April 6, 1992 P848/D11

PROCEDURE FOR THE DETERMINATION OF THE AMPACITY DERATING OF FIRE PROTECTED CABLES

Prepared by Task Group 12-45
of the Test and Measurements Subcommittee #12
of the IEEE Insulated Conductors Committee

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PROCEDURE

for the Determination

of the

AMPACITY DERATING OF FIRE PROTECTED CABLES

DRAFT 11

April 1992

INTRODUCTION

Many installations incorporate individual or grouped cables which do not limit the flame propagation under fire conditions. This deficiency can be attributed to conventional cable constructions, such as polyethylene insulated PVC jacketed control cables; which were popular in the sixties and early seventies. Such cables do not meet the flame spread criteria when subjected to the vertical tray flame test which has been accepted in one form or another. Other installations which fall in the same category include metal sheathed or armored vertical shaft cables with overall polyethylene jacket and secured with clamps at various intervals. Polyethylene jacket is used because of its high resistance to creep under pressure in the clamp area to support the sheer weight of the cable.

The foregoing installations include industrial, commercial, marine, nuclear or fossil generating stations and others.

To retard the flame propagation properties of cables in cable trays, protective coatings are applied either along the entire length of the cable(s) or in certain sections as deemed necessary. The flame retardant coatings may be in a form of tapes, blankets, liquids or mastics applied to individual or to grouped cables, both for retrofitting existing installations or for new installations.

1. PURPOSE

The purpose of the standard is to provide a test procedure which may be used to determine the ampacity derating required for fire protected cables in conduit, in penetrations (fire stop) and in cable tray systems.

2. SCOPE

This standard provides a detailed procedure for determining the ampacity derating required for fire protected cable systems. The tests are intended to be used to determine the ampacity derating of fire protected systems which is to be applied to the ampacity of cables determined by standard methods such as ICEA P-46-426 Power Cable Ampacity Volumes 1 & 2, and ICEA P-54-440 Cables in Open-top Cable Trays.

2.1 General

The procedure presented in this standard includes the principles and methods of testing. This test procedure will provide the ampacity derating of a fire protected cable system.

2.2 Applicability

Fire protected cable systems outlined herein are intended for use in power generating stations, both nuclear and fossil, as well as other applicable commercial and industrial installations, both outdoors and indoor. The categories of cables include, but are not limited to: power, control, and instrumentation including signal and communication cables. Testing of flame retardant coatings on horizontal cables will qualify the coatings for all orientations. The tests as described herein are intended to be used in determining the derating factor, which may be required for fire protected cables in conduits and trays. The ampacity of the cable in raceway will typically have first been determined using accepted practices such as ICEA P-46-426 Power Cable Ampacities Volumes I and II, and ICEA P-54-440 Cables in Open-Top Cable Trays.

The user of flame retardant coatings is cautioned to determine that the coating is compatible with the cable materials with which it comes in contact and with the environment in which it is installed. The user may specify tests in addition to those specified in this standard to reflect the installation conditions, e.g., for nuclear stations, the user may wish to add irradiation test or effects of added weight; or for outdoor installations, the user may wish to add a U.V. resistance test.

3. DEFINITIONS

These definitions establish the meanings of words in the context of their use in this standard.

Fire Protected Cable Systems

Cable systems to which an application of a flame retardant barrier, fire resistive barrier or coating (flame retardant coating) to protect cables from fires from any cause has been applied.

Flame Retardant Coatings

A material applied to a completed cable or assembly of cables to prevent the propagation of flame when exposed to a flame source. Flame retardant coatings include tapes, blankets, liquids, flame retardant mechanical system or mastics.

Passive Fire Protection Systems

Systems which embody fire resistant construction such as coatings, barriers, walls, and penetrations (fire stops) as opposed to water sprinkler systems or gaseous extinguishing systems.

Through-Penetration Fire-stop

A specific construction of devices, fill materials, or both, designed to resist the penetration of fire through those openings in fire resistive floors or walls that are intended to accommodate electric cables, raceways and mechanical service penetrations.

Ampacity Derating Factor

A factor applicable to the ampacity rating of a cable (or other device) to account for the adverse affects of some installation or environmental condition.

Raceway

Any channel that is designed and used expressly for supporting or enclosing wires, cables, or bus bars. Raceways consist primarily of, but are not restricted to, cable trays and conduits.

Cable Tray

A continuous rigid structure used to support cables. Cable trays include ladders, troughs, channels and other similar structures. Conduits are not included in this category.

Enclosures

A surrounding case or housing used to protect the contained equipment and prevent personnel from accidentally contacting live parts.

4. REFERENCES

The following standards were used as references in preparing this standard and may be useful in the interpretation of its meaning:

ICEA P-46-426/IEEE S-135
Power Cable Ampacities, Vols. 1 and 2. Dated 1962 (Reprinted in 1984).

ICEA P-54-440/NEMA WC-51
Ampacities - Cable in Open Top Cable Trays. Dated 1986.

5. TEST DESCRIPTION

5.1 General

This section describes the method for determining ampacities of cable passing through single tray and conduit with and without a passive fire protection system.

5.1.1 Applicability

This method shall be applicable to a single cable or groups of cables enclosed in a passive fire protection system. Cables may be contained in a raceway or as dictated by the actual installation.

5.1.2 Method of Testing

Ampacity derating for cables of a passive fire protective system shall be by testing. Testing shall be performed using the configurations depicted in Figures 1 and 2. As an alternative, tests may be performed using representative assembly which can be analyzed to show its applicability to actual installed conditions. Results are also applicable for 1000 volts and higher rated cables.

5.2 Test Specimens

5.2.1 Cable Selection

The cable to be utilized is chosen as one which is representative of a wide range of cables. The selection of a 3 conductor cross link polyethylene insulated, #6 AWG 600 volts copper cable with an overall chlorosulfonated polyethylene (i.e. hypalon) jacket was chosen as representative.

5.2.2 Cable Fill

Cable fill is the ratio of cable area to the inside area of the tray expressed in percentage. A 40 percent cable fill, as determined from actual measurement shall be used for cable trays.

5.2.3 Cable Layout

The length of both the conduit and the tray shall be twelve feet. One to two feet of cable shall extend out each end and shall be wrapped with unfaced fiberglass blanket insulation (or electrically-heated tape) as necessary to eliminate heat flow out of raceway ends.

5.2.4 Conduit

The conduit system shall be 4 inch and 1 inch steel rigid conduit, 12 feet long supported every 18 inches from each end by a horizontal piece of "H"-shaped or 2" x 2" square structural tubing.

5.2.5 Tray

The tray shall be a 4 inch deep, 24 inch wide ladder-back steel cable tray 12 feet and support similarly to the conduit system. The tray and conduit systems, if tested together, must be at least 36 inches apart along their lengths.

5.2.6 Through-Penetration Fire-stops

A through-penetration fire-stop intended for installation in a fire resistive floor assembly, wall assembly, or both, is to be installed in a wall section so that the electrical cables pass horizontally through the wall. The through-penetration fire-stop is to be installed in

accordance with all requirements specified for the fire-stop being tested.

The sample wall section is to be representative of that specified for the through-penetration fire-stop. The thickness of the wall section is to be equal to the maximum thickness of the fir-estop system or device. The size of the through opening in the wall section is to be representative of the through opening size specified for the through-penetration fire-stop.

The fire protective system is to be installed around the electrical cable(s) and raceway(s) in accordance with all requirements specified for the system.

5.3 Test Facility

5.3.1 Test Room

The ampacity test shall be conducted in an enclosure as defined in Figure 3. The test specimen shall be suitably enclosed such that temperature around the specimen shall be controlled at the test temperature of 40°C±2°C. The enclosure surrounding the test specimen shall be of even temperature, but must not cause drafts on the test specimen. The temperature inside the enclosure shall be measured at no less than three places one foot from the specimen, and in the horizontal plane of the test specimen. The temperature of the enclosure shall be taken as the average of the steady state measurements.

5.3.2 Cable Installation

5.3.2.1 Tray

The tray is to be loaded with three conductor #6 AWG, 3/c copper cable, with an overall chlorosulfonated polyethylene jacket. The tray fill should be based on 40 percent fill.

Tray cables should be installed in an orderly, symmetric manner, so as to limit the flow of air through the bundle, and to facilitate inter and intra-laboratory repeatability of these tests. The cables shall be connected as a single series electrical circuit, which contains all conductors in the system. The tray is to be supported by two horizontal pieces of "H"-shaped or a suitable support system, located as shown in Figure 3. A 3" x 25" piece

of 1" thick mineral fiber blanket shall be placed between the tray and support system to form a thermal break. Thermal insulation (e.g., fiberglass or electrically-heated tape) shall be wrapped around the cable which extends out of both ends of the tray to allow adjustment of end temperatures. The end temperatures must be adjusted such that the average values for the thermocouples at locations 1 and 3 are within 4°C of the average for location 2 to minimize axial heat flow.

5.3.2.2 Conduit

Since the application of the fire protection system may result in differing derating for different conduit sizes, two sizes of conduits shall be tested:

(a) 1 inch rigid steel conduit with one 3/c No 6 AWG copper cable

(b) 4 inch rigid steel conduit with one 3/c, 750 Kcmil copper cable

Derating for both sizes shall be reported. Lowest factor shall be used for ampacity derating. The bundle shall be instrumented with thermocouples as shown in Figure 2, tied with wraps every 2 feet, and pulled into position in the conduit. The cables shall be connected as a single series electrical circuit, which contains all conductors in the system. The conduit is to be supported by two horizontal pieces of "H" shaped or 2" x 2" structural square tubing with a minimum of 36 inches clearance from the tray or walls of the enclosure. The attachment points between the conduit and the supporting beam are to be insulated with 1" thick mineral fiber blanket to form a thermal break similar to the tray system. Insulation (or electrically-heated tape) shall be wrapped around the cable which extends out of both ends of the conduit to allow adjustment of end temperatures. The end temperatures must be adjusted such that the average values for the thermocouples at locations 1 and 3 are within 4°C of the average for location 2, to minimize axial heat flow. In other words, the ends should be close to the same temperatures as the middle, thereby minimizing axial heat flow.

5.3.2.3 Through-Penetration Fire-stops

The electrical cable(s) and raceway(s) penetrating the sample wall section are to be representative of those specified for the through-penetration fire-stop and are to be of sufficient length to project a minimum of 24 inches beyond both sides of the wall section. For this purpose maximum thickness of fire-stop shall be measured. Thermocouples on the electrical cables in through-penetration fire-stops are to be located so that temperatures are measured in the interior of the fire-stop and at the fire-stop mid-depth as in figure 5.

5.3.2.4 Orientation

The test specimens shall be mounted and the tests run in the horizontal direction so as to eliminate any possibility of a "chimney-effect" which could cause air movement within the system.

5.3.2.5 Thermocouple Placement

Thermocouples (24 gage, Type K [Special Grade] Chromel-Alumel, accuracy $\pm 1.15°C$) shall be installed by slitting the cable insulation and jacket and placing the thermojunction in intimate physical contact with the conductor strands, as illustrated in Figure 4. The cable shall then be restored as closely as possible to its original condition, and the slit sealed with a single-layer spiral wrap of electrical tape. Since the test is evaluating the temperature at the hottest position, rather than the average of all thermocouples, the cables within the bundle have been instrumented, instead of those near the outside. For both the conduit and tray systems, thermocouples shall be placed at each of three vertical planes along their lengths, as illustrated in Figures 1 and 2. The tray system shall be instrumented with 13 thermocouples at each plane, for a total of 39 thermocouples, and the conduit system shall be monitored with 1 thermocouple at each plane, for a total of 3 thermocouples.

5.3.2.6 Installation of Passive Fire Protection Systems

The tray and/or conduit is to be lifted off it's support after the completion of the baseline test, the passive fire protective system applied in accordance with the manufacturer's instructions, and the entire assembly lowered onto the horizontal

support, thereby minimizing any heat sink effect from the support system. After installation, the passive fire protection system shall be allowed to equilibrate (or cure) to a state of constant moisture content, if applicable. Moisture content (in terms of percent moisture) shall be taken 4 hours or less before the test is begun and within 4 hours after completion of the test, using either a hand-held moisture meter, or standard 120°C oven-dry methods). Such moisture determination is to be made on the top and bottom exterior surfaces of both the tray and conduit systems at their mid-length, and the results of top and bottom averaged.

5.4 Test Procedure

5.4.1 Baseline Evaluation

At least one baseline experiment for each system (conduit and tray) using Sections 5.4.2, 5.4.4, and 5.4.5 shall be conducted to establish the cable ampacity prior to application of the fire protective system. The ampacity value measured should be compared to the IEEE-ICEA Power Cable ampacities standards.

5.4.2 Current

The circuit shall be energized with 60 Hz, single phase alternating current sufficient to reach a steady-state temperature of 90°C at the hottest single point monitored at location 2 (see Figures 1 & 2). The current values measured shall be reported to the nearest 0.1 ampere. The use of a constant-current amplifier is highly recommended as a power source, since the increasing temperatures of the conductor circuit cause resistance changes. Alternatively large variable transformers may be used, with constant readjustment to maintain a set current flow

5.4.3 Temperature Measurement

All temperatures shall be recorded at intervals no greater than 1 minute. The current in each test circuit shall be adjusted so as to give an equilibrium temperature of 90°C±1.1°C at the hottest point monitored within location #2 (those located at the center of the system). The average temperatures of thermocouple locations #1 and #3 shall be within ±4°C of the average of thermocouple location #2. Each cable circuit shall be

considered to be in steady state condition when a three-hour period has elapsed since any perturbation of the system occurred (current adjustment, box temperature change, additional insulation placed on ends, etc.) and the rate of change of the average of all monitored conductor temperatures in that circuit does not exceed ±0.55°C for the conduit[1] and ±0.35°C for tray[1]. Re-adjustment of the current flow to a circuit in order to maintain a given amperage value is not to be considered a perturbation.

In order to statistically assure thermal equilibrium, the conductor temperatures should be averaged at each sampling period and a linear regression analysis (least-squares fit) performed on the data obtained from that and all other averages taken over the preceding 60 minute period. The slope of the line obtained will be in units of °C/hour. As soon as the absolute value of the slope of these data becomes less than 0.55 (conduit) or 0.35 (tray), equilibrium has been reached. The degrees of freedom obtained by averaging many thermocouple locations (3 for conduit, 39 for tray), allows the precision to exceed the ±1.1°C limit of any one thermocouple. The only practical method of obtaining the required accuracy in determining thermal equilibrium is through the use of computerized data retrieval.

As an example of the least-squares technique, consider the tray system in Figure 1. At each sampling time, an average temperature of thermocouples 1 through 39 will be calculated. This value will then be added to the top of an array large enough to hold 60 minutes worth of these averages, and the oldest value discarded. A linear regression fit is then performed on the array and presented on the video screen to the operator. When the next data sampling is completed, the entire process is repeated, thus yield a linear regression fit of the data from the previous 60 minutes. As each new data point is added to array, all previous ones are shifted down one time increment, until each is finally discarded due to the fixed size of the array.

[1] Chosen as the 95% confidence limits for Special Grade, Type K thermocouples at 90°C.

LINEAR REGRESSION (LEAST SQUARES METHOD) FIT:

$$Y = mX + b \qquad \bar{X} = \Sigma X/n$$

$$\bar{Y} = \Sigma Y/n$$

$$m = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}$$

$$b = \bar{Y} - m\bar{X}$$

Where:

Y = Average Conductor Temperature (°C)
X = Time Increment (min)
m = Slope of line (C/min)
b = Y-Axis intercept (°C)

5.4.4 Enclosure Temperature

The temperature within the test enclosure shall be controlled to 40°C ±2°C. Some induced air movement within the enclosure is necessary to achieve uniform steady-state temperatures, but care must be taken to avoid direct air currents against the test specimens. Method of ambient temperature control within the test enclosure is important and care must be taken to avoid any additional heat loading on the cables by radiation from heat source.

6. EVALUATION OF TESTS

By a simple comparison of the baseline and test specimen ampacities, a derating factor can be calculated.

Data Interpretation: Ampacity Derating Factor

The maximum current carrying capacity shall be determined by derating applied as dictated by the test. The derating factor as determined by the test is to be calculated as follows:

% Ampacity Derating Factor = $(I_0 - I_f)/ I_0 \times 100$

Where:

I_0 = Current in amperes required to attain a temperature of 90 °C for the baseline (un-protected) system. However, if I_0 is larger than published ampacity i.e. ICEA P-46-426, P-54-440 then published ampacity shall be used for I_0.

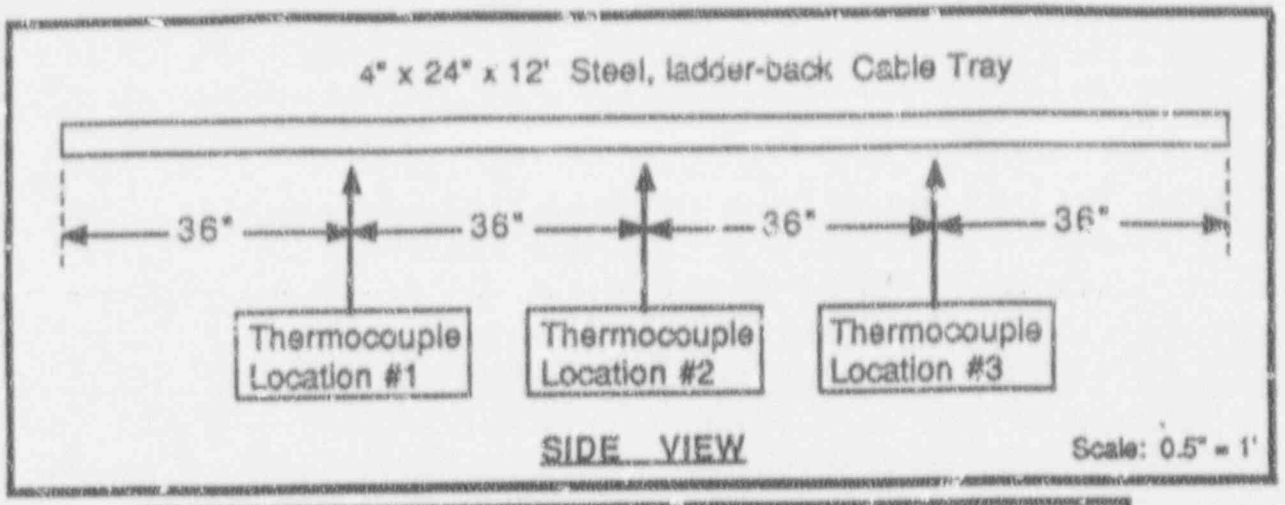
I_f = Current in amperes required to attain a temperature of 90 °C for the system as protected by the passive fire protection system.

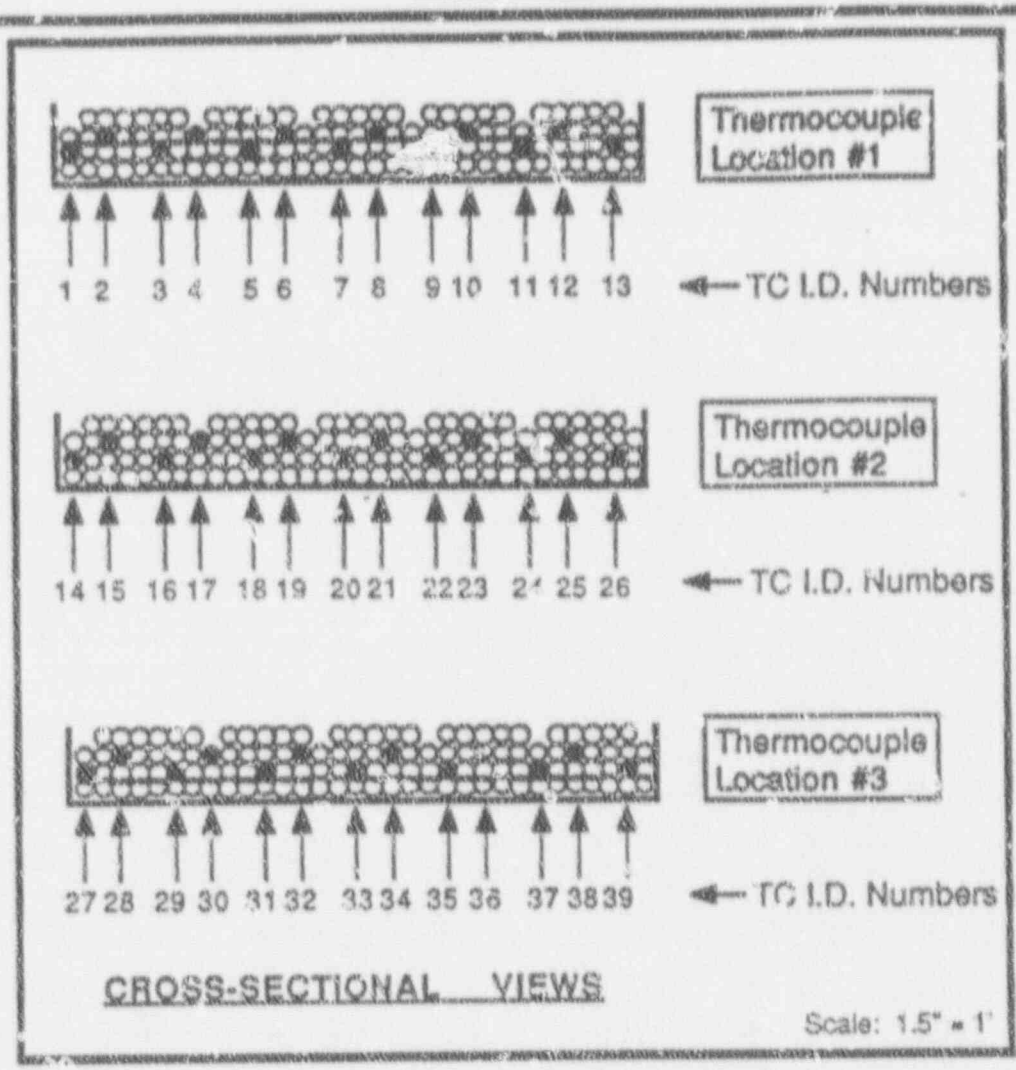
7. DOCUMENTATION OF TESTING

Following the procedure outlined in this standard, provide percentage ampacity derating and record the following specific data.

- Description of cables and raceway, if different from specified herein.
- All thermocouple data
- All current and voltage values
- Current and conductor temperature values observed at equilibrium
- Weight of passive fire protection system (lb/ft)
- Average thickness of fire protective system (inches)
- Details of installation of fire protective system

The documentation of records shall be provided in the form of a FINAL 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. 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.

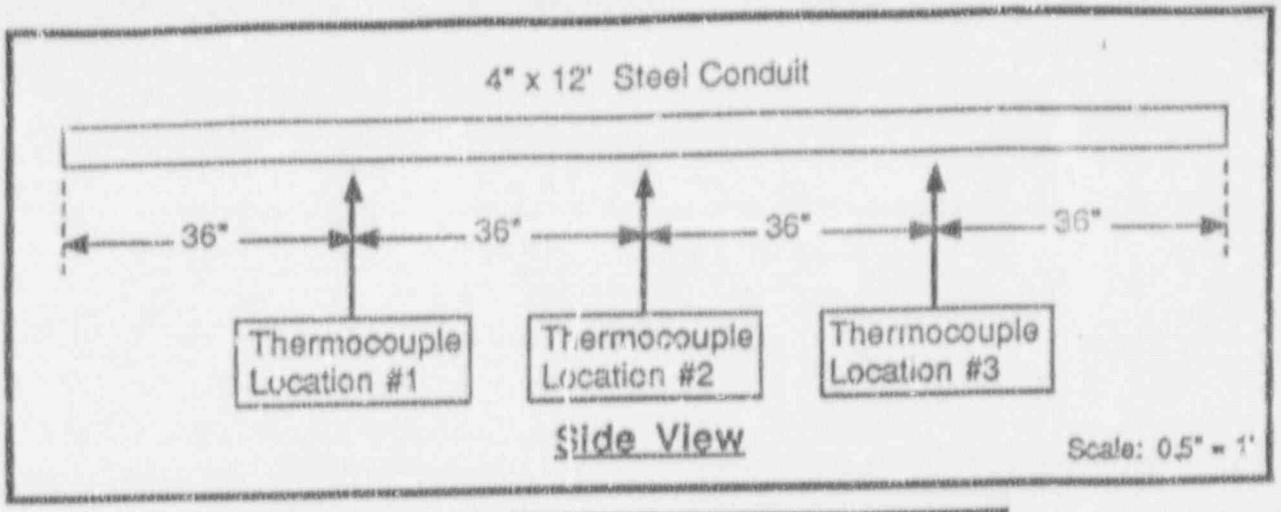


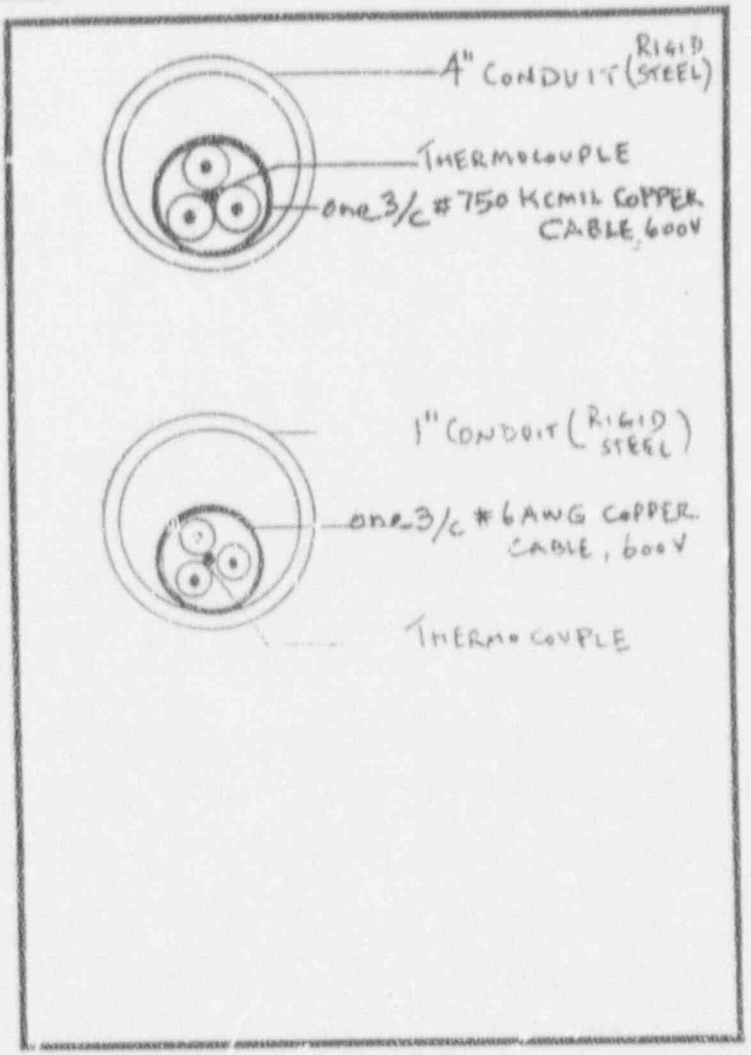


NOTE: Cable tray is to be 100% visual-fill with 3 Conductor #6 AWG Cable. Number of cables = 122. Cable diameter = 0.75 inch.

TRAY AMPACITY DESIGN

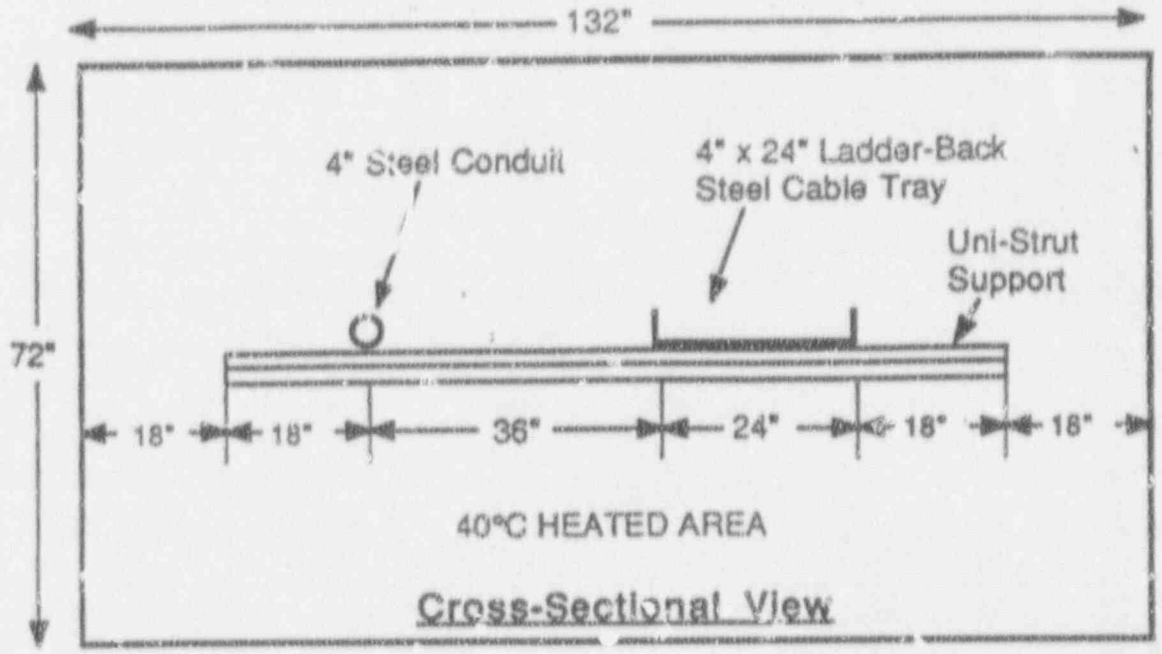
Figure 1



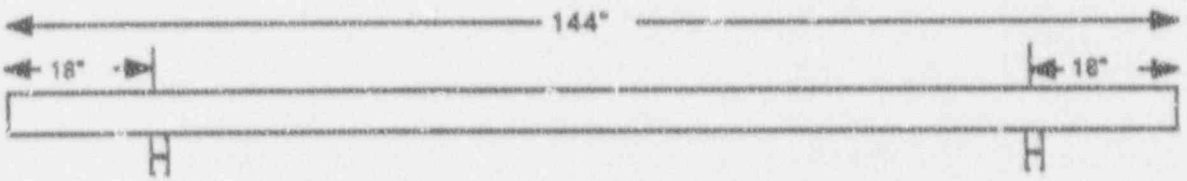


CONDUIT AMPACITY DESIGN

Figure 2



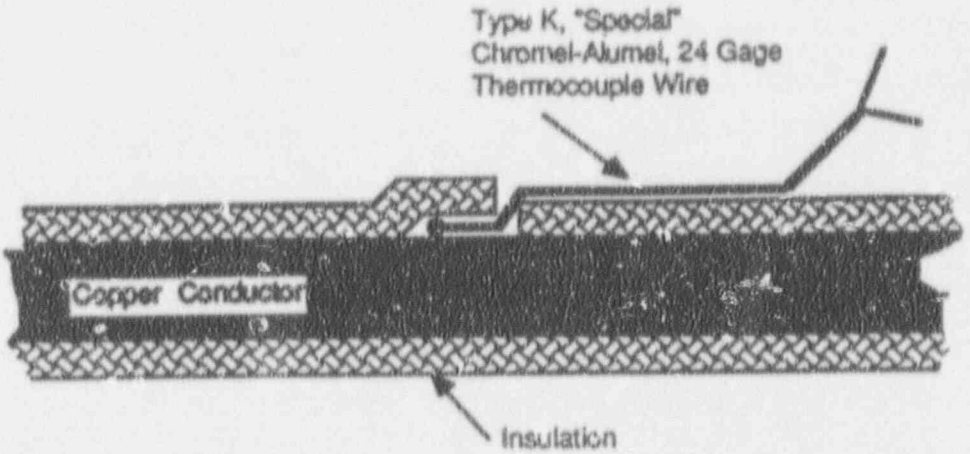
Cross-Sectional View



Conduit & Tray Support Points

CONDUIT AND TRAY AMPACITY DESIGN

Figure 3

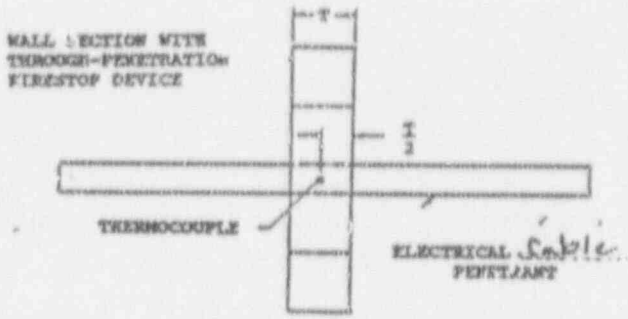


NOTE:

To attach thermo-junction to copper conductor, make an approximately 2 inch long slit in the outer wrap, expose the three conductors, locate the conductor to be instrumented, make a 1 inch slit in the insulation and insert the thermocouple junction in contact with the strands. Close the slit, reposition the wouter wrap and seal with a spiral wind of a single layer of glass-reinforced electrical tape.

Figure 4

LOCATION OF THERMOCOUPLE-THROUGH-PENETRATION FIRESTOP



THROUGH PENETRATION FIRESTOP AMPACITY DESIGN

Figure 5

FIGURE 7.1

COMANCHE PEAK STEAM ELECTRIC STATION DESIGN CHANGE AUTHORIZATION

DCA NO./ REVISION: 87040, 1

PAGE 1 OF 12

LOCATION INFO. APPLICABLE? BLDG/ROOM/ELEVATION/AZIMUTH ☐ YES ☒ NO IF YES, LOCATION

EQUIPMENT/COMPONENT AFFECTED? ☐ YES ☒ NO IF YES, I.D. NO.:

SYSTEM/SUBSYSTEM APPLICABLE? ☒ YES ☐ NO IF YES, SYSTEM/SUBSYSTEM NO.: GENERIC

INITIATING DOCUMENTS APPLICABLE? ☐ YES ☒ NO IF YES, I.D. NO.:

REASON CHANGE IS REQUIRED/PROPOSED CHANGE (OPTIONAL):

REV. 0 - SEE PAGE 2

REV. 1 - ADDITIONAL ENGINEERING BASIS PROVIDED.

REQUESTED BY: J.P. DILUCA DATE: 6/22/89 ORGANIZATION: SW/EE EXT. 0956

APPROVAL: COMANCHE ... DATE: 6/22/89

DETAILS OF CHANGE:

FOR ADDITIONS TO MS-38H SEE ATTACHED PAGES.

* MEL IS NOT EFFECTED

FOR INFORMATION ONLY

RECEIVED OCT 27 1989 EDC

ENGINEERING BASIS:

SEE PAGE 2.

AFFECTED DOCUMENT NUMBER(S) AND REVISION	INCORPORATION REQUIRED? YES	NO
M1-1701 SH. 02 REV. CP-1	✓	
M1-1701 SH. 04 REV. CP-1	✓	
M1-1901 REV. CP-1 SH. 1		✓
SH. 2		✓
SH. 3		✓
SH. 4		✓
SH. 5		✓
SH. 6		✓
SH. 7		✓

REFERENCE DOCUMENTS ☐ YES ☒ NO IF YES, INDICATE:

UNIT: ☒ 1 ☐ 2 ☐ 1 & COMMON ☐ BOTH

THE HIGHEST CLASS OF AFFECTED DOCUMENT(S) IS? ☒ CLASS I OR II ☐ NON-SAFETY

DM, PPF, OR DMRC APPLICABLE? ☐ YES ☒ NO IF YES, DM/PPF NO.: , DMRC NO.:

DOES DESIGN CHANGE CHANGE LICENSING REQUIREMENTS? ☒ YES ☐ NO IF YES, CORRESPONDENCE NO.: SWTU-12,740 / ...-0625 IF YES, IS BACKFIT REVIEW ☐ YES ☒ NO

DOES DESIGN CHANGE AFFECT DESIGN BASIS DOCUMENT? ☐ YES ☒ NO IF YES, DBD NO.: REV.:

DOES DESIGN CHANGE AFFECT A LICENSING DOCUMENT? ☐ YES ☒ NO IF YES, CORRESPONDENCE NO.:

DID DESIGN CHANGE REQUIRE THE REVIEW OF A PREVIOUSLY ISSUED CALCULATION? ☐ YES ☒ NO IF YES, CALCULATION NO.: REV.:

IS A NEW CALCULATION OR REV. REQUIRED? ☐ YES ☒ NO IF YES, CALCULATION NO.: REV.:

REMARKS ☐ YES ☒ NO IF YES, INDICATE:

K. King - 10/17/89 EE-644

ORGANIZATION PREPARING DESIGN CHANGE: SW/EE

RESPONSIBLE ENGINEER: J. DILUCA DATE: 6/22/89

ADD'L DISTRIBUTION ☒ YES ☐ NO IF YES, INDICATE:

D. KING - G2/694 J. RICHARDS OP/...
T. DONAHUE - SWU/BT 428
R. REEVES - C08 M. GRESHO - IM1

ENGINEERING REVIEW: DATE:

DESIGN REPRESENTATIVE REQUIRED? IF YES, ORGANIZATION: SIGNATURE: DATE:

ENGINEERING APPROVAL: A.M. VAUST DATE: 10/27/89

REASON CHANGE: (BLOCK 3c)

ATTACHMENT A OF PROJECT PROCEDURE PP-108 (PP-108-A) DETAILS THE TYPES OF PROTRUDING RACEWAYS WHICH DO NOT REQUIRE AN AMPACITY REVIEW.
ATTACHMENT B LISTS THE RACEWAYS / ROUTING CONTAINING CABLES WHICH REQUIRE SF 60/150 SEAL MATERIAL DUE TO AMPACITY CONCERNS, WHEN PENETRATION SEALS ARE REQUIRED. SF-20 SEAL MATERIAL MAY BE USED FOR ALL OTHER RACEWAYS.

ENGINEERING BASIS: (BLOCK 7b)

ATTACHMENTS A & B WILL PROVIDE CONSTRUCTION DIRECTION FOR FPIR SIGN-OUT OF NON MI-1700 PROTRUDING RACEWAYS, AND THE INSTALLATION OF THE APPROPRIATE PENETRATION SEAL.

1. REPLACING SF-20 WITH SF-60/150 SHOULD NOT HAVE ANY SIGNIFICANT IMPACT ON CABLE LIFE.
CLASS 1E CABLES ARE SIZED BASED ON 1.25 X FULL LOAD CURRENT, BUT ACTUALLY OPERATE AT 1.00 X FULL LOAD CURRENT OR 80% OF RATING. THIS MEANS THAT 64% OF THE ALLOWABLE HEAT IS GENERATED IN THE CABLE; ALSO THESE CABLES HAVE BEEN ENERGIZED INTERMITTENTLY AND IN MANY CASES LESS THAN FULL LOAD.
THEREFORE: THESE CABLES HAVE NOT RUN AT OR NEAR DESIGN TEMPERATURES. IN THESE CASES WHERE SF-20 WAS INITIALLY INSTALLED AND IS BEING REPLACED WITH SF-60, THERE SHOULD BE NO APPRECIABLE EFFECT ON THE QUALIFIED LIFE OF THE CABLE.

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	:

ATTACHMENT A

NO AMPACITY DERATING LIMITS CRITERIA FOR PROTRUDING AND INTERFERENCE ITEMS (1)(2)(3)

RACEWAY LEVEL	CONDUIT (SHELL)	CABLE TRAY	AIR DROP
1	2 FT.	(LTR)	ENG REVIEW REQ'D
2	2 FT.	(LTR)	ENG REVIEW REQ'D
3	NO LIMIT	NO LIMIT	NO LIMIT
4	NO LIMIT	NO LIMIT	NO LIMIT
5	NO LIMIT	NO LIMIT	NO LIMIT
6	NO LIMIT	NO LIMIT	NO LIMIT

(1) Cables Analyzed for SF-20 Firestop Material.

(2) This Criteria is Not Applicable to Raceways which have SF-60 Fire Stops.

(3) This Criteria is for thermolag only.

INCORPORATE INTO MI-1701 SH. 2

NOTE:
10. REFERENCE DCA 87040 FOR RACEWAYS THAT REQUIRE SF-60/150 SEAL MATERIAL, SHOULD PENETRATION SEALS BE REQUIRED.

NOTE:
12. REFERENCE DCA 87040 FOR RACEWAYS THAT REQUIRE SF-60/150 SEAL MATERIAL, SHOULD PENETRATION SEALS BE REQUIRED.

INCORPORATE INTO MI-1701 SH. 4

REV. 0 : AS NOTED	REV. :	AFFECTED DOCUMENT SHEETS
REV. :	REV. :	MI-1701 02 & 04

ATTACHMENT B

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PPOC: 9887?-09-0512 RUN DATE: 23 MAY 1989

SF-60/150

C-02801041
C-02803104
C-02803106
C-02804330
C-02804974
C-02807925
C-02808348
C-02808349
C-02808923
C-02810057
C-02810325
C-02810326
C-02810333
C-02810334
C-02810335
C-02810780
C-02810823
C-02810824
C-02810859
C-02810860
C-02811233
C-02811955
C-02811960
C-02812128
C-02812129
C-02815739
C-02819334
C-02819351
C-02830057
C-02903114
C-02903116
C-02903117
C-02905618
C-02905623
C-02905626
C-02905627
C-02905628
C-02908275
C-02908276
C-02911539
C-02911540
C-02911967
C-02911968
C-02911977
C-02912057
C-02912057
C-02913631
C-02914147
C-02914222
C-02914223
C-12000314
C-12001025
C-12001026
C-12001027
C-12001029
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C-12001034
C-12001037
C-12001038
C-12001039
C-12001040
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C-12001047
C-12001048
C-12001049
C-12001050
C-12001051
C-12001052
C-12001053
C-12001057
C-12001060
C-12002852
C-12003126
C-12003268
C-12003269
C-12003272
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C-12003275
C-12003276
C-12003291
C-12003523
C-12003755
C-12004490
C-12004782
C-12004927
C-12004983
C-12005058
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C-12006083
C-12006084
C-12006085
C-12006086
C-12006088
C-12006111
C-12006345
C-12006574
C-12006599

LABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PROC: PW877-89-0513 RUN DATE: 23 MAY 1989

SF-60/150

C-12015046
C-12015047
C-12015073
C-12015C77
C-12019621
C-12019622
C-12019623
C-12019631
C-12019682
C-12030167
C-12030501
C-12030502
C-12030503
C-12030504
C-12034087
C-12034247
C-12072425
C-12072427
C-12072432
C-12073350
DB1A1-04
DB1A2-04+1
DB1A3-04
IV1C1
IV1EC2+1
IV1EC3
IV1EC4+1
IV1PC1+2
IV1PC2
IV1PC3
IV1PC4+1
JC1A10610
JB1A12040
JB1A2228
JB1A243
JB1A243+1
JC1A244
JB1A244+1
JB1A2630
JB1A2648
JB1A3270
JB1A41240
JB1A41250
JB1A42610
JB1A42790
JB1A43030
JB1A451

JB1A5100
JB1A5170
JB1A5180
JB1A5190
JB1A5200
JB1A5250
JB1A5320
JB1A5369
JB1A5400
JB1A5460
JB1A5460+1
JB1A5598
JB1A5740
JB1A5740+1
JB1A5820
JC1A7530
JB1A7550
JB1A950
JB1C1320
JB1C2208
JB1C3668
JB1F035+1
JB1F100
JB1F101
JB1F128
JB1M2060+2
JB1S0440
JB1S0450
JB1S1216
JB1S30260
JK1S30270
JB1S30280
JB1S30290
JB1S345
JB1S40050
JB1S43548
JB1S582
JB1S6090+2
JB1S6140
JB1S6080
JB1S7700
JB1S898
JB1S932
JB1S9330
JB1S9330+1
JB1T40840
JB1T41300

JB1T41310
JB1T41320
JB1T41340
MH1A1+3
MH1A2+3
PBP-1EC4
PBP-1EC5
PEN-E10+1
PEN-E11
T120A0F02
T120A0F03
T120A0F10
T120A0F11
T120A0F12
T120A0F13
T120A0F14
T120A0F15
T120A0F16
T120A0F17
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T120A0F19
T120A0F20
T120A0F21
T120A0F22
T120A0F23
T120A0F24
T120A0F24+
1
T120A0F25
T120A0F26
T120A0F26+
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T120A0F27
T120A0F27+
1
T120A0F28
T120A0F29
T120A0F30
T120A0F31
T120A0F32
T120A0F33
T120A0F33+
1
T120A0F34
T120A0F34+
4
T120A0F34+

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-155A PROC: SWG77-89-0512 RUN DATE: 23 MAY 1989

57-60/150

6
T12BA8F34*
7
T12BA8F35
T12BA8F35*
1
T12BA8F36
T12BA8F37
T12BA8F38
T12BA8F39
T12BA8F40
T12BA8F41
T12BA8F42
T12BA8F43
T12BA8F44
T12BA8F45
T12BA8F46
T12BA8F47
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T12BA8F49
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T12BA8F51
T12BA8F71
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T12BA8F84*
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T12BA8F87
T12BA8F88
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T12BA8F99
T12BA8P01
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T12BA8P02
T12BA8P03
T12BA8P04
T12BA8P06
T12BA8P07
T12BA8P08
T12BA8P09
T12BA8P10
T12BA8P11
T12BA8P12
T12BA8P13
T12BA8P14

T12BA8P15
T12BA8P17
T12BA8P17*
1
T12BA8P18
T12BA8P18*
1
T12BA8P19
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T12BA8P26
T12BA8P27
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T12BA8P29
T12BA8P30
T12BA8P31
T12BA8P32
T12BA8P33
T12BA8P33*
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T12BA8P35
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T12BA8P37
T12BA8P38
T12BA8P39
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T12BA8P41
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T12BA8P43*
2
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T12BA8P44*
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T12BA8P59
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T12BA8P68
T12BA8P68*
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T12BA8P68*
2
T12BA8P69
T12BA8P69*
1
T12BA8P69*
2
T12BA8P71
T12BA8P71*
1
T12BA8P72
T12BA8P73
T12BA8P74
T12BA8P75
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T12BA8P78
T12BA8P79
T12BA8P80*
1
T12BA8P81*
1
T12BA8P82
T12BA8P83
T12BA8P84
T12BA8P85
T12BA8P86
T12BA8P90*
3
T12BA8P91
T12BA8P92
T12BA8P93
T12BA8P94*
1
T12BA8P95
T12BA8P96

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PROC: SWB77-89-0012 RUN DATE: 22 MAY 1989

SF-60/150

T1206BF97
T1206BF98
T1206BF99
T1206BG14
T1206BG15
T1206BG16
T1206BG17
T1206BG17e
1
T1206BG18
T1206BG19
T1206BG20
T1206BG21
T1206BG22
T1206BG23
T1206BG24
T1206BG25
T1206CBF52
T1206CBF53
T1206CBF54
T1206CBF55
T1206CBF56
T1206CBF57
T1206CBF58
T1206CBF59
T1206CBF60
T1206CBF61
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T1206CBF67
T1206CBF68
T1206CBF69
T1206CBF70
T1206CBF73
T1206CBF74
T1206CBF75
T1206CBF75e
1
T1206CBF76
T1206CBF76e
1
T1206CBF77
T1206CBF78
T1206CBF79

T1206CBG54
T1206CBG57
T1206CBG58
T1206CBG59
T1206CBG60
T1206CBG60e
1
T1206CBP48
T1206CBP49e
1
T1206CBP50e
3
T1206CBX01e
3
T1206DBG64
T1206EBG25
T1206EBG26
T1206EBG27
T1206EBG28
T1206EBG29
T1206EBG29e
1
T1206EBG30
T1206EBG30e
2
T1206EBG30e
3
T1206EBG30e
4
T1206FBG31
T1206EBG31e
1
T1206EBG32
T1206EBG33
T1206EBG34
T1206EBG35
T1206EBG35e
2
T1206EBG36
T1206EBG36e
3
T1206EBG36e
4
T1206EBG36e
5
T1206EBG36e
6

T1206EBG37
T1206EBG38
T1206EBG40
T1206EBG41
T1206EBG42
T1206EBG43
T1206EBG44
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T1206BM16
T1206BM17
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T1206BM20
T1206BM21
T1206BM22
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T1206BM24
T1206BM25
T1206BM26
T1206BM27
T1206BM28
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T1206BM30
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T1206BM36
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T1206BM38
T1206BM39
T1206BM40
T1206BM41
T1206BM42
T1206BM43
T1206BM44

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-155# PROC: SW877-BV-U512 RUN DATE: 23 MAY 1989

SF-60/150

T12BBBB45	2	T120ABA44*
T12BBBB46	T12BBBB53	1
T12BBBB47	T12BBBB53*	T120ABA45
T12BBBB48	1	T120ABA45*
T12BBBB49	T12BBBB54	1
T12BBBB01	T12KEBJ08	T120ABA46
T12BBBB02	T12KEBJ09	T120ABA47
T12BBBB03	T12KEBJ10	T120ABA48
T12BBBB04	T12KEBJ11	T120ABA49
T12BBBB05	T12KEBJ12	T120ABA50
T12BBBB06	T12KEBJ13	T120ABA51*
T12BBBB07	T12KEBB63	1
T12BBBB08	T12KEBB63*	T120ABA51*
T12BBBB09	2	2
T12BBBB10	T12KFBV05	T120ABA51*
T12BBBB11	T12KFBV06	3
T12BBBB12	T12KFBV07	T120ABA52
T12BBBB13	T12KFBV08	T120ABA53
T12BBBB14	T12KFBV09	T120ABA54
T12BBBB15	T12KFBV10	T120ABA55
T12BBBB18	T12KFBV11	T120ABA56
T12BBBB19	T12KFBV12	T120ABA57
T12BBBB21	T12KFBV13	T120ABA58
T12BBBB22	T12KFBV14	T120ABA59
T12BBBB39	T12KFBV15	T120ABA60
T12BBBB40	T12KFBV16	T120ABA61
T12BBBB41	T12KFBV17	T120ABA62
T12BBBB45	T12KFBV18	T120ABA63
T12BBBB46	T120ABA12	T120ABA64
T12BBBB47	T120ABA13	T120ABA65
T12BBBB48	T120ABA14	T120ABA66
T12BBBB48*	T120ABA15	T120ABA67
3	T120ABA16	T120ABA68
T12BBBB50	T120ABA17	T120ABA69
T12BBBB50*	T120ABA18	T120ABA70
1	T120ABA19	T120ABA71
T12BBBB50*	T120ABA20	T120ABA72
2	T120ABA21	T120ABA95
T12BBBB50*	T120ABA40	T120ABA96
2	T120ABA41	T120ABA97
T12BBBB51	T120ABA42	T120ABA98
T12BBBB51*	T120ABA42*	T120AB801
1	1	T120AB802
T12BBBB52	T120ABA43	T120AB803
T12BBBB52*	T120ABA43*	T120AB804
1	1	T120AB805
T12BBBB52*	T120ABA44	T120AB806

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

COMANCHE PEAK STEAM ELECTRIC STATION
DESIGN CHANGE AUTHORIZATION CONTINUATION SHEET

DCA NO./ REVISION 87040 / 1
PAGE NO. 10 OF 12

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-155R PROC: SWBTP-89-0512 RUN DATE: 23 MAY 1989

SF-60/150

T120A8807
T120A8808
T120A8809
T120A8810
T120A8811
T120A8812
T120A8824
T120A8824+
1
T120A8825
T120A8825+
1
T120A8826
T120A8826+
1
T120A8827
T120A8828
T120A8829
T120A8829+
1
T120A8830
T120A8833
T120A8850
T120A8850+
3
T120A8852
T120A8853
T120A8854
T120A8854+
1
T120A8854+
2
T120A8855
T120A8856
T120A8856+
1
T120A8856+
3
T120A8857
T120A8858
T120A8859
T120A8860
T120A8861
T120A8862
T120A8863
T120A8864
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T120A8877
T120A8878
T120A8879
T120A8880
T120A8881
T120A8882
T120A8882+
1
T120A8883+
1
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T120A8893
T120A8894
T120A8895
T120A8C01
T120A8C02
T120A8C03
T120A8C04
T120A8C05
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T120A8C07
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T120C8967
T120C8968
T120C8969
T120C8970
T120C8971
T120C8978
T120C8979
T120C8980
T120E8A31+
2
T120E8A32
T120E8A33
T120E8A34
T120E8A35
T120E8A3a

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PROC: SWB77-09-0012 RUN DATE: 23 MAY 1989

SF-60/150

T1208E8A37
T1208E8814
T1208E8817
T1208C8818
T1208E8819
T1208E8819+
2
T1208E8819+
3
T1208E8841
T1208E8842
T1208E8843
T1208E8844
T1208E8845
T1208E8846
T1208E8851
T1208E8852
T1208E8853
T1208E8855
T1208E8855+
4
T1208E8855+
6
T1208E8855+
7
T1208E8856
T1208E8857
T1208E8912
T1208E8912+
1
T1208E8912+
5
T1208E8913
T1208E8913+
1
T1208E8914
T1208E8915
T1208E8C25
T1208E8C26
T1208E8C27
T1208E8C28
T1208E8C29
T1208E8C30
T1208E8C31
T1208E8C32
T1208E8C33+
4
T1208E8C35+
8
T1208E8C36
T1208E8C36+
8
T1208E8C37+
8
T1208E8C40
T1208E8C41
T1208E8C42
T1208E8C43
T1208E8C44
T1208E8C44+
1
T1208E8C45
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T1208E8C47+
1
T1208E8C47+
2
T1208E8C48+
1
T1208E8C48+
4
T1208E8C52
T1208E8C53
T1208E8C54
T1208E8C55
T1208E8C56
T1208E8C57
T1208E8C58
T1208E8C59
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T1208E8C69
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T1208E8C76
T1208E8C77
T1208E8C78
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T1208E8D05
T1208E8D06
T1208E8D07
T1208E8D08
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T1208E8D09+
1
T1208E8D09+
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T1208E8D11
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T1208E8L3
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TEXAP8A02
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TWB-A-003+
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1
TWB-A-003+
2
TWB-A-004+
1
TWB-A-005+
3
TWB-A-005+
3
TWB-A-007+
4
TWB-A-007+
5
TWB-A-010
TWB-A-010+
3
TWB-A-010+
4
TWB-A-010+
5
TWB-A-010+
6
TWB-A-010+
7
TWB-A-011+

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PROC: SWB77-89-0512 RAW DATE: 23 MAY 1989

SF-60/150

1
TWB-A-011A
2
TWB-A-011A
3
TWB-A-011A
4
TWB-A-011A
5
TWB-A-011A
6
TWB-A-019
TWB-A-019A
2
TWB-A-028
TWB-A-028A
6
TWB-A-028A
7
TWB-C-001
TWB-C-021A
2
TWB-C-091A
3
TWB-C-001A
4
TWB-C-002
TWB-C-002A
1
TWB-C-002A
2
TWB-C-004
TWB-C-004A
1
TWB-C-004A
2
TWB-E-008
TWB-N-007A
4
TWB-S-003A
7
TWB-S-004
TWB-S-005
TWB-S-009A
3
TWB-S-017
TWB-S-018

TWB-S-018A
5
TWB-S-018A
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TWB-S-018A
9
TWB-S-019A
7
TWB-S-022A
11
TWB-S-022A
13
TWB-S-022A
14
TWB-S-022A
15
TWB-S-022A
7
TWB-S-022A
8
TWB-S-023

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	

TU ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION UNIT NO. 1
REVISION CODE: CP-1558 PROC: SW877-89-0512 RUN DATE: 23 MAY 1989

BF-60/150

C-12007131	C-12034504	C-12001334
C-12007132	C-12034505	C-12001344
C-12008113	C-12072469	C-12001671
C-12008114	C-12072470	C-12002624
C-12008115	C-12072471	C-12002832
C-12008177	C-12K02538	C-12002834
C-12008191	C-12K04047	C-12003144
C-12008353	C-12K04050	C-12003160
C-12013249	C-12K04051	C-12003166
C-12013351	C-12K04052	C-12003408
C-12013542	C-12K04053	C-12003411
C-12014656	C-12K04066	C-12003536
C-12014725	C-12K04067	C-12003537
C-12015051	C-12K04068	C-12003539
C-12015052	C-12K04069	C-12003544
C-12015053	C-12K04772	C-12003548
C-12015054	C-12K12799	C-12003549
C-12018721	C-12K12800	C-12004280
C-12019414	C-12K12801	C-12004281
C-12019752	C-12K12836	C-12004282
C-12019756	C-12K12837	C-12004800
C-12019755	C-12K15042	C-12005077
C-12030083	C-12K15050	C-12005078
C-12030084	C-12K15074	C-12005093
C-12030505	C-12K15081	C-12005096
C-12030506	C-12K15082	C-12005098
C-12030507	C-12K15083	C-12005108
C-12030508	C-12K15116	C-12005142
C-12033494	C-12K15117	C-12005150
C-12033495	C-12000952	C-12005151
C-12033514	C-12000956	C-12005189
C-12033515	C-12000958	C-12005190
C-12033516	C-12000959	C-12005316
C-12033517	C-12000990	C-12005442
C-12033518	C-12000999	C-12005539
C-12033519	C-12001002	C-12005631
C-12033521	C-12001004	C-12005632
C-12033522	C-12001005	C-12005984
C-12033524	C-12001006	C-12006014
C-12033525	C-12001008	C-12006017
C-12033526	C-12001009	C-12006188
C-12033527	C-12001010	C-12010195
C-12033528	C-12001016	C-12011187
C-12033529	C-12001019	C-12012404
C-12033530	C-12001021	C-12013024
C-12033531	C-12001316	C-12013025
C-12033532	C-12001335	C-12013041

CABLE AND RACEWAY DATA SYSTEM

REV. :	REV. :	AFFECTED DOCUMENT
REV. :	REV. :	