

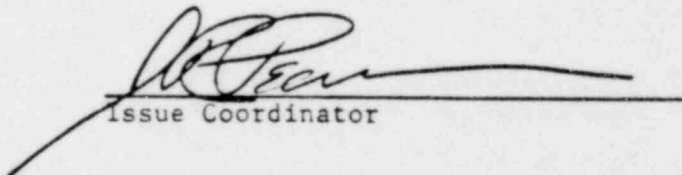
COMANCHE PEAK RESPONSE TEAM

RESULTS REPORT

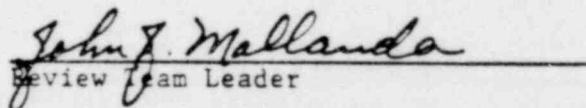
ISAP: I.a.4

Title: Agreement Between Drawings and Field Terminations

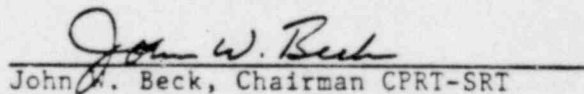
REVISION 1


Issue Coordinator

3/12/86
Date


Review Team Leader

3/12/86
Date


John W. Beck, Chairman CPRT-SRT

3/13/86
Date

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RESULTS REPORT

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Agreement Between Drawings and Field Terminations

1.0 DESCRIPTION OF ISSUE IDENTIFIED BY NRC (NUREG-0797, Supplement Number 7, Page J-29)

"...the TRT selected 380 cables, involving 1600 individual terminations, and inspected them in detail with respect to drawing requirements. This inspection revealed that six cables (five of which are safety-related) were not terminated in accordance with current drawings. These six cables are:

- E0139880 in panel CP1-ECPRCB-14*
- E0110040 in panel CP1-ECPRTC-16,
- E0118262 in panel CP1-ECPRTC-16,
- NK139853 in panel CP1-ECPRCB-02 (non-safety),
- EG104796 in panel CP1-ECPRTC-27, and
- EGO21856 in panel CPX-ECPRCV-01."

2.0 ACTION IDENTIFIED BY NRC (NUREG-0797, Supplement Number 7, Item Number 6 (c), Page J-31)

"TUEC shall accomplish the following actions prior to fuel load:

Reinspect all safety-related and associated terminations in the control room and in the termination cabinets in the cable spreading room to verify that their locations are in accordance with all current design documents. Should the results of this reinspection reveal an unacceptable level of nonconformance to design documents, the scope of this reinspection effort shall be expanded to include all safety-related and associated terminations at Comanche Peak Steam Electric Station (CPSSES)."

3.0 BACKGROUND

The specific cables identified above have been re-inspected and the "as-built" configurations reviewed by TUGCO Nuclear Engineering (TNE). The engineering review has considered design changes and temporary modifications authorized prior to the TRT identification.

The results of this review are as follows:

* The TRT notified TUEC that the panel identified as CP1-ECPRCB-14 should be CP1-ECPRCB-04.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

3.0 BACKGROUND (Cont'd)

One cable (EØ139880) was terminated correctly, but the color-code table on the drawing had not been correctly reflected in the conductor termination details. This drawing was corrected, and all other drawings with the same type of cable were checked to ensure that this condition does not exist elsewhere. No errors were found.

One cable (EØ110040) was found to be properly connected in accordance with the document revision in effect at the time the termination was made. However, a subsequent drawing revision changed the color code of the conductor for no apparent reason. This drawing error was detected and corrected prior to the September 18, 1984, letter from the NRC to TUGCO.

One cable (EØ118262) contained a drafting error at the time of the TRT inspection, (two green conductors shown). The cable was functionally correct as landed. The drawing error has been corrected.

One cable (EG104796), a two conductor cable, was found to have wires interchanged on the terminal points. This connection has no polarity requirement. Thus, the interchange of wires had no affect on the operability of the circuit. The physical terminations have, however, been corrected to match the drawing.

One cable (EG021856) was found to be a designated "spare" per a properly issued design change authorization (DCA) document (DCA 19948, dated March 21, 1984). However, the interconnection drawing for one end of the cable still showed the cable to be terminated. The cable has been deleted from the current revision of the interconnection drawing.

One cable (NK139853), a non-safety cable, had the orange and yellow/orange pair of conductors designated on the drawing as "spare", but these conductors were left terminated. However, the corresponding vendor-side conductors had been removed from the terminal blocks. The subject conductors have subsequently also been removed from the terminal blocks.

In summary, all of the cables identified by TRT were found to be functionally correct as landed. The causes of the discrepancies identified by the TRT are as follows:

EØ139880 Drawing error

EØ110040 Drawing error

RESULTS REPORT

ISAP I.a.4
(Cont'd)

3.0 BACKGROUND (Cont'd)

- EØ118262 Drawing error
- EG104796 Interchanged conductors in a circuit with no polarity requirements
- EG021856 Interconnection drawing not revised to incorporate a DCA
- NK139853 Spare conductors terminated (non-safety)

4.0 CPRT ACTION PLAN

4.1 Scope and Methodology

The objective of this action plan was to assure that the safety-related and associated cable terminations in the control room and cable spreading room are in accordance with current design documents. To achieve this objective, a program to inspect terminations was implemented.

4.1.1 Inspection Program

An inspection program employing random sampling was initiated which enabled a determination to be made with reasonable assurance of whether the essential (i.e., safety-related) Class 1E conductors in the control room and cable spreading room, which are in circuits that interface with the Alternate Shutdown Panel, were terminated in accordance with the applicable drawings.

A sample inspection was considered to be a reasonable approach for the following reasons:

- 1) No programmatic deficiencies had been identified in this population to date.
- 2) The population was homogeneous with respect to the attribute of agreement with drawings.

4.1.1.1 Population Identification

The first step in the sampling program was to identify the population of all essential Class 1E terminations in the control room and cable spreading room that are in circuits

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ISAP I.a.4
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

which interface with the Alternate Shutdown Panel in Unit 1. This population of "safe shutdown" terminations was taken from over 14,000 Class 1E terminations in these two rooms.

The "safe shutdown" terminations were chosen as a sub-group of the population of all Class 1E terminations due to their crucial role in plant safety. Since there are no product or process differences between this sub-group and the remainder of the Class 1E terminations, this approach allowed for an investigation, which focused on safety, while still attaining an engineering assessment of the quality of the larger population.

4.1.1.2 Random Sampling

The sampling plan was designed in accordance with the guidelines of Appendix D, to test for reasonable assurance that programmatic deficiencies do not exist in the population.

This plan employed a 95/1 screen, which was significantly more conservative than the 95/5 screen which was used in the majority of the ISAPs in which a sampling program was employed. The decision to enforce this higher standard (which increases sample sizes by approximately a factor of five) was made by the Electrical Review Team Leader (M. B. Jones, Jr.).

Based on the preliminary determination of a population size of 3812, the minimum sample size according to Appendix D was 300 with a rejection number of zero (i.e., the critical region was one or more deficiencies found in the sample). If one (1) deficiency had been found, a root cause evaluation of the deficiency would have been performed, and a sample expansion in accordance with Appendix D undertaken.

RESULTS REPORT

ISAP I.a.4
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4.0 CPRT ACTION PLAN (Cont'd)

If the number of deficiencies discovered in the original sample had been two (2) or more, or a programmatic root cause had been identified, then a 100% reinspection of all essential and associated terminations in the control room and cable spreading room of Unit 1 would have been performed.

4.1.2 Use of Results

If the CPRT inspection program had identified any deficiencies, then a root cause and generic implications evaluation would have been performed, and appropriate corrective action determined.

4.2 Participants Roles and Responsibilities

The organizations and personnel that participated in this effort are described below with their respective work scope.

4.2.1 TUGCO Comanche Peak Project

- 4.2.1.1 Assisted the Review Team Leader in identifying the essential Class 1E terminations which interface with the Alternate Shutdown Panel.
- 4.2.1.2 Prepared sample inspection list using input provided by the third-party statistics adviser.
- 4.2.1.3 Processed NCRs, if any, generated as a result of this action plan.
- 4.2.1.4 Personnel

Mr. W. I. Vogelsang TUGCO Coordinator

4.2.2 Electrical Review Team

- 4.2.2.1 Reviewed sampling plan, inspection procedure, NCRs (if any) and inspection reports.
- 4.2.2.2 Evaluated inspection results and specified additional inspections, if required.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

4.2.2.3 Performed root cause, generic implications and safety significance evaluations, if required.

4.2.2.4 Personnel (prior to October 18, 1985)

Mr. M. B. Jones, Jr. Review Team Leader

Mr. E. P. Stroupe Issue Coordinator

4.2.2.5 Personnel (starting October 18, 1985)

Mr. J. J. Mallanda Review Team Leader

Mr. J. R. Pearson Issue Coordinator

Mr. M. B. Jones, Jr. Third-Party Adviser

Mr. E. P. Stroupe Third-Party Adviser

4.2.3 CPRT - QA/QC Review Team

4.2.3.1 Prepared procedure for inspecting terminations.

4.2.3.2 Inspected terminations for compliance with acceptance criteria.

4.2.3.3 Personnel

Mr. J. L. Hansel Review Team Leader -
QA/QC

4.2.4 Third-Party Statistics Adviser

4.2.4.1 Provided input to the sampling plan.

4.2.4.2 Personnel

Dr. F. A. Webster Statistics Adviser

RESULTS REPORT

ISAP I.a.4
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

4.3 Qualifications of Personnel

Where tests or inspections required the use of certified inspectors, qualifications at the appropriate level were to the requirements of ANSI N45.2.6, "Qualification of Inspection, Examination, and Testing Personnel at Nuclear Power Plants". CPRT third-party inspectors were certified to the requirements of the third-party employer's Quality Assurance Program, and specifically trained to the CPRT Program Plan.

Third-party participants in the implementation of this action plan met the personnel qualification and objectivity requirements of the CPRT Program Plan and its implementing procedures.

Other participants were qualified to the requirements of the CPSES Quality Assurance Program or to the specific requirements of the CPRT Program Plan. Activities performed by other than third-party personnel were governed by the applicable principles of Section III.K, "Assurance of CPRT Program Quality", of the CPRT Program Plan.

4.4 Procedures

4.4.1 Instruction QI-001, "Procedure for Class 1E Cable Terminations Inspection - CPRT Action Item I.a.4".

4.5 Acceptance Criteria

4.5.1 Inspections

The acceptance criterion for the termination inspection was that either:

- The termination was physically in agreement with the drawing (a conductor of a larger size than that shown on the drawing was also acceptable), or
- The termination was not in agreement with the drawing but was functionally correct (e.g., connected to an electrically common point, or wires reversed in circuits with no polarity requirements).

RESULTS REPORT

ISAP I.a.4
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

4.6 Decision Criteria

If any terminations had not been acceptable per Section 4.5.1, further investigations would have been performed including either sample expansion in accordance with Appendix D or a 100% reinspection. As discussed in Section 5, no further investigations were necessary.

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS

5.1 Summary of Implementation

The actions carried out under this ISAP consisted of a sample inspection of "safe shutdown" terminations, analysis of the results of that inspection and a further investigation of the specific NRC-TRT findings.

The inspection program was performed using the methodology specified in Section 4.1. No deviations from the acceptance criteria of Section 4.5 were found. Two minor errors were discovered, which did not affect the adequacy of the terminations. The identification of additional population members necessitated an additional sample inspection, which was also completed without finding any deviations from the acceptance criteria. The results of the entire inspection program are presented in Section 5.2.

The results of the further investigation into the specific NRC-TRT findings are presented in Section 5.3.

5.2 Results of the CPRT Inspection Program

5.2.1 Original Population and Inspection Results

Initially there were 3,812 terminations in the control room and cable spreading room identified as being in Unit 1 essential Class 1E circuits which interface with the Alternate Shutdown Panel. The population was identified by drawing review.

Though the initial minimum sample size was to be 300, a list of 350 randomly-selected terminations from the population was created. This list was generated in accordance with the guidelines in Appendix D to the

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

CPRT Program Plan. The extra 50 terminations in the list were included to cover duplicate numbers (inherent in the random selection process), physically-inaccessible terminations, or any unforeseen problems, which might later have required additional terminations to be inspected.

This list of 350 terminations yielded 313 valid samples (thus still in excess of the 300 required to meet the 95/1 screen if no deficiencies were found). The CPRT inspection of these 313 terminations uncovered one (1) drawing error and one (1) cable-tagging error. Both errors were judged to be minor, and neither violated the acceptance criteria of Section 4.5. These two errors are discussed in detail in Section 5.2.2.

5.2.2 Discussion of Specific Findings

As noted in Section 5.2.1, two errors were found during the inspection of the terminations. Neither error constitutes a deviation from the acceptance criteria of Section 4.5, since in each case the conductor involved was terminated correctly. Those errors are discussed below.

5.2.2.1 Drawing Error

The CPRT inspections revealed a cable number drawing error. On drawing 2323-E1-0172-17 cable EG120248 was shown as "EG 20248". Since all cable numbers have six digits, a five-digit number would have been recognized as a drawing error by maintenance or operations personnel who would have been using the drawing. The proper number could then have been determined by a drawing review of this and other related drawings. (It is also noted that the subject cable was in Unit 1, and cable numbers beginning with "2" are assigned to Unit 2 cables, a convention well-known to maintenance and operations personnel.) A drawing error of this type would not have an adverse impact on the adequacy of safety-related terminations, since it did not lead to an incorrect termination. The specific drawing has been reissued with the number corrected.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

5.2.2.2 Cable-tagging Error

The CPRT inspections also revealed an error in the prefix of a field-applied cable identification number (cable EG145725 was tagged as "EC145725"). "C" is not a valid character for the prefix of a cable number. As such, this tag number would be recognized as an error in the sleeve identification. Also, the six-digit number alone provides unique identification of the cable. An error of this type does not violate the acceptance criteria of Section 4.5 and would not have an adverse impact on the adequacy of safety-related terminations, since it did not lead to an incorrect termination. The specific tag has been corrected.

5.2.3 Population Changes and Additional Inspection Results

As part of the CPRT overview of activities performed for this action plan, two types of anomalies in the CPRT sample identification process were uncovered. The first type consisted of errors in the process of "mapping" random digits to the correct terminations to be inspected. These errors were due to a tedious manual method for performing this work, which was easily subject to human error. The entire mapping process has subsequently been checked by third-party personnel. Each incorrectly-mapped selection was eliminated from the final sample, even though the resultant termination had been inspected and found to be functionally correct. The final count of 313 valid samples reflects the elimination of these samples.

The second anomaly was in the determination of the total population (originally 3,812). A review by third-party personnel uncovered an additional 105 terminations, which were not included in the original population. These 105 omissions were due to: (1) incorrect count of conductors within some cables; and (2) entire cables missing from the population list.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

If the entire population of 3,917 terminations had been identified originally, the required sample size per Appendix D would still have been 300. However, due to the actual sequence of events, none of the additional 105 terminations could have been selected for inspection. Therefore, CPRT instituted an additional inspection program, which consisted of a random sample being drawn from the additional terminations. The sample size was chosen to be in equal proportion to the additional population as the original sample size was to the original population. This approach restored an original premise of the sampling approach - that each population item had an equal chance of being selected for inspection. The additional sample size was thus calculated to be nine (9).

The 9 terminations were selected at random from the population of 105 in accordance with the method specified in Appendix D. These 9 terminations were inspected in accordance with the action plan requirements and no deviations were found.

5.2.4 Other Findings

During the CPRT inspections, it was noted that two conductors had a low chromatic blue color. The inspection reports noted the color as "greenish-grey and as such the color code is indeterminate". This finding was investigated by a third-party consultant and the Electrical Review Team Leader (RTL). It was determined that the blue conductor would not have been confused with any other conductor.

The subject conductors were terminated correctly, and the Electrical RTL considers that the conductors are sufficiently discernible from one another to ensure that other cables of this type will not be incorrectly terminated due to the low chromatic purity of their conductors.

5.3 Further Investigation of the NRC-TRT Findings

The results of a review by TNE of the six (6) cables, which had been identified by NRC-TRT as not being terminated in accordance with current drawings, are presented in Section 3.0. A further review of these cables by CPRT was performed during implementation of this action plan.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

A discussion of the review for each of the 6 cables follows:

5.3.1 Cable EØ139880

This cable was terminated correctly, but the color-code table on the drawing had not been correctly reflected in the termination details. This multi-conductor cable was supplied with a different color code than shown on the design documents. This drawing has been corrected, and other drawings, which had this type of cable and color-code table, were checked by CPRT to ensure that they had also been corrected. No errors were found.

5.3.2 Cable EØ110040

The drawing and termination were in agreement at the time the termination was made. However, a subsequent drawing revision mistakenly changed the color code of the conductor. The drawing has been corrected. This was an isolated drafting error, and did not adversely impact the adequacy of the termination.

5.3.3 Cable EØ118262

This cable was properly connected in accordance with the document in effect at the time the termination was made. However, the drawing contained a drafting error at the time of the TRT inspection, i.e., two green conductors were shown for this cable. The drawing error has been corrected. This is an isolated drafting error, and did not adversely impact the adequacy of the termination.

5.3.4 Cable EG104796

This two-conductor cable was found to have its conductors reversed at the terminal block. The specific circuit had no polarity requirement and thus the reversal did not have any functional impact on the circuit operation. The physical terminations have been corrected to match the drawing.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

5.3.5 Cable EG021856

This cable was found to be a designated "spare" per a properly issued design change document (DCA 19948, dated March 21, 1984). However, the interconnection drawing for Panel CPX-ECPCV-01 still showed the cable to be terminated. The cable has subsequently been deleted from the current revision of the interconnection drawing and is not terminated. There is no potentially adverse impact on the adequacy of the termination, since the DCA had been properly used in determining the cable, and the cable was not terminated at the time of the NRC-TRT inspection.

Since the cause of this finding appeared to be a delay in updating the interconnection drawing to reflect a DCA, the Electrical RTL requested a third-party review of the drawing update process. This review indicated that delays had been caused by the volume of changes and by priority having been given to activities necessary to support the Unit 1 start-up effort. The review also found, however, that an effort had been initiated by TUGCO in September of 1984 to significantly reduce the volume of open design change documents.

5.3.6 Cable NK139853

The drawing for this non-safety cable had the orange and yellow-orange pair of conductors designated as "spare", but the conductors were left terminated. However, the corresponding vendor-side conductors had correctly been lifted from the terminal blocks and thus there was no functional deviation. The subject spare conductors have subsequently also been lifted from the terminal blocks.

5.4 Root Cause and Generic Implications

Since the activities carried out during the implementation of this action plan did not reveal any deficiencies, neither a root cause nor a generic implications evaluation is necessary.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

5.0 IMPLEMENTATION OF ACTION PLAN AND DISCUSSION OF RESULTS (Cont'd)

5.5 Discussion of Related CPRT Activities

ISAP I.a.2, "Inspection Reports on Butt Splices," includes the inspection of all AMP preinsulated environmentally-sealed butt splices in safety-related circuits in the control room and cable spreading room of Unit 1. A necessary step in identifying the location of these butt splices is to trace conductors from terminal points to butt splices (and vice-versa). While not an attribute of the ISAP I.a.2 inspection procedure, the correctness of these terminations is verified by this process. In inspecting over 500 conductors with butt splices, no functionally-incorrect terminations were discovered. One cable (AØ130852) was noted to have two conductors reversed at the terminal points. As in the case of the conductor reversal discovered by NRC-TRT, these conductors were in a single circuit with no polarity requirement, and thus were functionally correct. These conductors, however, have been reterminated to match the drawing.

ISAP VII.c, "Construction Reinspection/Document Review Program," will include an inspection of 60-120 cables (including at least 60 in circuits that are important to safety). One of the inspection attributes is the correctness of terminations, and thus all conductors in each of these cables will be checked to ensure that they are correctly terminated. The results of this inspection will be included in the results report for ISAP VII.c.

5.6 Out-of Scope Findings

During the sample inspections, the inspectors found four (4) white conductors terminated at points which drawing 2323-EI-0156, Revision CP-4, showed to be vacant. These conductors were not part of the sample. TNE reviewed this drawing and determined that the subject conductors had been deleted (by drafting error) during incorporation of a DCA. The terminations were in accordance with the DCA and are functionally correct. The subject drawing has subsequently been corrected to show these terminations.

RESULTS REPORT

ISAP I.a.4
(Cont'd)

6.0 CONCLUSIONS

A CPRT inspection of 322 randomly-selected "safe shutdown" terminations found all to be functionally in accordance with the applicable design documents. Further, of the six cases identified by NRC-TRT involving cables not being terminated in accordance with drawing requirements, none was found to be in functional disagreement with design requirements. It is noted that the NRC-TRT inspection included 1600 terminations consisting of both safety-related and non-safety-related cables. Functional correctness of an additional 500-600 terminations was assured as a necessary step in completing Action Plan I.a.2 involving butt-splice inspections. Inspection of the terminations of all conductors in 60-120 cables is being performed by CPRT as part of the Quality of Construction program (specifically within Action Plan VII.c). This inspection is not limited to only the "safe shutdown" terminations.

The rigorous sample inspection program performed under this Action Plan, together with the added screens provided by the related inspections and tests discussed herein, provide reasonable assurance that there are no undetected safety-significant or programmatic deficiencies that involve correctness of safety-related electrical terminations.

The small number of anomalies, none of which adversely affected the adequacy of safety-related terminations, is within the bounds to be expected, given the number of terminations reviewed.

7.0 ONGOING ACTIVITIES

There are no activities still ongoing with respect to CPRT effort for this action plan. Related inspections will be reported in the Results Report for ISAP VII.c, "Construction Reinspection/Documentation Review Plan."

8.0 ACTION TO PRECLUDE OCCURRENCE IN THE FUTURE

Since no programmatic deficiencies were found, there are no corrective actions required.