lot number.

The thermocouples shall be placed at 6" intervals and methods of attachment shall be in accordance with the requirements of sections 4.18, 19, 20, and 21 of reference 4.3. The thermocouples shall be attached to the bare copper conductors by wire ties, or equivalent.

7.8 INSTALLATION OF THE ERFBS TO THE TEST ARTICLES

Thermo-Lag ERFBS shall be installed by TVA crafts in accordance with applicable specifications, design drawings and procedures provided by TVA. Details of the ERFBS configurations including fasteners, orientation of structural ribs, etc., shall be documented in the final test report.

7.9 FIRE SEAL INSTALLATION

Upon completion of the fabrication and installation of the ERFBS to the test articles, all openings in the test articles shall be sealed by OPL. All openings in the test deck (slab, wall) assemblies shall be sealed by OPL. All open ends of raceways (conduits, etc.) which extend through the deck shall be sealed with both internal and external fire seals. Internal seals shall consist of silicone foam material (or equal), installed to a depth of nominally 6" and located at the end of the exposed raceway.

7.10 PREBURN INSPECTION

7.10.1 Prior to the commencement of the fire endurance test, a thorough check of the test assembly and associated equipment (including data recording equipment) shall be performed and documented by OPL.

7.10.2 TVA shall inspect the ERFBS for workmanship, surface defects, etc., prior to test.

7.10.3 Written approval of the construction, assembly, installation and instrumentation will be supplied by OPL prior to performance of each fire exposure test (a sign-off sheet for this purpose will be supplied by OPL and included in the final report).

7.10.4 Fire endurance testing of assemblies will not commence until the Thermo-Lag ERFBS attains a moisture meter reading that does not exceed 20 when using a meter with a scale of 1-100 such as a Delmhorst Model DP or equivalent, or 30 days has elapsed since completion of the ERFBS installation.

8.0 PROCEDURE

8.1 FIRE ENDURANCE TEST

8.1.1 The protected test article shall be exposed to the standard time/temperature curve found in ASTM E119-88 for one hour. TVA personnel may request stopping of test if premature failure of the specimen occurs.

8.1.2 OPL shall adapt their testing procedures to assure the fire test complies with the requirements established in all referenced standards. Any changes, revisions, or deviations required to comply with this requirement shall be documented and properly justified and included as a part of the final test report.

8.2 WATER HOSE STREAM TEST

8.2.1 Immediately (within 10 minutes) following the fire endurance test, accessible surfaces of the protected test article shall be subjected to the cooling, impact and erosion effects of a hose stream delivered through a 1½-inch fog nozzle set at a discharge angle of 15° with a nozzle pressure of 75 psig and a minimum discharge of 75 gpm. The nozzle orifice is to be a maximum of 10 feet from the edge of the tested assembly.

9.0 DATA SYSTEMS

During the fire exposure period, the thermocouples will be scanned at one minute intervals or less. Data storage for reporting purposes will be at one minute intervals (minimum); however, the furnace thermocouples should be scanned at 15 second intervals to allow close control of the furnace. A printer output of all thermocouple data should be done every 30 seconds.

10.0 FIRE TEST REPORT

10.1 OPL shall submit a report on the results of the test and thermocouple data. The test report shall be prepared and submitted in accordance with the requirements of sections 10.2 and 10.3 following.

10.2 OPL will assemble the final test report, containing the collected data and required quality control documentation.

10.3 The test report shall be prepared in sufficient detail to summarize the total testing activity. The report shall include as a minimum:

a. Date of the test
b. Location of the test
c. Description of the test furnace and test article
d. Calibration documentation of all thermocouples
e. Qualification and certification for test personnel
f. Test procedures used
g. Acceptance criteria
h. Provide quality control records for:
   (1) Test article construction
   (2) Identification and installation of ERFBS
   (3) Thermocouple locations
   (4) Cables, sizes, type and location
   (5) Actual raceway fill densities (mass per linear foot)
i. Computer printout and graphic results of the fire endurance test
j. All raw data
k. 35mm photographic coverage of the test project and video tape documentation of the fire and hose stream test
l. Provide a chronological log (Event Log) of all activities from receipt of materials through final test report
m. A copy of the test plan and fire barrier installation procedures provided by TVA

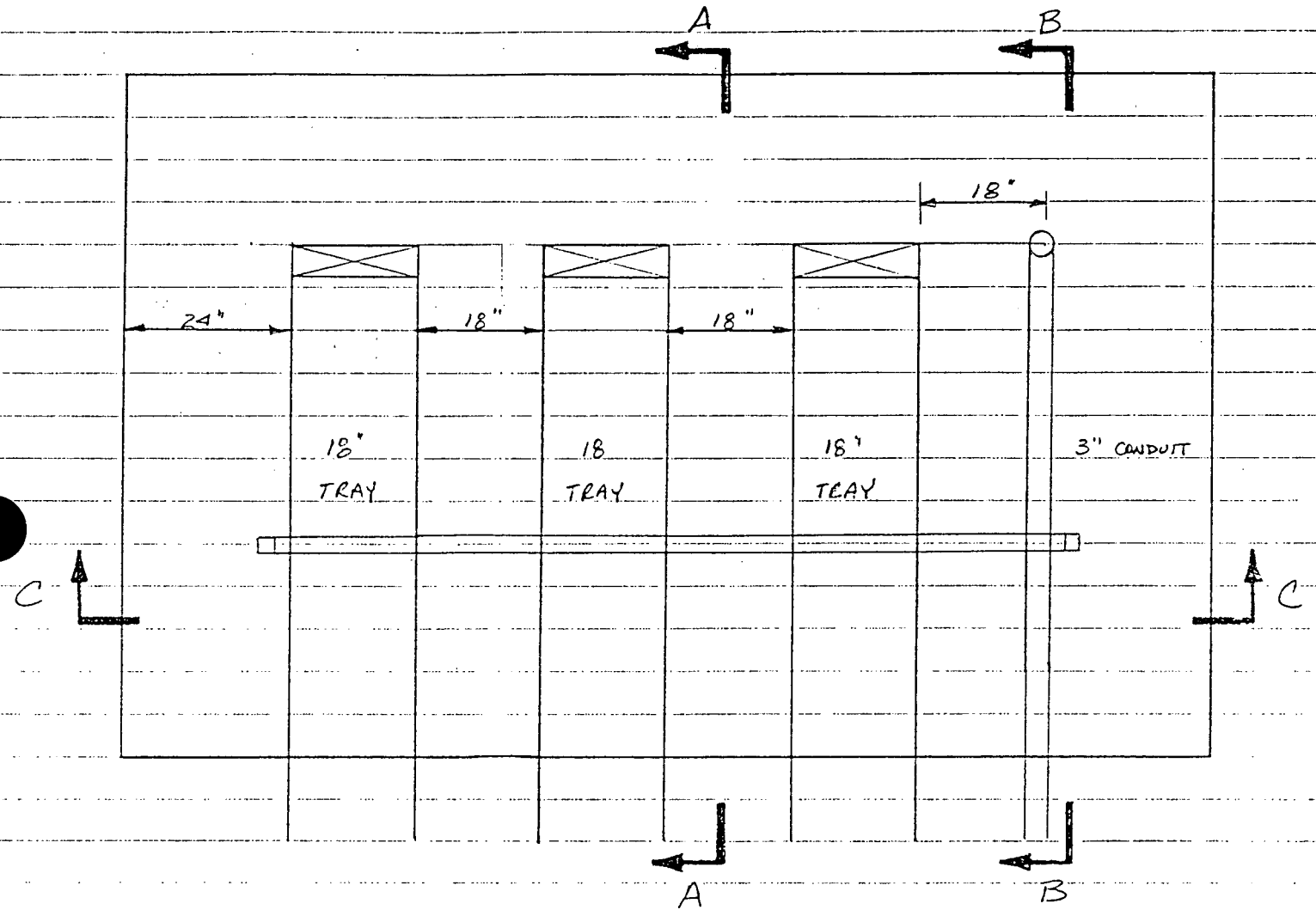
10.4 OPL shall provide six copies of each test report to TVA and one copy of each test report to TSI.

APPENDIX A

DESIGN DRAWINGS

SUBJECT TEST DECK 1 PROJECT TVA-TSI

COMPUTED BY DATE CHECKED BY DATE



PLAN VIEW
TRAY FILL TEST
AND TSI-3M INTERFACE

SUBJECT TEST DECK 1 PROJECT TVA-TSI

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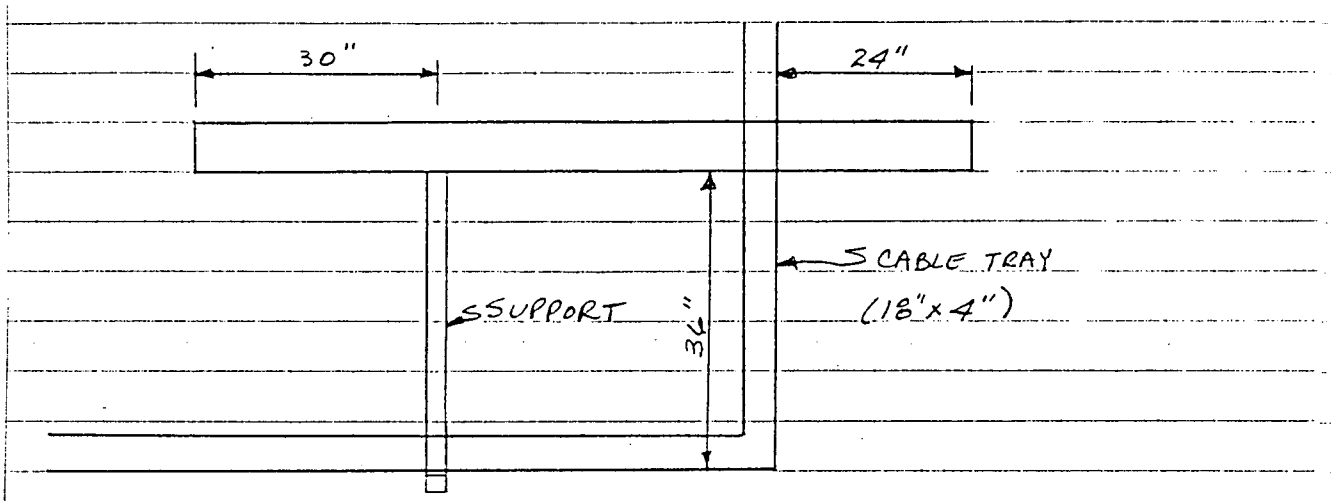
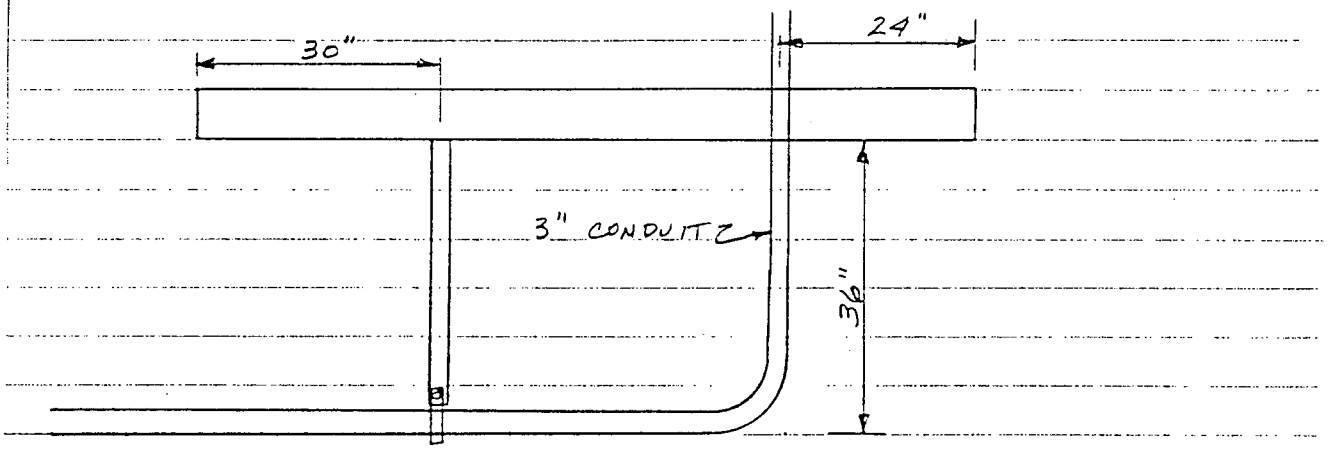


A-A

TYPICAL CABLE TRAY



B-B

TYPICAL CONDUIT

SUBJECT TEST DECK 1 PROJECT TVA-TSI

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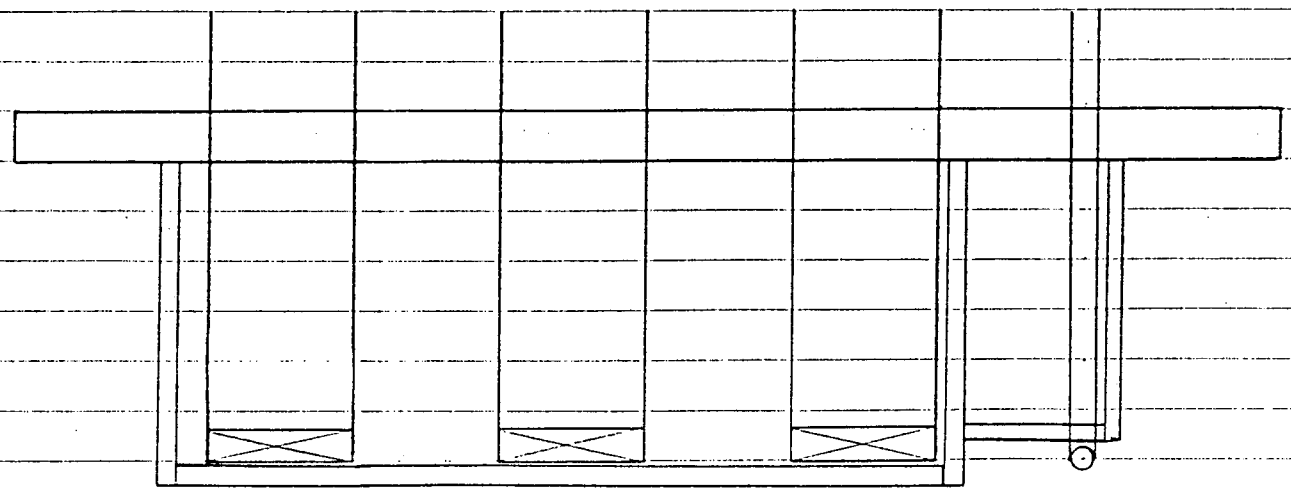

C - C

SUPPORT DETAIL

SUBJECT TEST DECK 2 PROJECT TVA-TSI

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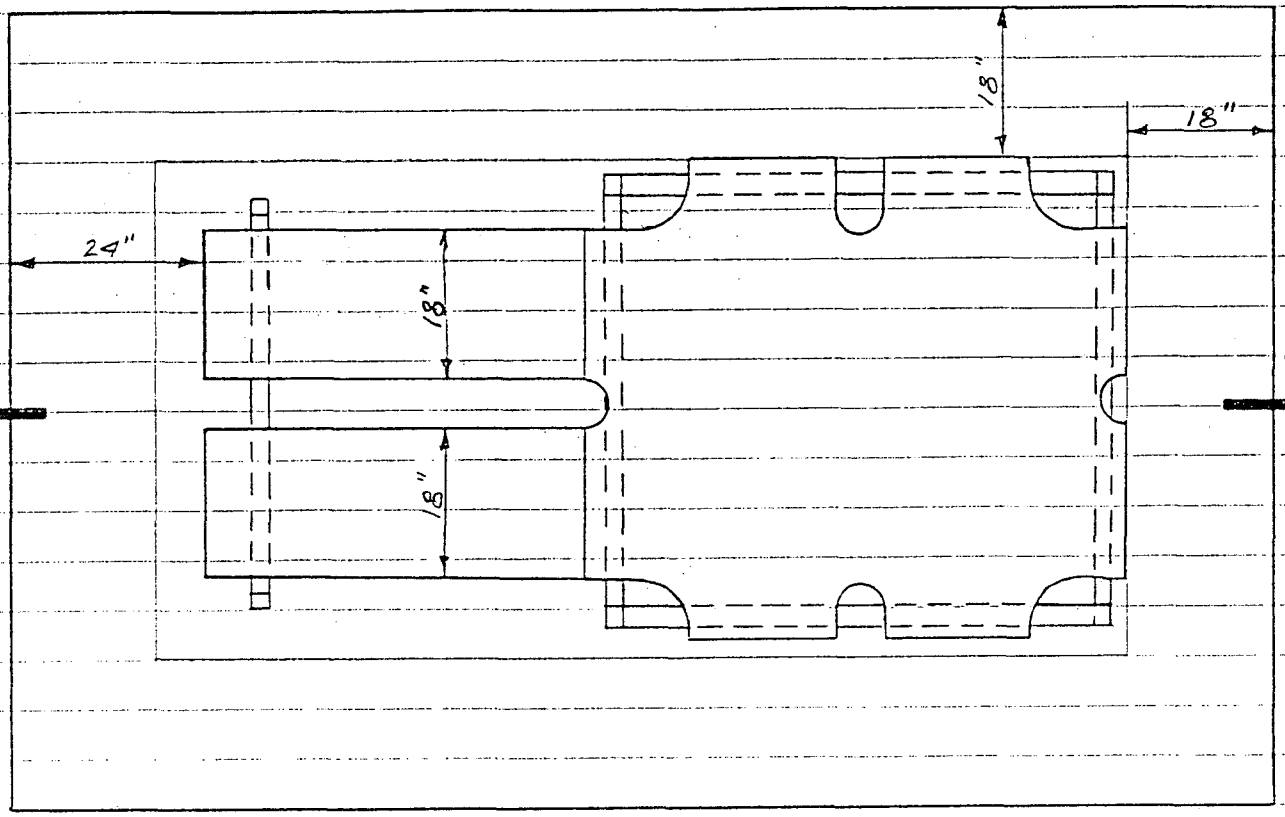

PLAN VIEW
SPECIAL TRAY

SUBJECT TEST DECK 2 PROJECT TVA-TSI

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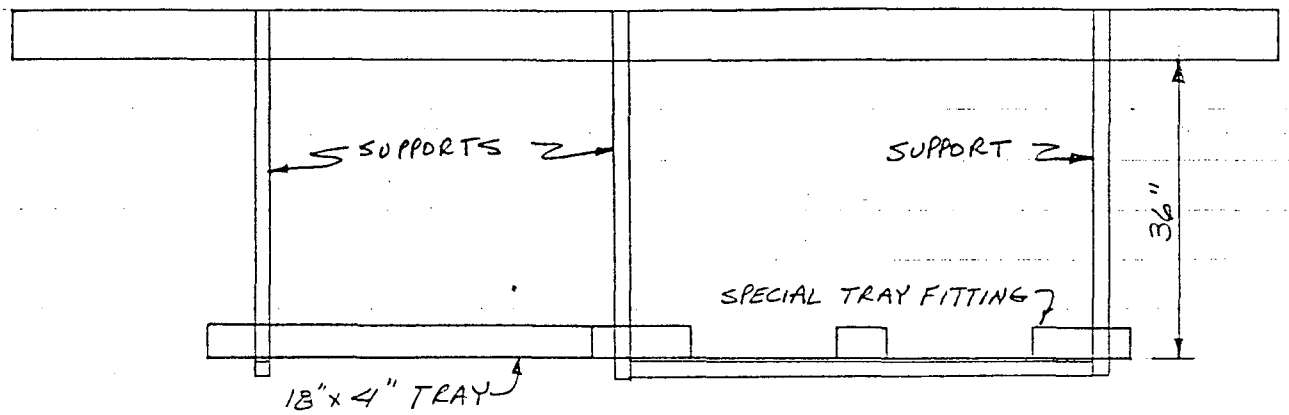

SECTION A-A
SPECIAL TRAY

SUBJECT TEST DECK 3 PROJECT TVA-TSI

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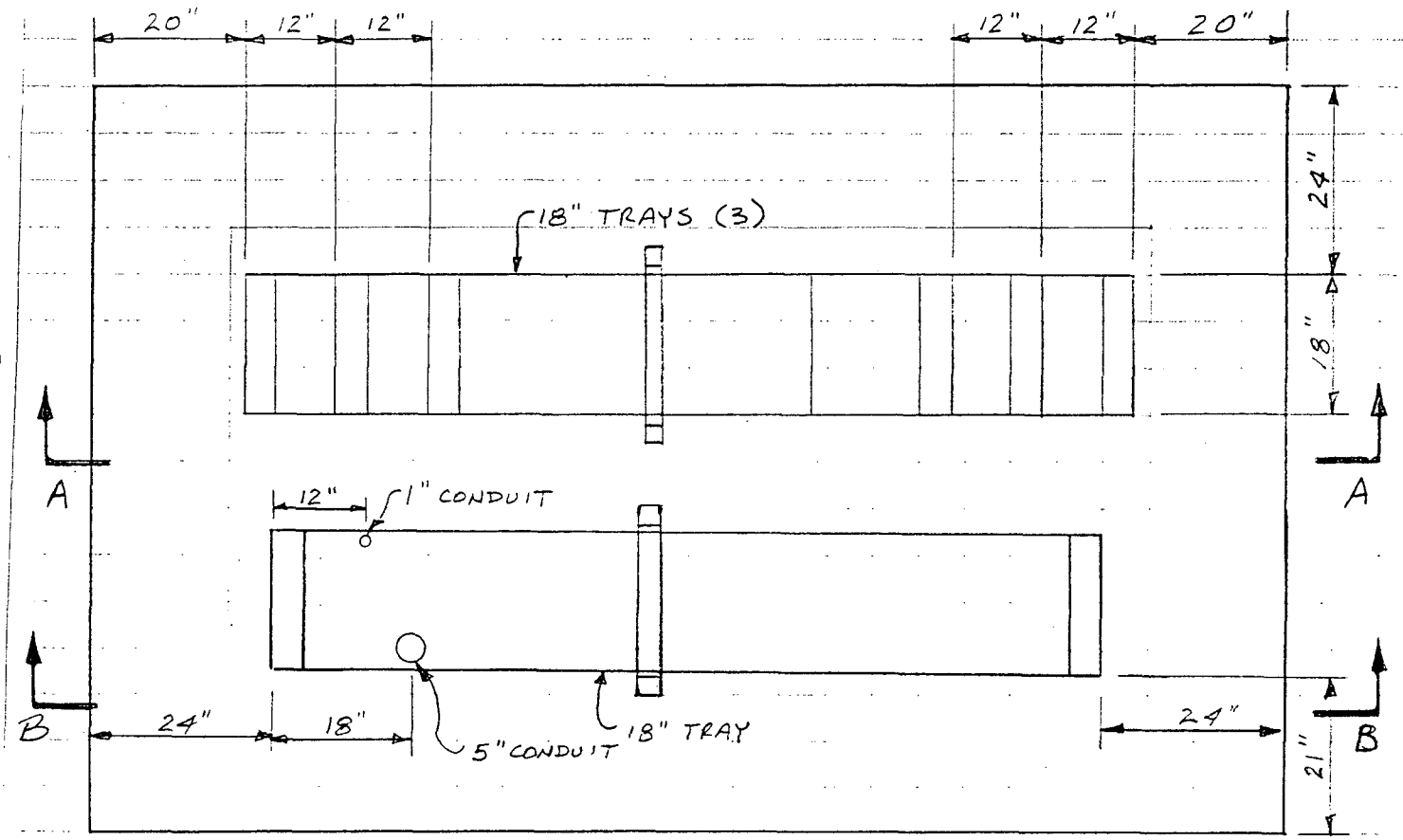

PLAN VIEW

SUBJECT TEST DECK 3 PROJECT

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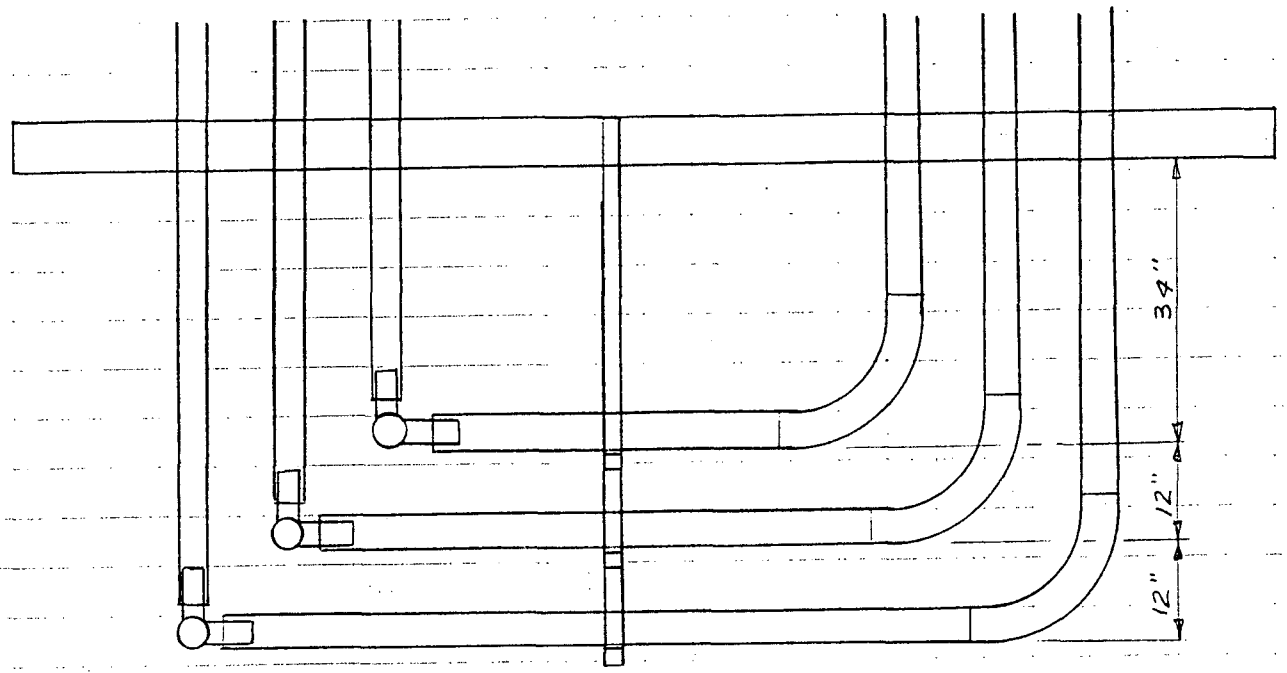
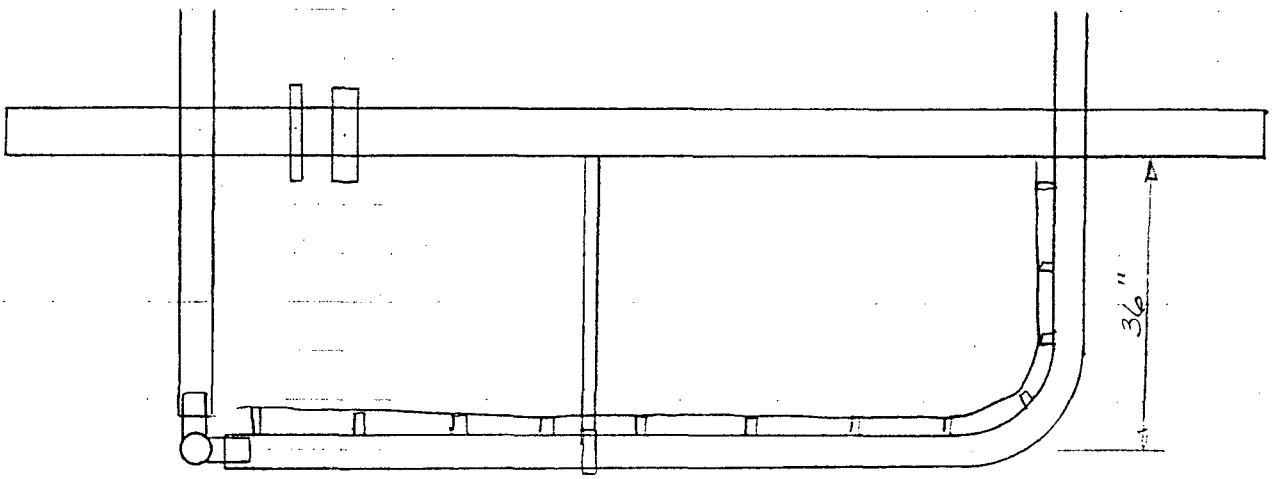
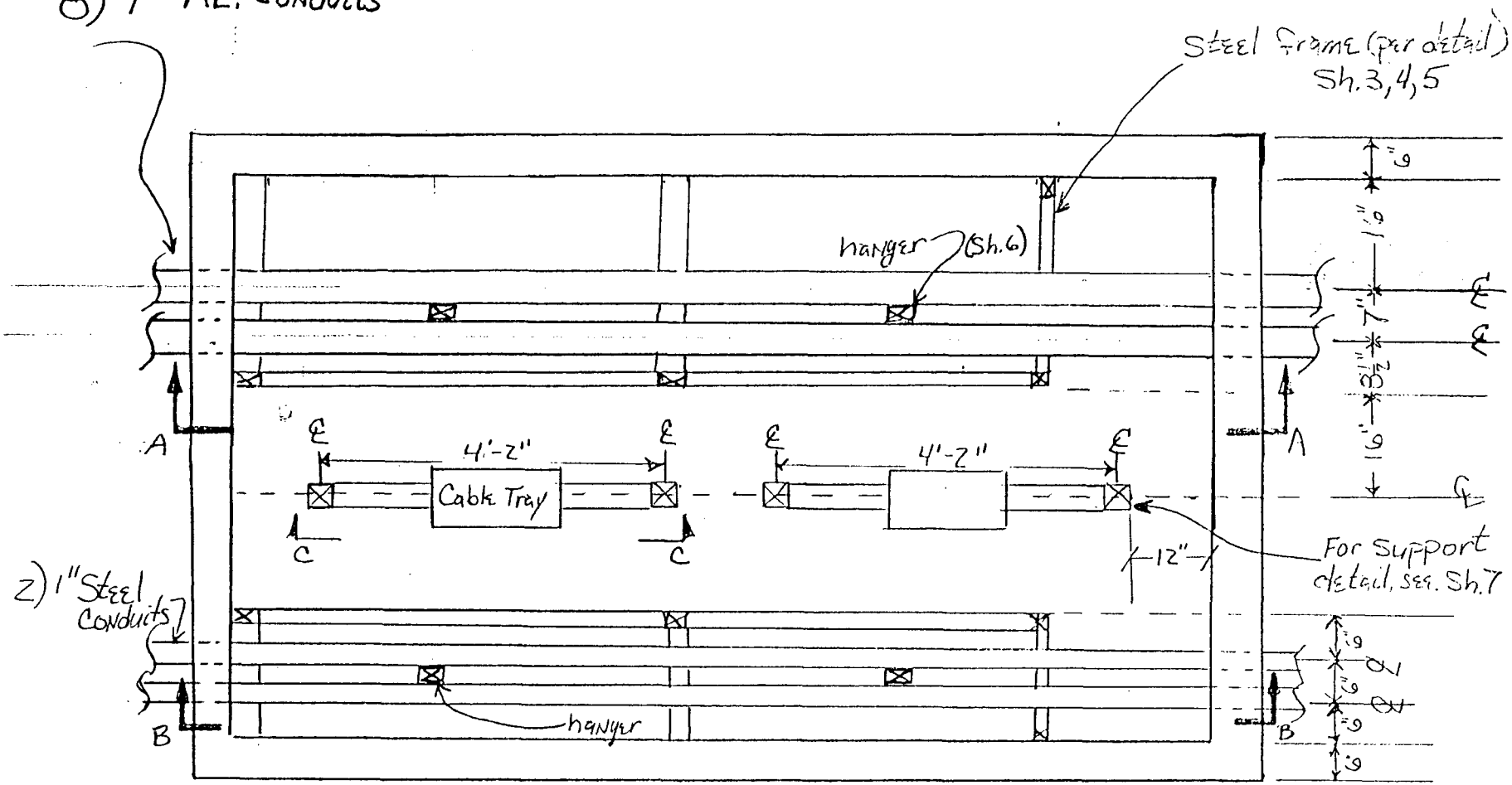


SECTION A-A



SECTION B-B

8) 4" AL. Conduits



Plan

Note: Conduit hangers alternate. Conduits fastened w/ 2 hole straps on one side only. Center supports to support conduits location.

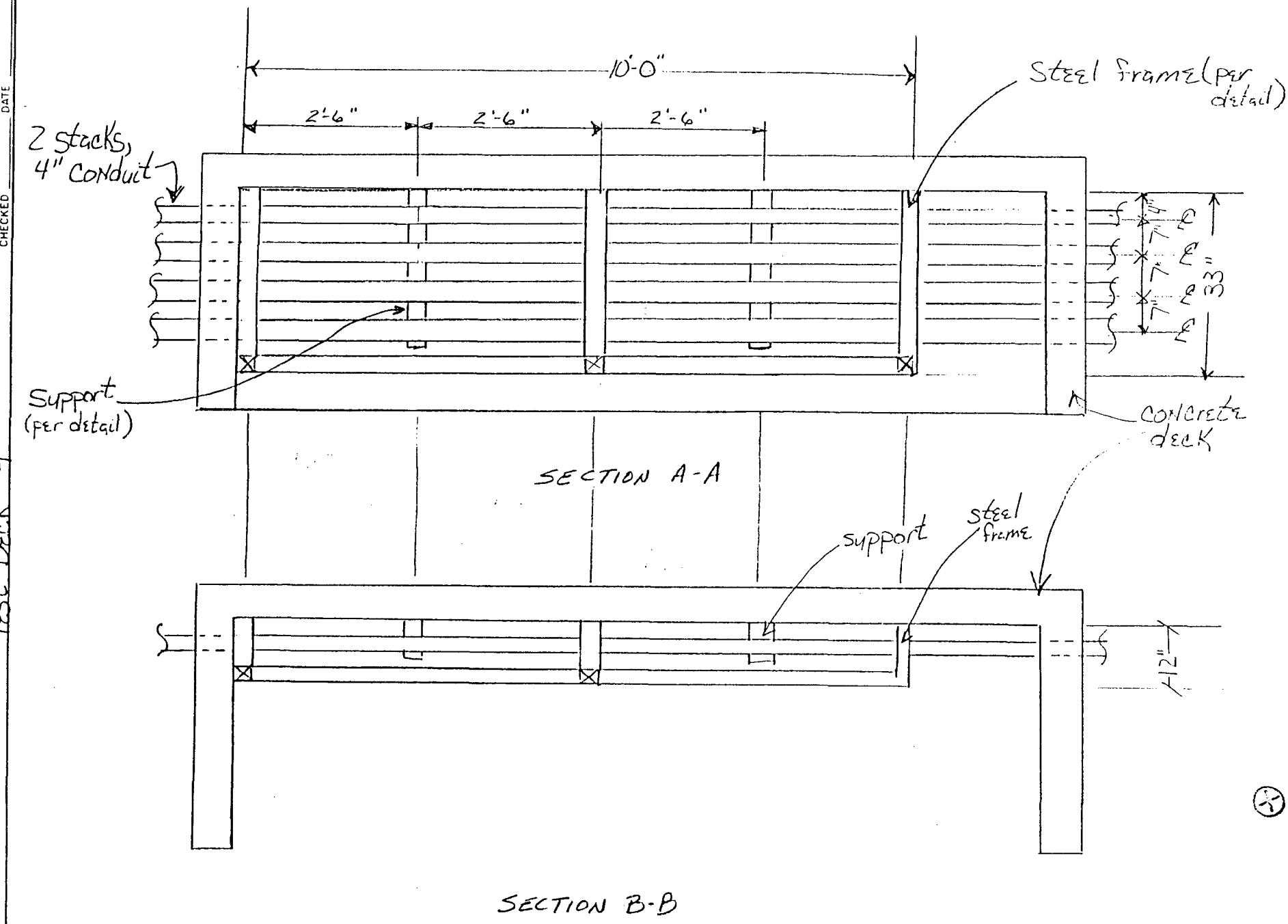
Test Deck #4

2-Sided Box 1

COMPUTED DATE

CHECKED DATE

7 of 7



Test Deck #4

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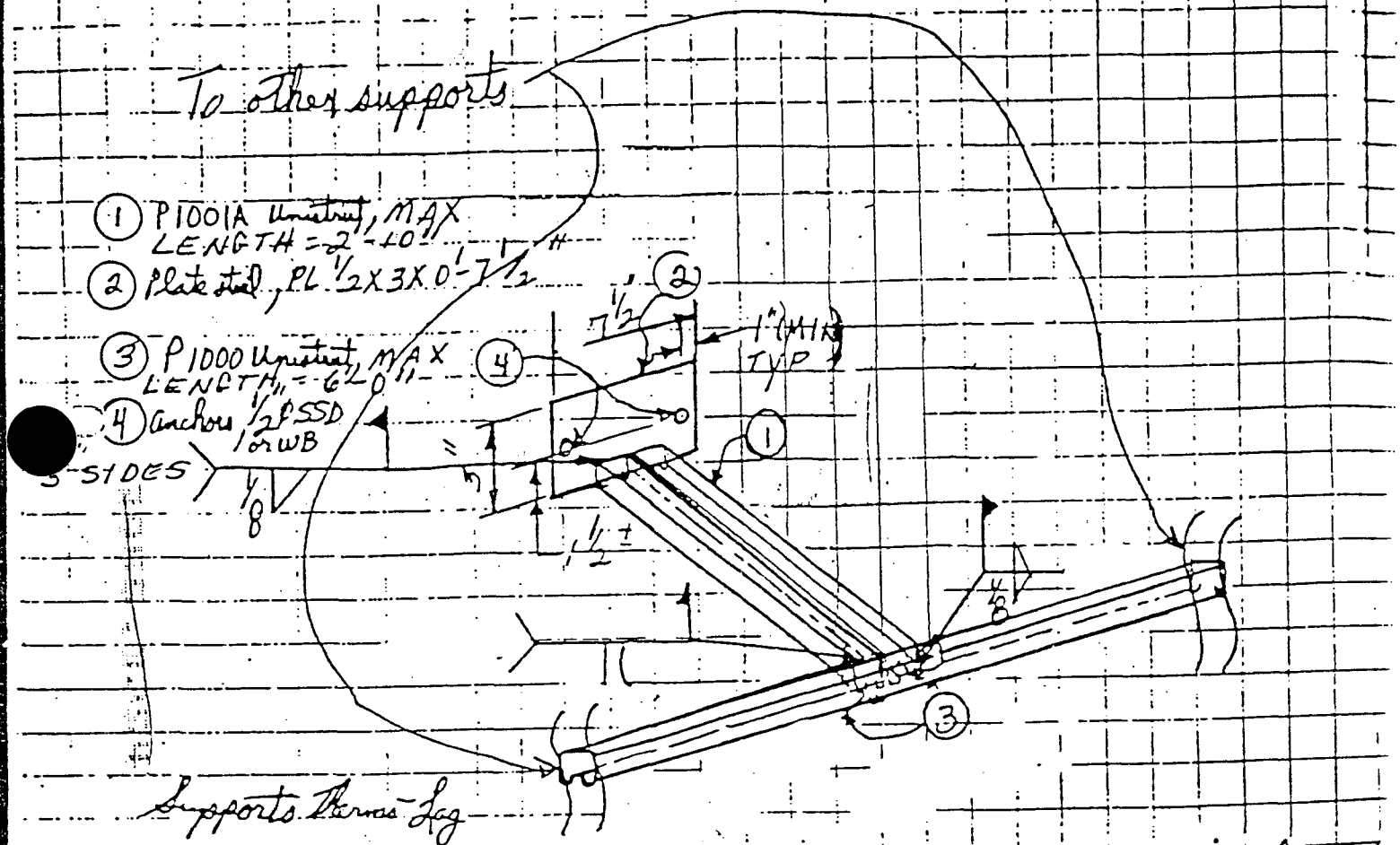
2 of 7

2-Sided Ex

3 of 7



Add the above support to drawing 48N1314-5 for the following location

1-3½-11-3½ ≈10'-2" W of u at A1 Elev ≈ 761'

47A053-90 series can apply

WP 17605

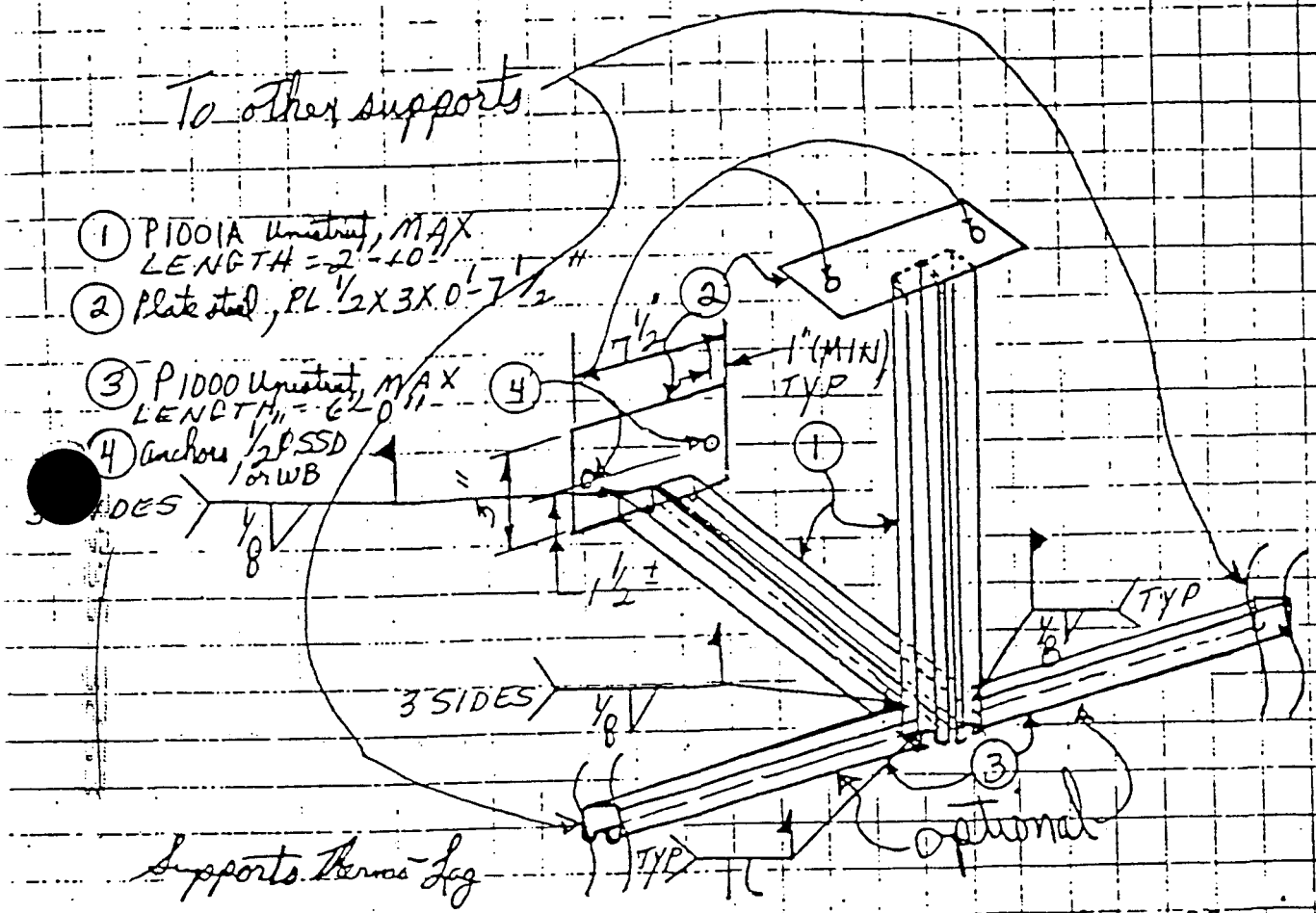
PAGE VI-59 OF VI-101

FCR-3451 R1

E417

To other supports

(1) P1001A Unistrut, MAX LENGTH = 2'-10"
(2) Plate steel, PL 1/2 X 3 X 0'-7 1/2"
(3) P1000 Unistrut, MAX LENGTH = 6'-0"
(4) Anchor 1/2" SSD or WB



Supports Barnes-Log

Add the above supports to drawing 48N1314-5 for the following locations:

(378-11377)	(1) ≃ 6'7½" W of u at A1	Elev ≃ 761'
(380-11378)	(2) ≃ 15'11" W of u at A1	
R2	(3) ≃ 0'8" W ft at A1	
	(4) ≃ 11'4" W of t at A1	
	(5) ≃ 17'4" W of t at A1	

47A053-90 series can apply

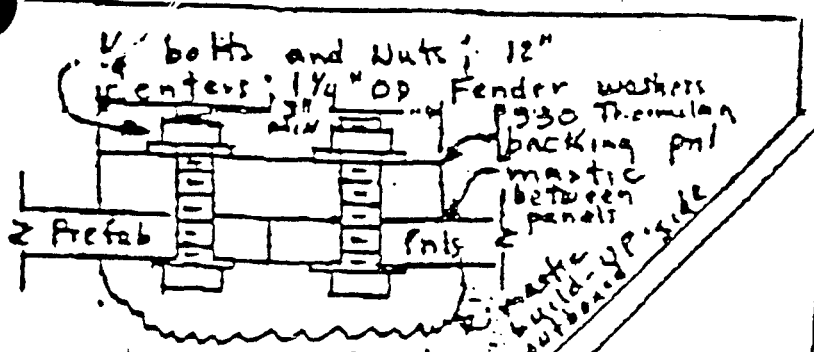
WP 11605
PAGE VI-58 OF VI-101

FCR-3451 R2

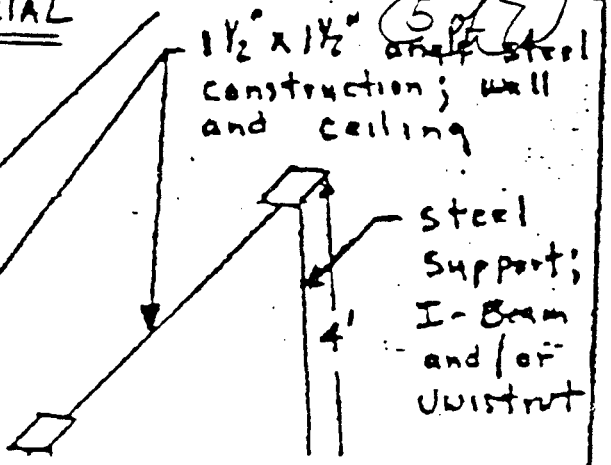
SEQUOYAH NUCLEAR PLANT

SK-DH 050286

TSI FIRE BARRIER INST - SPECIAL



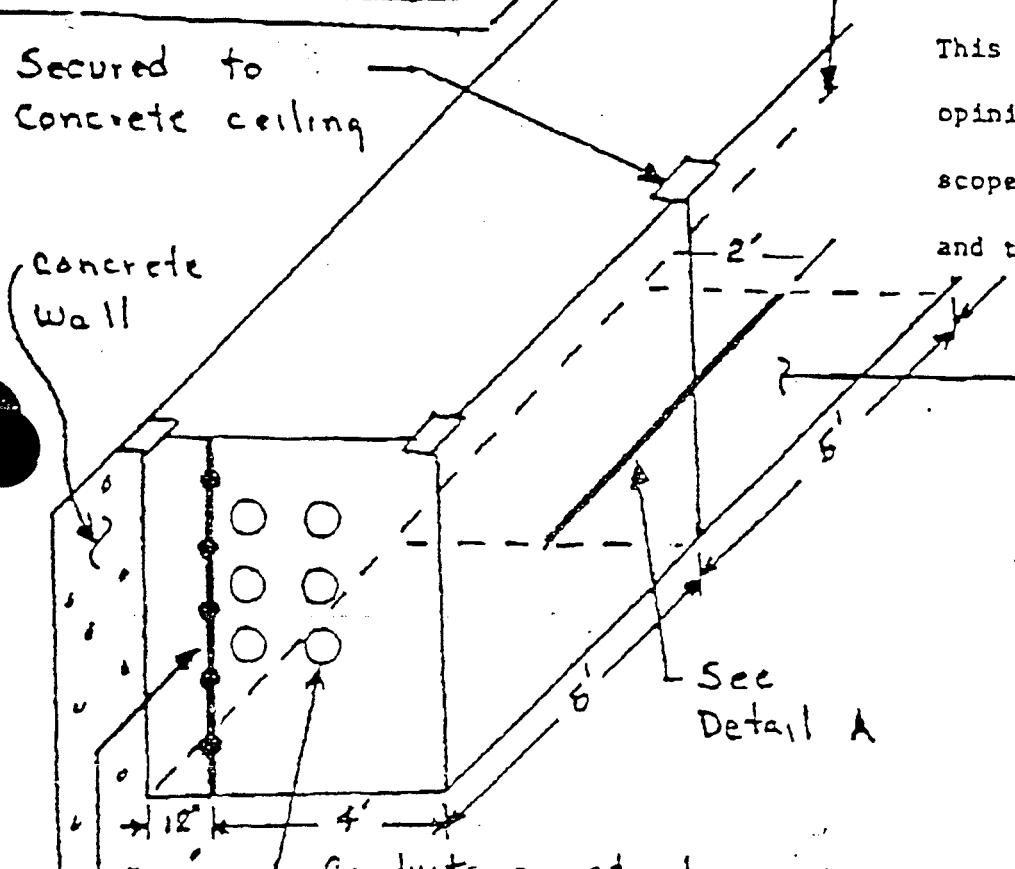
DETAIL A (ALT)



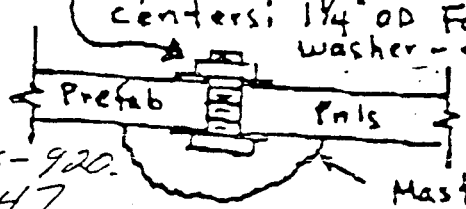
5-6-86

This application, in my opinion, is within the scope of the approved one and three hour test programs.

L. A. Johnson



Thermo-lag 330, 1 hr. Fire barrier material, ½" thick, Prefabricated panel construction, Secured around perimeter using Nelson studs on 12" centers (dimensions approx)



Detail A

* Pnls joined with mastic

TC-86-920
WP 113-47

PAGE X4-8 OF X4-8

NOTE: Thermo-lag Material furnished on contract 84KB5-836467

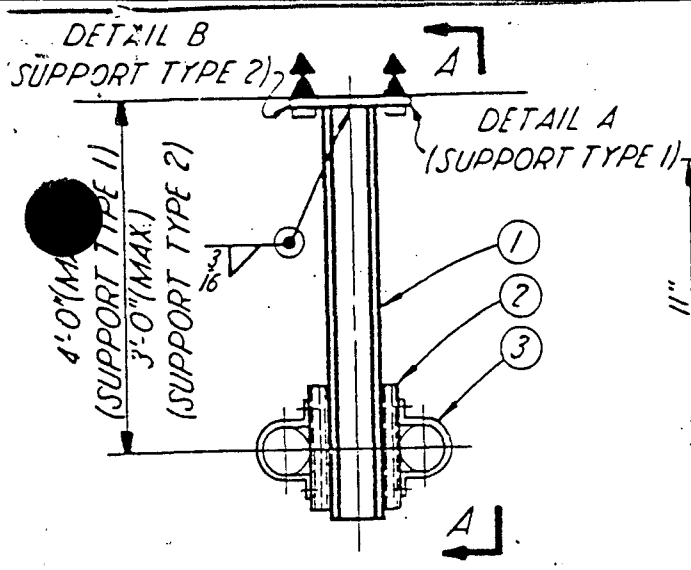
TVA 10038 (EN DEC-7-77)

DAM

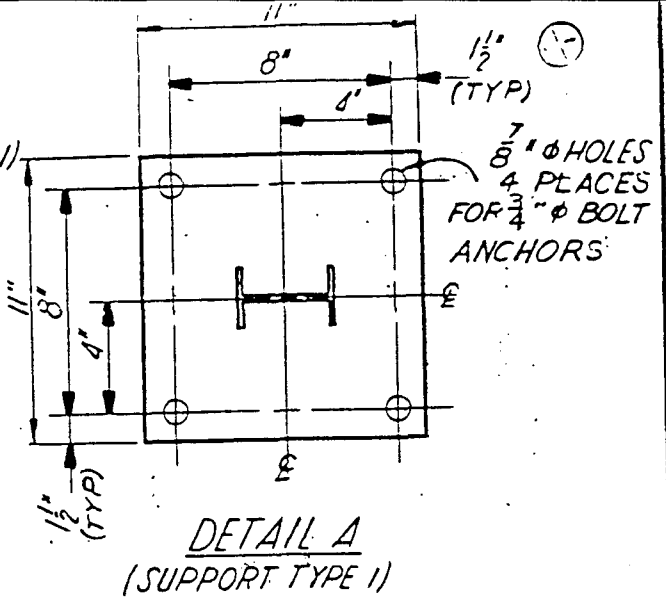
FROM

05/05/86 10:52 D 9 TOTAL D 9

06/17/85 08:57 P. 2



ELEVATION VIEW



DETAIL A
(SUPPORT TYPE 1)

TABLE A

SUPPORT TYPE	CONDUIT SIZE									STEEL SIZE "A"
	½"	¾"	1"	1½"	2"	2½"	3"	4"	5"	
1	50	50	9	13	11	6	4	3	2	W6 X 15.5
2	30	30	7	9	9	5	3	3	2	W4 X 13

NOTES:

1. FOR GEN. NOTES & REQUIREMENTS SEE 47A056-1.
2. THE NO'S. GIVEN IN THE BLOCKS OF TABLE A ARE THE THEORETICAL NOT THE PHYSICAL LIMIT OF CONDUIT SIZES TO BE SUPPORTED. WHEN SEVERAL SIZES ARE MIXED, THE LIMITING NO. IS TO BE THAT OF THE CONDUIT SIZE W/ THE SMALLEST ALLOWABLE NO. BY ITSELF.
3. THIS SUPPORT CAN BE MOUNTED TO FLOORS, CEILING, & WALLS USING EMBED. STEEL OR THE PL W/ CONC. ANCHORS.
4. THIS SUPPORT CAN BE USED AS AN AXIAL FOR UP TO 25FT OF CONDUIT WHEN USING OPTIONAL BRACE AS SHOWN IN SECTION A-A
5. UNISTRUT IS TO BE USED FOR THE ATTACHMENT OF CONDUIT. IT IS NOT NECESSARY FOR THE UNISTRUT TO RUN THE FULL LENGTH OF THE MAIN SUPPORT MEMBER.
6. COMPANION DWG 47A056-53A

NOTE *:

1. THIS DWG SHALL NOT BE USED AFTER NOV. 22 1985 WITHOUT PRIOR OF APPROVAL
2. THIS DWG HAS BEEN REPLACED BY 47A056-1053

NOT TO SCALE

REV NO.	NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR	SSD
1	L6530	11-22-85	RJD	DLW	ERLA			MGM	PLG	HPV		
	ADDED NOTE * PER 3770											

DSGN H.P.KGG
DRWN CALVIN V. HENDERSON
CHKD W.G. MONROE
SUPV R.S. ARRINGTON
INSP
ENGINEER J.L. Runkey

SEISMIC CLASS I STRUCTURES

MECHANICAL SEISMIC SUPPORT CONDUIT

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

Q

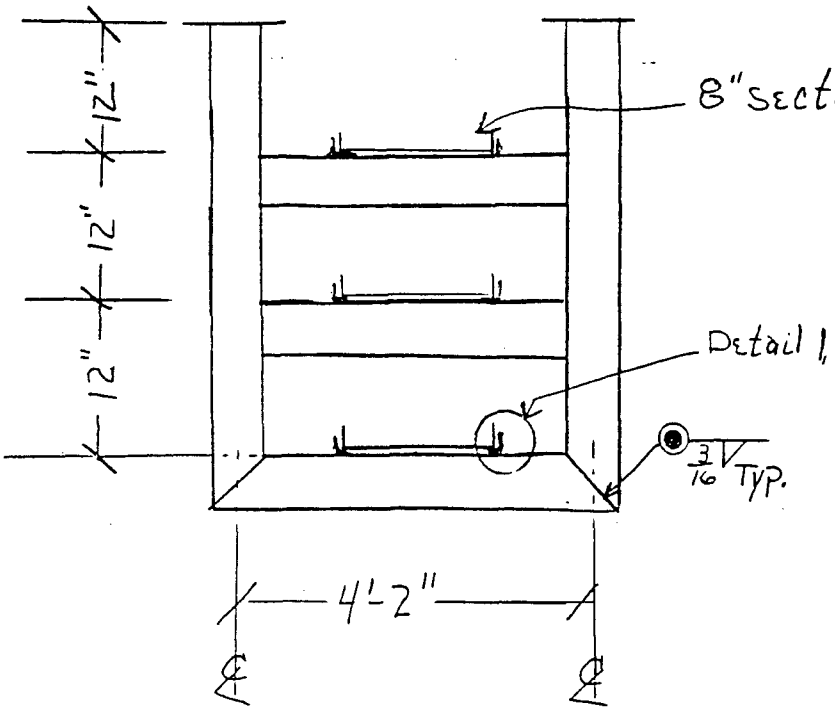
SUBMITTED	RECOMMENDED	APPROVED
J.L. Runkey	J.L. Kay	R.M. Rescek
KNOXVILLE	10-23-75	45 M 47A056-53 R1

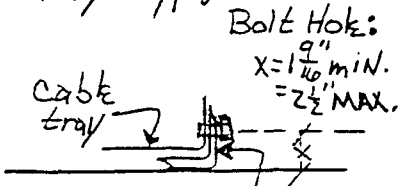
Test Deck #4

COMPUTED _____ DATE _____

CHECKED _____ DATE _____

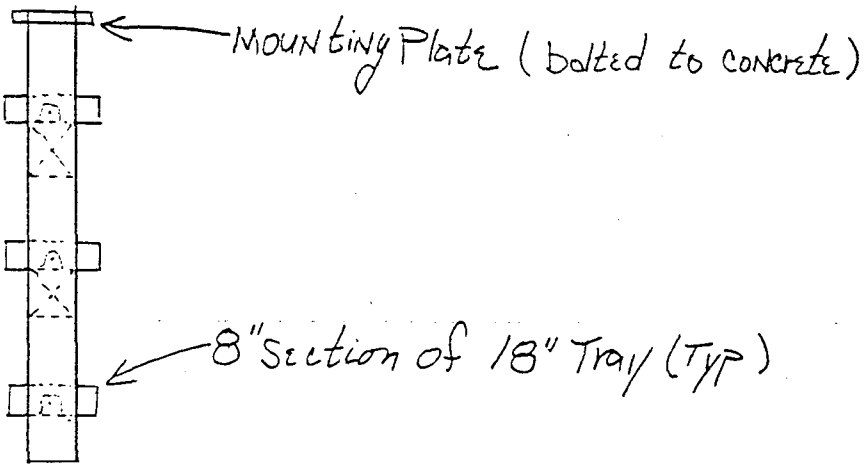
Cable Tray Support Details





Detail 1

1) Bolt = 3/8" x 1", Hole = 7/16" ϕ
Head installed inside tray.



Notes: 1) Tube Steel 6"x6"x0.5", ASTM-A500 Grade B or ASTM A501
2)
3)

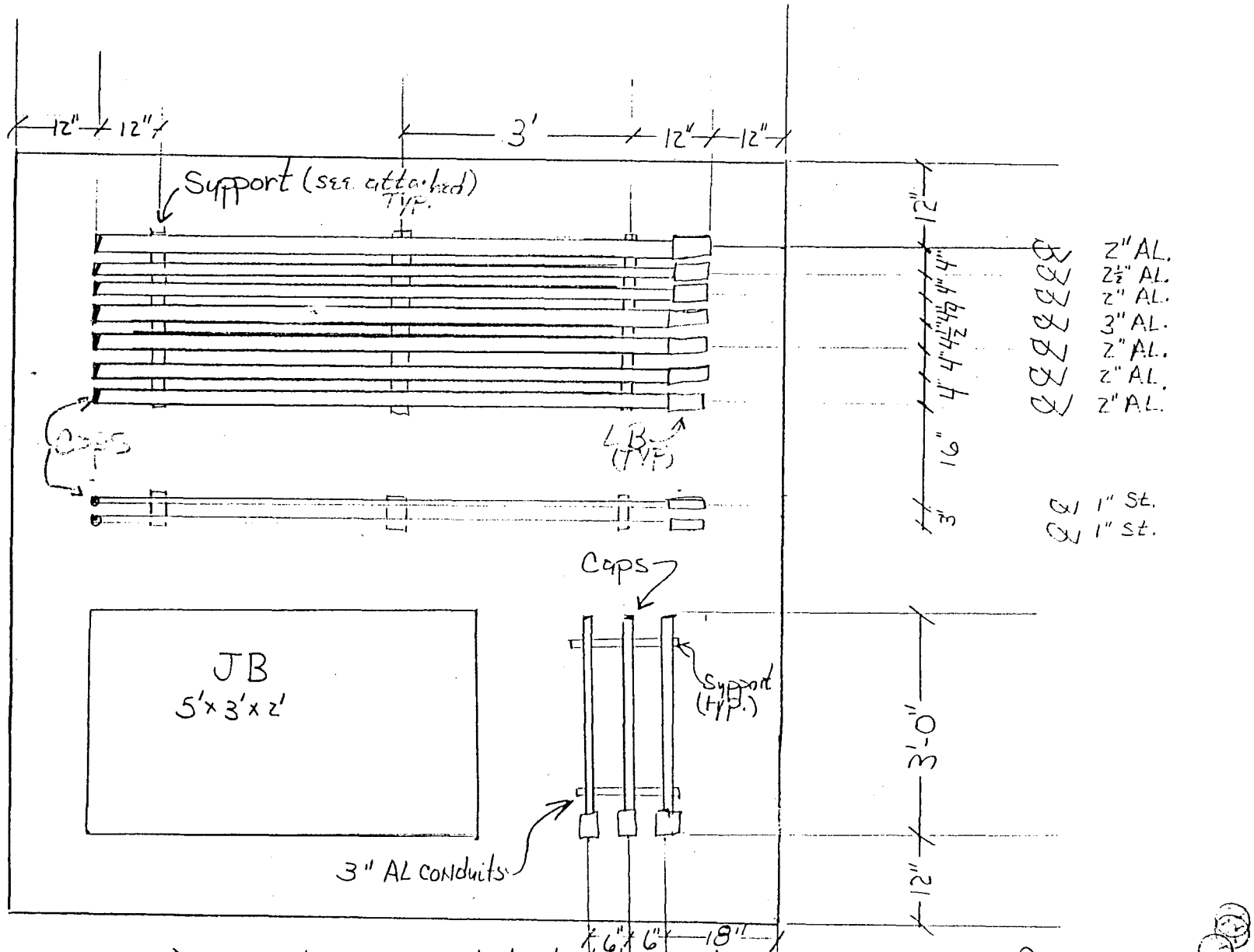
- 3 sided - Boxed Conduits
- Large J.B.
(Wall Config)

Test Deck #5

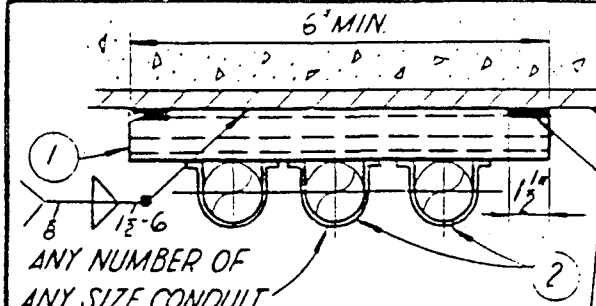
COMPUTED ____ DATE ____

CHECKED ____ DATE ____

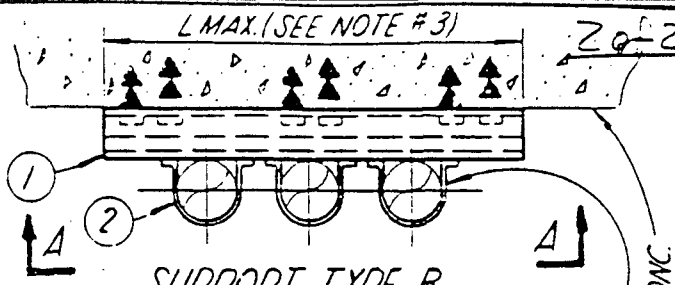
SHEET 1 OF 2



Note: 1) Supports per attached detail. UNistrut to be cut flush with END of 2 hole strap.
2) LB to exit through back of deck
3) Conduit ends to be Capped



SUPPORT TYPE A
SEE ALTERNATE SUPPORT A



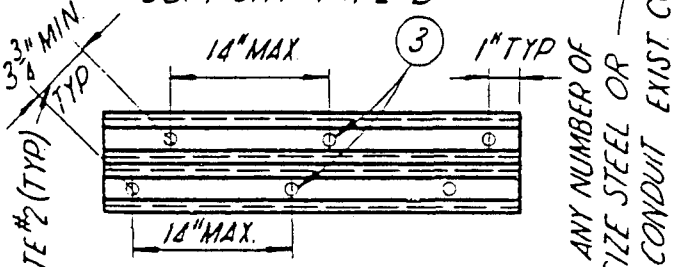
SUPPORT TYPE B

COND. Ø	L_{AXIAL} *
½"	50'
¾"	50'
1"	40'
1½"	25'
2"	25'
2½"	10'
3"	10'
4"	10'
5"	10'

TABLE A

TYP BOTH ENDS

1/8 1½"



SECTION A-A

* L_{AXIAL} IS THE MAX LENGTH OF THE ATTACHED CONDUIT FOR WHICH THIS SUPPORT WILL PROVIDE AXIAL RESTRAINT. (SEE NOTE 6)

NOT TO SCALE

NOTES:

1. FOR GENERAL NOTES & SPECIFICATIONS SEE 47A056-1
2. BOLT ANCHORS MUST BE A MIN. OF 3¾" APART IN ACCORDANCE W/ GENERAL CONSTRUCTION SPECIFICATION G-32.
3. L MAX MAY VARY AS NEEDED AS LONG AS MAX BOLT ANCHOR SPACING OF 14" IS NOT EXCEEDED ON EITHER CHANNEL OF THE PIOOIA UNISTRUT.
4. CONDUITS MUST BE ATTACHED TO EITHER CHANNEL OF THE PIOOIA UNISTRUT BETWEEN BOLT ANCHORS SECURING THAT PARTICULAR CHANNEL.
5. THIS SUPPORT MAY BE ATTACHED TO WALLS, FLOORS, OR CEILINGS.
6. THIS COND. SUPPORT WILL PROVIDE AXIAL RESTRAINT FOR THE SIZES & LENGTHS OF CONDUIT ATTACHED TO IT AS SHOWN IN TABLE A. CONDUIT SIZES MAY BE MIXED WITH THE AXIAL SPAN FOR THE LARGEST CONDUIT BEING THE LIMITING AXIAL SPAN FOR ALL CONDUITS ATTACHED
7. BOLTING TO CONC. MAY BE COMBINED W/ WELDING TO EMBEDDED PLS. AS LONG AS THE MAX. DISTANCE BETWEEN THE ADJACENT BOLT & WELD IS NO MORE THAN 14".
8. COMPANION DWG 47A056-59A.

MK NO	QTY	MATL DESCRIPTION
5	AS REQD	TS (SIZE AS REQD)
4	AS REQD	PIOOI UNISTRUT (LENGTH VARIES)
3	AS REQD	3/8" Ø BOLT ANCHOR ASSEMBLIES
2	AS REQD	P2558 UNISTRUT PIPE STRAPS W/ NUTS, BOLTS, & FLAT WASHERS
1	1	PIOOIA UNISTRUT (LENGTH VARIES)

REV NO	ECN NO	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD
5	L6530	11-23-73									
	ADDED NOTE * PER FCR 3770										
3	LS1	1-19-73									
	REV. PER SQ-FCR-1121 FOR ECN L-5198										
2	S1	5-2-72									
	ADDED NOTE 6										
1	S1	7-6-71									
	ADDED NOTE 7 PER FCR 2696										

REVISED PER FCR 2598 R1

DSGN G.H. PIGG
DRWN C.V. HENDERSON
CHKD W.G. MONROE
SUPV J.S. ARRINGTON

INSP
ENGINEER J. L. Rumsey

SEISMIC CLASS I STRUCTURE
MECHANICAL
SEISMIC SUPPORT
CONDUIT

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

Q

SUBMITTED | RECOMMENDED | APPROVED

KNOXVILLE 4-10-74 45 M 47A056-59

NOTE:
1. THIS DWG SHALL NOT BE USED A. - R NOV 22 1985
WITHOUT PRIOR OF APPROVAL
2. THIS DWG HAS BEEN REPLACED BY 47A056-1059

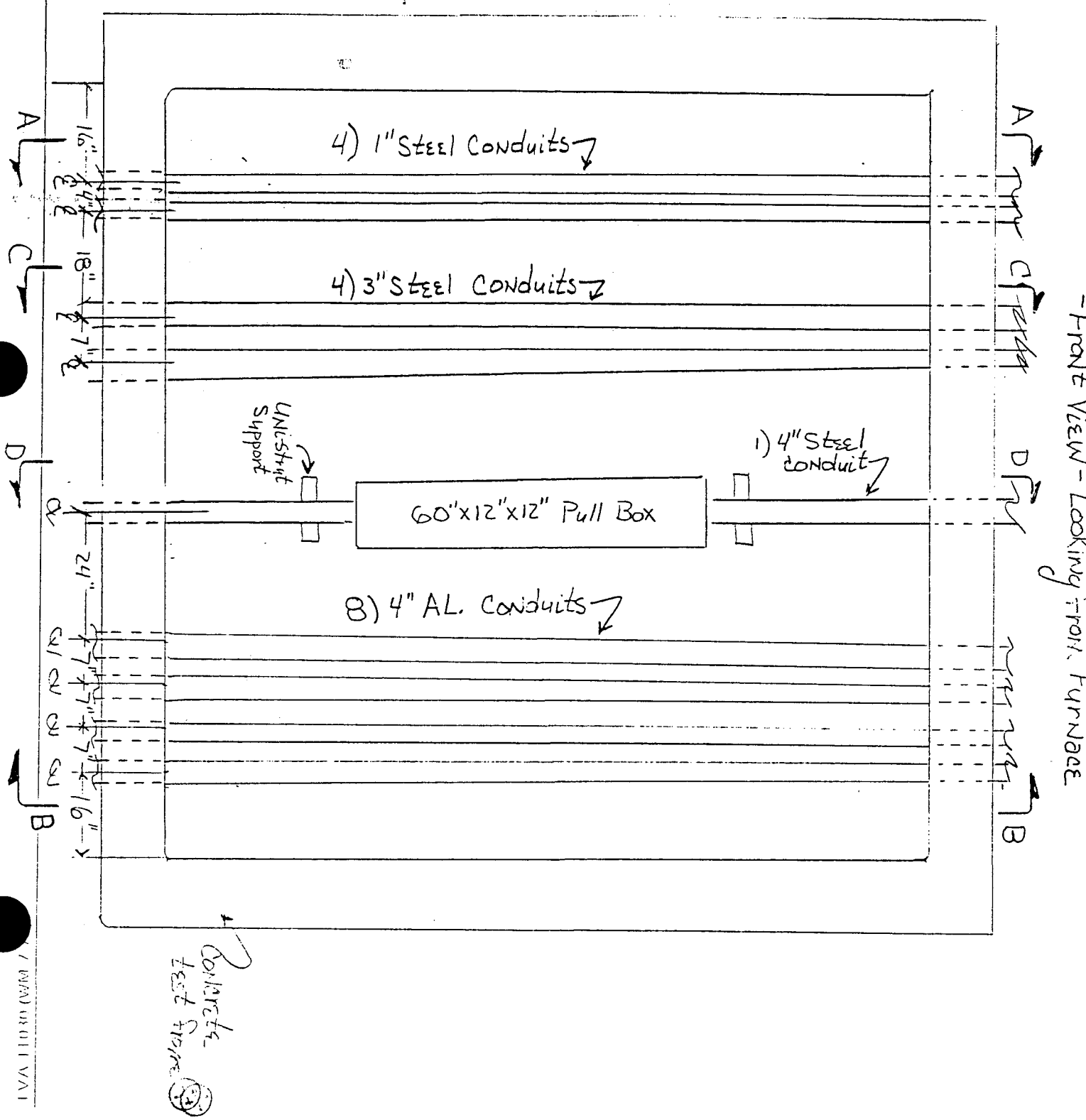
Sloped Thermocouple Box SHEET 3 OF 3

Test Deck*

Concrete Wall

COMPUTED _____ DATE _____

CHECKED _____ DATE _____

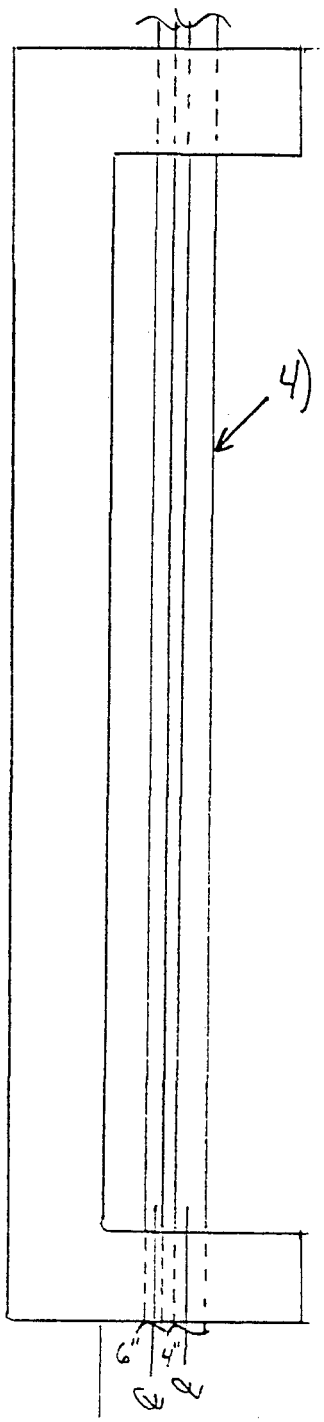


COMPUTED _____ DATE _____

CHECKED _____ DATE _____

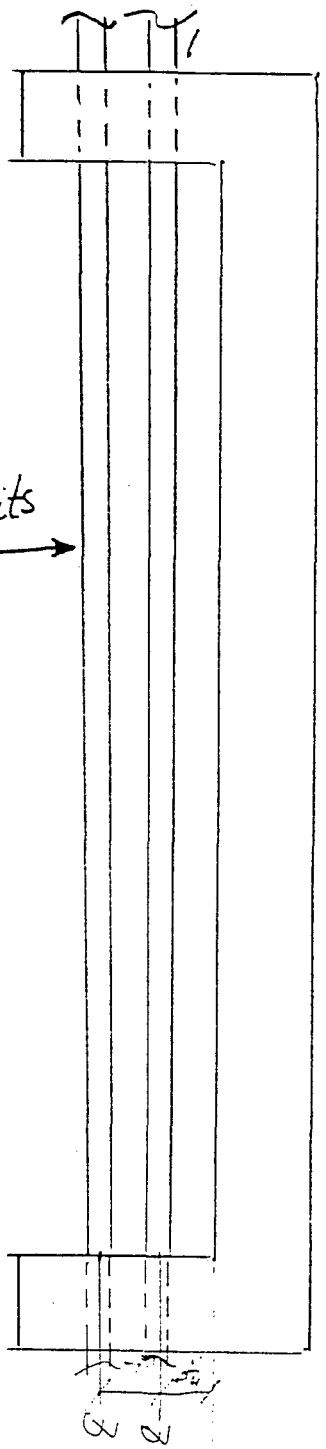
Test Deck #6

Left View



"A-A"

Right View



"B-B"

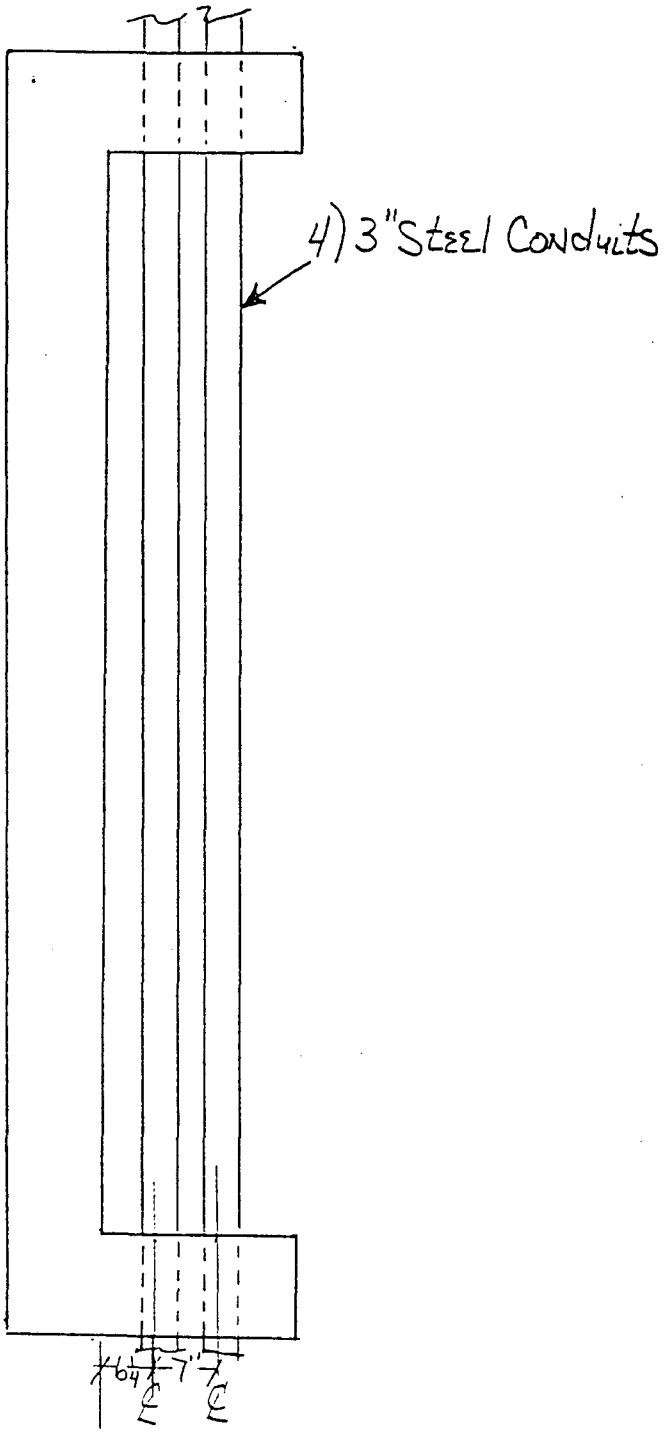
Note: Lab can pour concrete in place around conduits or sleeve and seal or core bore and seal around conduits.

COMPUTED _____ DATE _____

CHECKED _____ DATE _____

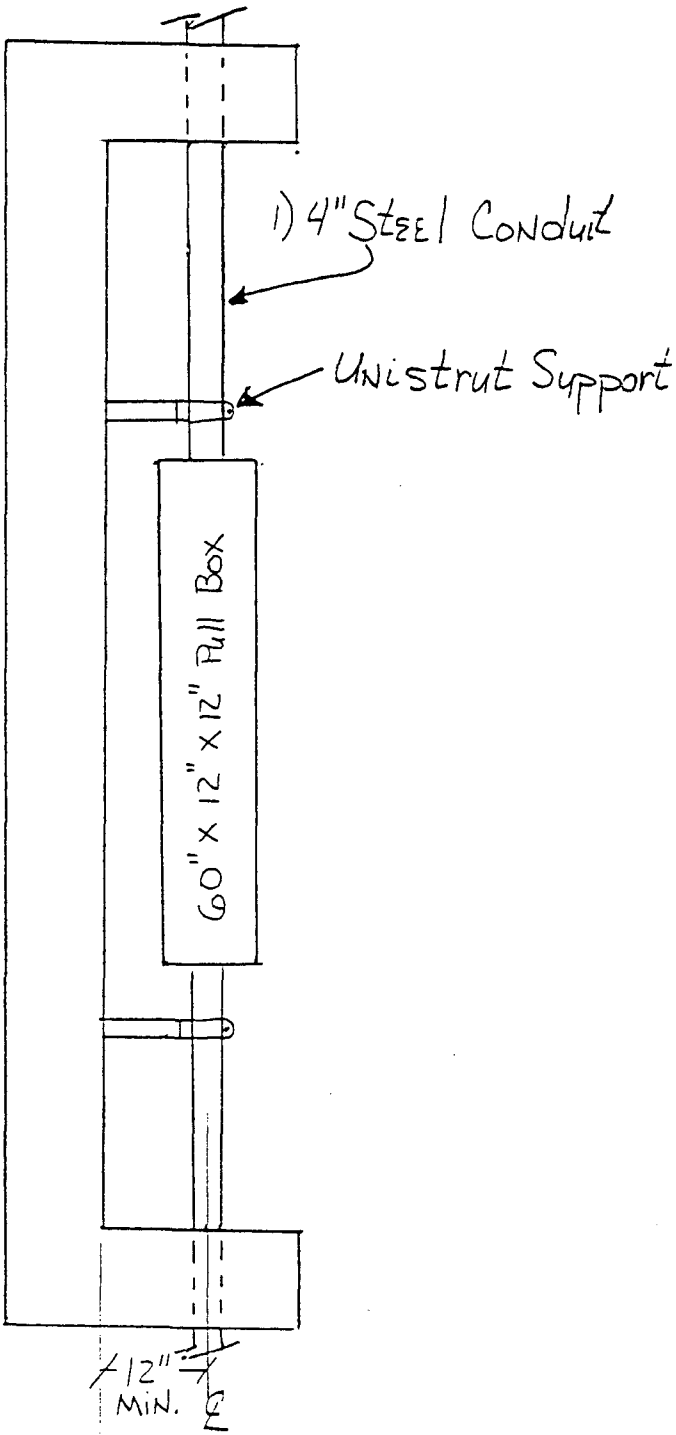
Test Deck #6

Left View



"C-C"

Left View



"D-D"

Note: 12" to ℄ is MIN. Lab may move out from wall on "D-D".
Unistrut support by Lab.

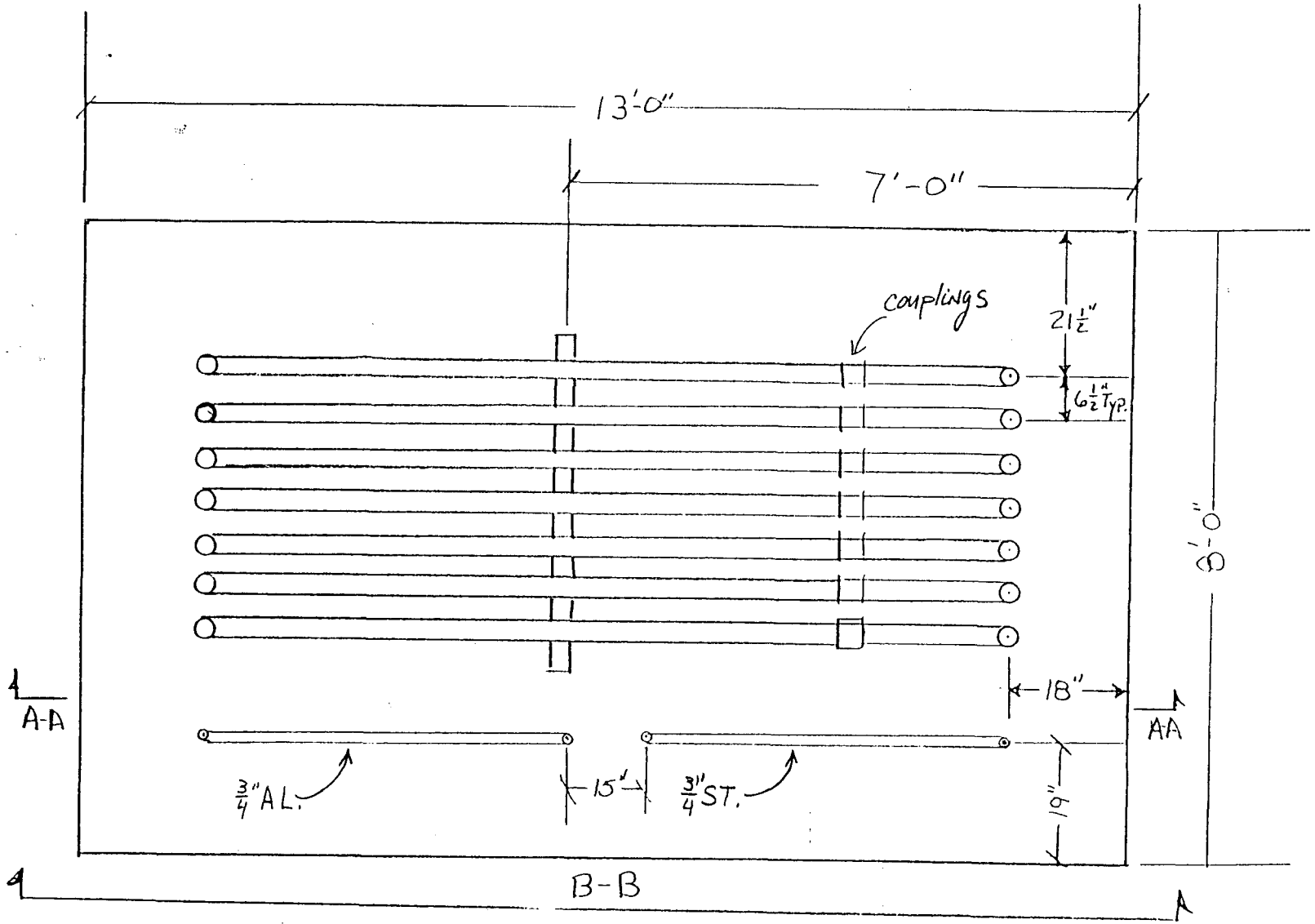
Large Ganged Conduit

Test Deck #7

Steel Deck - Horiz -

COMPUTED DAA

CHECKED DATE



7) 4" Steel conduits. Spaced 6½" on ℄

plan view

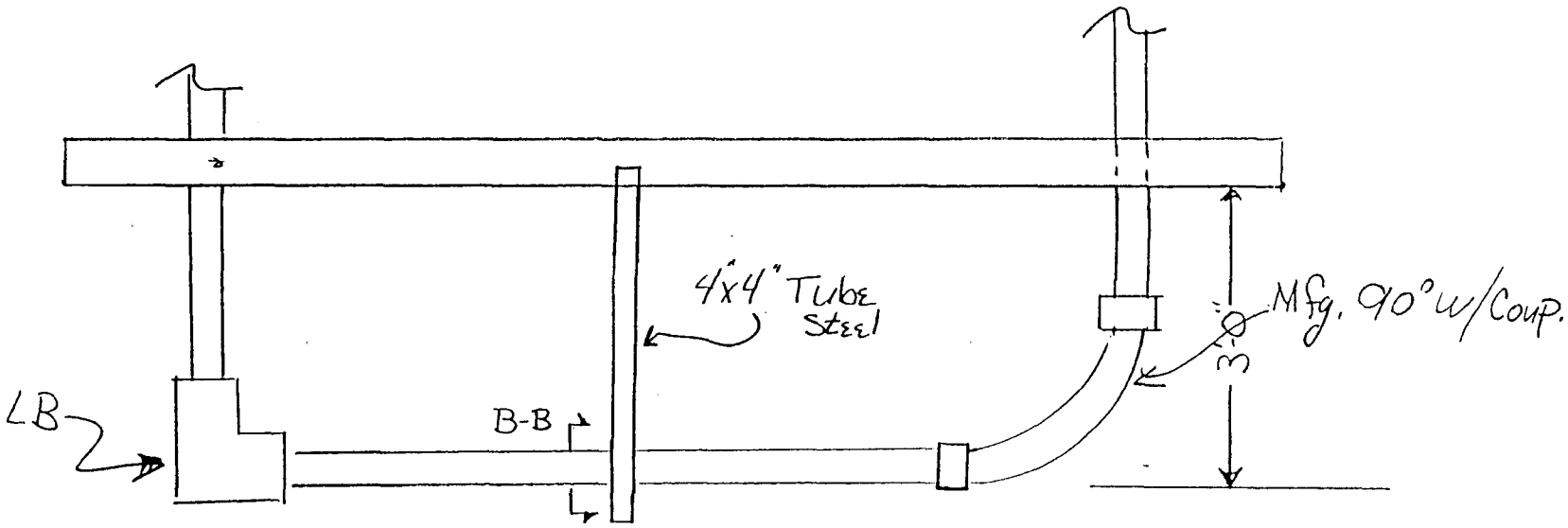
Large Ganged Conduits

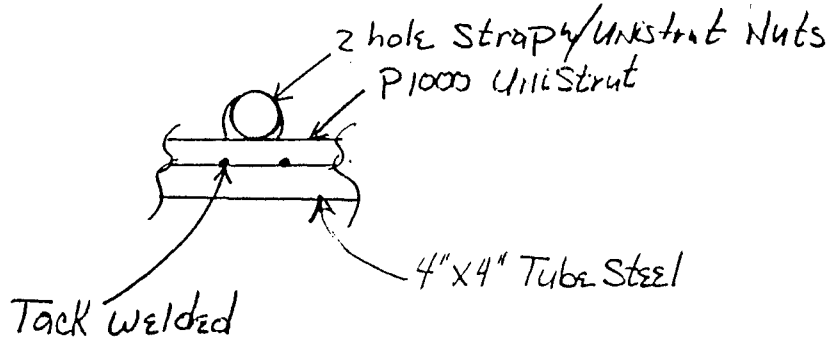
COMPUTED _____ DATE _____

CHECKED _____ DATE _____

SHEET 02 OF 2

Elevation A-A





Note: The two 3/4" conduits (1AL, 1ST) are the same configuration as Elevation A-A only half as long. The conduits shall extend 3'-0" down from the test deck. No center support is required.

ENCLOSURE 2

AMPACITY DERATING TESTS OF ARTICLES PROTECTED WITH THE TSI THERMO-LAG ELECTRICAL RACEWAY FIRE BARRIER SYSTEM

1.0 SCOPE

This test plan describes the methods and guidelines for performing tests which identify the ampacity derating values for TSI Electrical Raceway Fire Barrier Systems (ERFBS) protected trays, grouped conduits and grouped trays. The plan covers assembly of the test setup, installation of the ERFBS, instrumentation requirements, performance of the tests and documentation requirements.

2.0 OBJECTIVE

The objective of these tests is to obtain the data necessary to establish derating factors for TSI ERFBS applied to trays, grouped conduits and grouped trays. The subject configurations are based on those fire tested in accordance with the document entitled, "One Hour Fire Endurance Tests of Articles Protected with the TSI Thermo-Lag Fire Barrier System" (Ref. 4.1). Ampacity tests shall be conducted based on methodologies identified in draft 14 of IEEE Standard P-848, "Procedure for the Determination of the Ampacity Derating of Fire Protected Cables" (Ref. 4.2). The results of the test will allow determination of a single derating factor for each configuration of fire barrier material.

3.0 ACCEPTANCE CRITERIA

There are no pass/fail criteria for this test. The cables shall be maintained at a equilibrium temperature of 90°C in both their baseline and wrapped conditions to establish the ampacity values which will be used to calculate the derating factor for each configuration.

4.0 REFERENCES

4.1 TVA-TSI Fire Endurance Program Test Plan entitled, "One Hour Fire Endurance Tests of Articles Protected with the TSI Thermo-Lag Fire Barrier System."

4.2 IEEE P-848 Draft 14, "Procedure for the Determination of the Ampacity Derating of Fire Protected Cables," February 28, 1994, B44 940406 001.

4.3 ANSI N45.2.2, "Packaging, Storage, and Handling of Items for Nuclear Power Plants," 1972 edition.

5.0 RESPONSIBILITIES

5.1 TENNESSEE VALLEY AUTHORITY (TVA) shall:

a. Establish the criteria, guidelines drawings (as required), etc., to govern the configuration of the test items.

b. Provide the electrical raceway materials (e.g., cable, cable trays, conduits, fittings).

c. Provide specific Thermo-Lag installation procedures and work package documentation for each test.

d. Establish the criteria, guidelines, drawings (final), recommendations, hold points, etc., to govern the installation of the Thermo-Lag ERFBS to the test articles.

e. Provide personnel to install the Thermo-Lag fire barrier systems.

f. Provide test scoping documents to OPL to define the configurations to be tested and the methodologies for configurations not covered by IEEE P-848.

5.2 THERMAL SCIENCE, INC (TSI) shall:

5.2.1 Provide the Thermo-Lag materials (5/8" and 3/8" thick, preformed, ribbed and flat board, trowel grade material), stress skin, stainless steel tie wire and bands.

5.2.2 Make the necessary arrangements with, and provide adequate funding for Omega Point Laboratories to perform the tests.

5.3 OMEGA POINT LABORATORIES, INC. (OPL)

5.3.1 Prepare and assemble the test trays, conduits, cables, test enclosure, power supplies, supports and insulation, and provide all required test instrumentation in accordance with its Appendix B Quality Assurance and Quality Control Program and other applicable procedures.

5.3.2 Provide written calibration documentation of all thermocouples, data acquisition systems, surface emissivity instrumentation and other measuring devices used in the program.

5.3.3 Provide computer generated drawings of the electrical raceways which clearly indicate critical dimensions, thermocouple locations, etc. Critical dimensions are those specified in P-848 including raceway length, raceway-to-raceway spacing, placement of thermocouples, thermal breaks, room size and spacing from the test chamber.

5.3.4 Prepare a detailed test plan and coordinate all phases of the ampacity test preparation.

5.3.5 Supply miscellaneous hardware and personnel to assemble the test article raceway configurations in accordance with TVA's installation procedures and directions, including those contained in IEEE P-848

(TVA's directions will serve to resolve any questions or discrepancies identified during the test). Also supply QC personnel to witness and document the above process.

5.3.6 Provide Thermo-Lag storage temperature and moisture content records.

5.3.7 Supply QC personnel to witness and document the installation of the Thermo-Lag ERFBS materials to the test articles and attendant instrumentation on each test article.

5.3.8 Notify TVA and TSI within three (3) working days of completion of each test specimen.

5.3.9 Conduct the baseline and wrapped ampacity tests.

5.3.10 Document the test parameters, including test steps and procedure changes made during the tests, and provide a formal, detailed written report of the test program and test results.

5.3.11 Ensure that all anomalies identified during the performance of these tests are immediately brought to the attention of TVA's Corporate Engineering Cable Specialist or his designee. The anomalies and resulting dispositions shall be clearly documented in the logbook and the test report.

6.0 PREREQUISITES

6.1 GENERAL TEST CONFIGURATIONS

The electrical raceway configurations to be tested to assess the derating effect of the ERFBS are as listed on Appendix 1. All tests will be conducted in an enclosure as specified by P-848. The enclosure shall ensure an even temperature and limit drafts on the test assemblies. Measurement of the ambient temperature within the enclosure shall be in accordance with P-848.

6.2 TRACEABILITY REQUIREMENTS

To ensure that the materials used in these tests are representative of those in actual use, or to be used at TVA facilities, all aspects of traceability, as required by the OPL QA Program, shall be applied.

All instruments used in these tests shall be calibrated and evidence of that calibration to National Institute of Standards and Technology (NIST) standards shall be documented.

6.3 DIMENSIONED DRAWINGS

Final as-constructed, dimensioned drawings will be prepared by OPL.

6.4 SHIPPING, RECEIVING, MATERIAL INSPECTIONS

OPL will make a visual inspection of all materials for damage and record lot numbers and expiration dates of materials as applicable.

OPL will also record jacket legend information on all cable specimens and vendor part numbers or TVA mark numbers for other TVA supplied items.

Thermo-Lag bulk grade materials are shipped under "protective service" with an in-transit temperature chart recorder included with each shipment in an identifiable container. That container reads "RECORDER IN HERE." The chart tape produced by this recorder shall be inspected by OPL personnel upon arrival of the shipment to ensure that the temperature limitations of 32°F to 100°F were not exceeded.

Thermo-Lag fire barrier materials shall be stored off the ground when not in use. The materials shall be stored in a totally enclosed and weather protected area when not in use (ANSI N45.2.2, level B or better). The bulk grade (trowel grade) material shall be maintained within the temperature limits of 32°F to 100°F as verified by the chart recorder.

Prior to application of the bulk grade material, OPL will verify that the expiration date of the products have not passed. All bulk product expiration dates are good through the end of the expiration date month.

6.5 THERMOCOUPLE INSTALLATION

All thermocouples used in this test program shall be provided and installed by OPL, with QC surveillance by OPL personnel. The thermocouple wires shall be calibrated (by lot number) prior to installation and/or use, and applicable quality control documentation records generated. All thermocouples shall meet the requirements of IEEE P-848 Draft 14.

The thermocouples shall be placed in accordance with IEEE P-848 and at other locations as specified by TVA.

6.6 INSTALLATION OF CABLES

The electrical cables shall be installed in their raceways in accordance with IEEE P-848 and drawings or procedures provided by TVA.

6.7 INSTALLATION OF THE ERFBS

Thermo-Lag ERFBS shall be installed by TVA craft personnel in accordance with applicable specifications, design drawings and procedures provided by TVA. Details of the ERFBS configurations including fasteners, orientation of structural ribs, etc., shall be documented in the final test report.

6.8 PRETEST INSPECTION

6.8.1 Written approval of the construction, assembly, installation and instrumentation of each test assembly shall be supplied by OPL prior to performance of each ampacity test (a sign-off sheet for this purpose shall be supplied by OPL and included in the final report).

6.8.2 Ampacity testing of the protected assemblies shall not commence until the Thermo-Lag ERFBS attains a moisture meter reading that does not exceed 20 when using a meter with a scale of 0-100 such as a Delmhorst Model DP or equivalent, or 30 days has elapsed since completion of the ERFBS installation.

7.0 TEST SEQUENCE AND PROCEDURE

7.1 SINGLE TRAY WRAPPED WITH 5/8" + 3/8" ERFBS

7.1.1 General

7.1.1.1 The configuration to be tested is shown as Assembly 1 in Appendix 1 and consists of a single ladder tray. For the tests on the protected assembly, a solid sheet steel cover will be placed on the tray and the assembly will be wrapped with 5/8" and 3/8" layers of Thermo-Lag. Trowel grade material will be applied between the cover and the first layer of Thermo-Lag and between the first and second layers of Thermo-Lag.

7.1.1.2 The tests shall be performed following IEEE P-848 draft 14, unless directed otherwise by this document or in writing by the TVA Corporate Engineering Cable Specialist.

7.1.1.3 The potential required to power the test specimens shall be measured across the specimen cables only (exclusive of the leads to the power supply) and recorded for each test.

7.1.2 Instrumentation

7.1.2.1 The cables shall be instrumented in the locations required by Figure 4-1 of P-848. Routing of the thermocouple leads shall be per P-848.

7.1.2.2 The surface temperature of the bare cables shall be measured. The thermocouples (type T, special grade) shall be placed in intimate contact with the middle cable on the top and bottom surfaces of the mass, approximately 3 feet to either side of location 2 (per Figure 4-1 of P-848). These thermocouples shall be left in place during the wrapped test.

7.1.2.3 The surface temperature of the fire wrap material shall be measured. The thermocouples (type T, special grade) shall be placed in intimate contact with the top and bottom surfaces of the wrap approximately 3 feet to either side of location 2 (per Figure 4-2 of P-848) in the middle of the assembly.

7.1.3 Baseline Evaluation

A baseline experiment shall be conducted to establish the cable ampacity in the unwrapped condition.

When the system has reached equilibrium, the surface emissivity of the cable mass shall be measured at locations consistent with that

specified for conduit in section 4.2.3 of P-848. The emissivity readings shall be recorded for information only.

7.1.4 Wrapped Evaluation

The wrapped tray shall be tested to establish the cable ampacity when protected with the ERFBS.

When the system has reached equilibrium, the surface emissivity of the wrap shall be measured at locations consistent with that specified for conduit in section 4.2.3 of P-848. The emissivity readings shall be recorded for information only.

7.2 MULTIPLE TRAYS WITHIN A COMMON 5/8" ERFBS

7.2.1 General

7.2.1.1 The configuration to be tested is shown as Assembly 2 in Appendix 1 and consists of a single stack of three open top ladder trays. For the protected test, the stack shall be wrapped with a 5/8" layer of Thermo-Lag board.

7.2.1.2 IEEE P-848 does not include a provide guidance for ampacity testing of multiple trays within a common enclosure. In general, the tests shall adhere to P-848 guidance for single tray testing. Additional guidance is provided by this document.

7.2.1.3 All trays shall be loaded with the number and size of cables as specified in Appendix 1, for Assembly 2. The cables in the top two trays are intended to represent power trays and shall be connected in a single series circuit. The cables in the bottom tray are intended to represent cables which serve a control function only and thus, shall not be energized.

7.2.1.4 The potential required to power the test specimens shall be measured across the specimen cables only (exclusive of the leads to the power supply) and recorded for each test.

7.2.2 Instrumentation

7.2.2.1 The cables in each of the top two trays shall be instrumented in the locations required by Figure 4-1 of P-848. Routing of the thermocouple leads shall be per P-848.

7.2.2.2 The surface temperature of the bare cables shall be measured in each tray. The thermocouples (type T, special grade) shall be placed in intimate contact with the top and bottom surfaces of the cable mass approximately 3 feet to either side of location 2 (per Figure 4-1 of P-848). These thermocouples shall be left in place during the wrapped test.

7.2.2.3 The temperature of one cable at location 2 (per Figure 4-1 of P-848) in the top layer in the center of the bottom tray shall be measured. The thermocouple (type T, special grade) shall be placed in intimate

contact with the outer surface of the insulation. This thermocouple shall be left in place during the wrapped test.

7.2.2.4 The surface temperature of the fire wrap material shall be measured. The thermocouples (type T, special grade) shall be placed in intimate contact with the top and bottom surfaces of the wrap approximately 3 feet to either side of location 2 (per Figure 4-1 of P-848).

7.2.3 Baseline Evaluation

A baseline experiment shall be conducted to establish the cable ampacity in the unwrapped condition.

When the system has reached equilibrium, the surface emissivity of the cable mass in the hottest tray shall be measured at locations consistent with that specified for conduit in section 4.2.3 of P-848. The emissivity readings shall be recorded for information only.

7.2.4 Wrapped Evaluation

The wrapped trays shall be tested to establish the cable ampacity when protected with the ERFBS.

When the system has reached equilibrium, the surface emissivity of the wrap shall be measured at locations consistent with that specified for conduit in section 4.2.3 of P-848. The emissivity readings shall be recorded for information only.

7.3 MULTIPLE CONDUITS WITHIN A COMMON 5/8" ERFBS

7.3.1 General

7.3.1.1 The configuration to be tested is shown as Assembly 3 in Appendix 1 and consists of a single row of three conduits. For the protected test, the row shall be wrapped with a 5/8" layer of Thermo-Lag board.

7.3.1.2 IEEE P-848 does not include a provide guidance for ampacity testing of multiple conduits within a common enclosure. In general, the tests shall adhere to P-848 guidance for single conduit testing. Additional guidance is provided by this document.

7.3.1.3 All conduits shall be loaded with the number and size of cables as specified in Appendix 1, for Assembly 3. The cables will be connected in a single series circuit.

7.3.1.4 The potential required to power the test specimens shall be measured across the specimen cables only (exclusive of the leads to the power supply) and recorded for each test.

7.3.2 Instrumentation

7.3.2.1 The cables in each conduit shall be instrumented in the locations required by Figure 4-2 of P-848. Routing of the thermocouple leads shall be per P-848.

7.3.2.2 The surface temperature of the conduits shall be measured. The thermocouples (type T, special grade) shall be placed in intimate contact with the top surface of the conduits approximately 3 feet to either side of location 2 (per Figure 4-2 of P-848). These thermocouples shall be left in place during the wrapped test.

7.3.2.3 The surface temperature of the fire wrap material shall be measured. The thermocouples (type T, special grade) shall be placed in intimate contact with the center of the top and bottom surfaces of the wrap approximately 3 feet to either side of location 2 (per Figure 4-2 of P-848).

7.3.3 Baseline Evaluation

A baseline experiment shall be conducted to establish the cable ampacity in the unwrapped condition.

When the system has reached equilibrium, the surface emissivity of each conduits shall be measured at locations consistent with that specified in section 4.2.3 of P-848. The size of the focal zone of the device used shall be appropriate for the conduits being tested. The emissivity readings shall be recorded for information only.

7.3.4 Wrapped Evaluation

The wrapped conduits shall be tested to establish the cable ampacity when protected with the ERFBS.

When the system has reached equilibrium, the surface emissivity of the wrap shall be measured at locations consistent with that specified in section 4.2.3 of P-848. The emissivity readings shall be recorded for information only.

8.0 DATA SYSTEMS

During the ampacity test period, all thermocouples shall be scanned at one minute intervals or less. All thermocouple and current data channels and tabulated data (i.e., rate of temperature change) shall be saved to disk at one minute intervals (minimum). Key data (current, average and maximum temperatures for each cross section, chamber ambient and rate of temperature change) shall be printed at one minute intervals.

9.0 REPORT

The report shall contain for permanent record all information pertaining to the test including the test plan, laboratory notebook, all raw data, interpretations, and observations. The report shall provide the documentation of all the above parameters and evidence of calibration to NIST standards for equipment used in obtaining this data (including before and after calibration of thermocouples), and appropriate resolution of any test anomalies. The report shall itemize all deviations taken from IEEE P-848 draft 14. All

calculations, conclusions or interpretations shall have been checked and approved by authorized individuals certified by the testing organization to be knowledgeable of the techniques used.

9.1 OPL shall submit a report on the results of the test in sufficient detail to summarize the total testing activity. The report shall include as a minimum the data required by section 6 of IEEE P-848 and the following:

a. Special surface temperature and emissivity data.
b. Circuit potential data for each test.
c. A chronological log (Event Log) of all activities from receipt of materials through final test report.
d. A copy of the test plan and fire barrier installation procedures provided by TVA.

9.2 OPL shall submit six copies of the final report to TVA and one copy to TSI.

APPENDIX 1
TEST CONFIGURATIONS

1. Assembly 1A Single open top 24" x 4" ladder back tray in free air.
   Assembly 1B Single open top 24" x 4" ladder back tray with a solid tray cover, protected with 5/8" Thermo-Lag and a 3/8" upgrade layer.

2. Assembly 2A Three open top 24" x 4" ladder back trays in free air.
   Assembly 2B Three open top 24" x 4" ladder back trays within the same enclosure made of 5/8" Thermo-Lag.

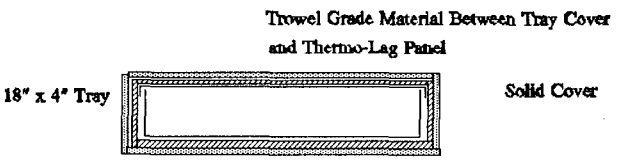
3. Assembly 3A A single row of three 4" rigid steel conduits in free air.
   Assembly 3B A single row of three 4" rigid steel conduits within the same enclosure made of 5/8" Thermo-Lag.

Cable Size: Per IEEE P-848, draft 14
96 - 3/c 6 AWG, 32 per layer

Tray Size: 24" x 4" x 12'

Thermo-Lag Thickness: 5/8" + 3/8"

Assembly 1



Single Tray Wrapped with 5/8" + 3/8" Thermo-Lag

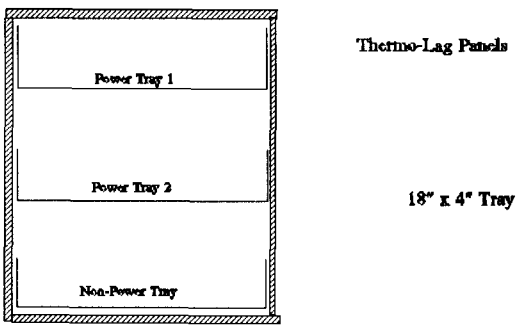
For Illustration Only: Thermo-Lag Installation Details are Governed by Other Drawings and Procedures

Cable Size: All trays, per IEEE P-848, draft 14, 96 - 3/c 6 AWG, 32 per layer

Tray Size: 24" x 4" x 12'

Thermo-Lag Thickness: 5/8"

Assembly 2



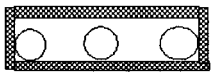
Multiple Trays Within a Common Thermo-Lag Enclosure
For Illustration Only: Thermo-Lag Installation Details are Governed by Other Drawings and Procedures

Cable Size: 10-3/c #6 AWG

Conduit Size: 4"

Thermo-Lag Thickness: 5/8"

Assembly 3



Thermo-Lag Panels

4" Conduits

Multiple Conduits Within a Common Thermo-Lag Enclosure
For Illustration Only: Thermo-Lag Installation Details are Governed by Other Drawings and Procedures

ENCLOSURE 3

ONE HOUR FIRE ENDURANCE TESTS OF ARTICLES PROTECTED
WITH THE TSI THERMO-LAG FIRE BARRIER SYSTEM

List of Commitments

1. TVA will submit test reports to NRC for those tests described in NRC submittal "Watts Bar Nuclear Plant (WBN) - Thermo-Lag Fire Barrier Issues - Cable Tray and Unique Configuration Test Program."