Enclosure
To GCA 88-001

WIRE AND CABLE PROGRAM REPORT

RANCHO SECO NUCLEAR GENERATING STATION

SACRAMENTO MUNICIPAL UTILITY DISTRICT

SACRAMENTO

REVISION 4

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WIRE AND CABLE PROGRAM REPORT

1. INTRODUCTION

The Rancho Seco Nuclear Generating Station at plant turnover in 1975 had a cable population of about 14,000 cables installed mostly in ventilated type cable tray and in steel conduit. Since 1975 about 9,000 cables have been added while a few have been deleted.

In common with all large modern power plants in the United States, Rancho Seco tracks its raceway and cable data in a computerized program run on a main frame computer. The current program has an acronym of CRTS (Cable Raceway Tracking System) and performs some checks and calculations as well as recording and reporting data. CRTS has been in place since July of 1980.

The original cable population of 14,000 was installed by Bechtel Power Corporation (BPC). BPC was both designer and constructor. Until the CRTS program was put in place in 1980, the cable and raceway was tracked by a BPC Program EE-553. This program has been used for over 20 nuclear power plants.

2. BACKGROUND DISCUSSION

2.1 INITIATING EVENTS

Although some questions concerning CRTS completeness, missing CRTS cards and conflicting procedures were raised by resident inspectors as early as 1983, major concerns did not arise until 1985 and 1986. In 1985 questions arose concerning the degree of design control exercised following spurious actuations reported in LER 85-16. In 1986 questions arose concerning the degree of control exercised during the installation process and the validity of "as-built" information in the CRTS data base following issuance of LER 86-10. Employee allegations regarding overfilled cable trays and incomplete data in CRTS, added to the level of concern.

The July Wire and Cable Program Report contained 56 CRTS Action Items, including entries for 16 Non-Conformance Reports [NCRs] and 12 Occurrence Description Reports [ODRs]. The August Report was reformatted and lists ODRs and NCRs separately from the CRTS Action Item List [Attachment (1)]. CRTS Action Items 1 through 22 remain the same, Item 23 of the July Report is now listed under NCR S-5270 in the CRTS NCR List, Items 24 and 25 of the July Report have been combined and are now Item 23. ODRs and NCRs listed as Items 26 through 52 of the July Report are now listed by the appropriate ODR or NCR number in either the CRTS ODR List [Attachment (2)] or the CRTS NCR List [Attachment (3)] as appropriate. CRTS Action Items 53 through 56 of the July Report now appear as CRTS Action Items 24 through 27 respectively. The August Report added Item 28. The September/October Report added Items 29 and 30.

WIRE AND CABLE PROGRAM REPORT
(Continued)

Identified problems and questions are listed in the CRTS Action Item List [Attachment (1)], the CRTS ODR List [Attachment (2)], and the CRTS NCR List [Attachment (3)], with appropriate references. The separate ODR and NCR lists have been expanded and now provide descriptions of the occurrences or nonconformances, direct causes, corrective actions and reference to the CRTS Action Item Commentaries [Attachment (4)], where appropriate.

2.2 INITIAL ACTIONS

Initial action taken by SMUD, in mid-1986, was to hire a contractor [Impell - Task 271] to provide computer applications and electrical engineering expertise required to resolve CRTS database discrepancies and verify that the CRTS database correctly reflected the plant "as-built" configuration. This task was essentially an engineering review and checking process aided by microcomputer programs written to sort CRTS data and to print data lists as requested by the engineers. Checks were made of raceway overfills, violations of separation criteria, intermixing of instrument cables with power and control cable and other discrepancies as listed in the Action Plan. Although a number of discrepancies were "bookkeeping" problems, generated by the enhancement, a significant number could, potentially, have been of real concern. Identified discrepancies are documented in reports from the SMUD contractor [IMPELL] to SMUD and their dispositions described in Item 2 of the CRTS Action Item List and supported by calculations in SMUD files. Late in 1986 a decision was made to signal trace a significant sample of the approximately 2400 safety cables installed from 1975 through 1986 and compare the "as-built" condition with plant documents and the CRTS data base to establish a level of confidence in the reliability of the data base. The signal tracing has found sufficient number of major defects in both Lot 1 (397 cables) and Lot 4 (78 cables) to require 100% inspection of each lot. In late June, 1987 sampling was complete in Lots 2, 3 and 4. However, in July, 1987 a decision was made to sample Lot 2 to the "one-defect" level, increasing the size of Lot 2 by 35 cables. Circuit tracing was completed on December 8, 1987 with a total of 617 cables either traced visually or by signal tracing. During the final checking and revision of the Sample Plan [Appendix (1)] cables deleted from the plant [after the populations were established] were deleted, from each lot, as follows:

	Lot 1	Lot 2	Lot 3	Lot 4
Was	422	1702	190	78
Is	397	1462	176	78

Additionally, in Lot 2, 76 Class 2 [Appendix "R"] cables and 3 Class 1 [Appendix "R"] cables were found to be pre-commercial operation vintage. Three [3] of the 76 were included in the Lot 2 inspection total of 91. Deleting 79 pre-commercial cables reduces the Lot 2 total to 1383. Three more cables were traced in Lot 2 in December and were found to be correct [no defects]. Final inspection totals and statistical inferences are given in Table 1 of the commentary to CRTS Action Item 28.

Simply stated, the intent was to establish 95 percent confidence that the true percentage of discrepant circuits [major defects] in the sampled population is no greater than 5 percent. Inspection totals are in fact higher for Lots 2 and 3 than are required to establish this confidence level. See commentary to CRTS Action Item 28.

2.3 ACTION PLAN

SMUD has provided a document [Appendix (2)] to the NRC which describes a five part Action Plan to consolidate the various activities of the Nuclear Engineering Department, which deal with the cable and raceway questions.

Although the scope of the plan is complete, the details and the individual actions require additional definition to enable a reviewer to easily determine the acceptability of the resolution of each item (i.e., question or issue raised). The Wire and Cable Program Report is intended to replace the Action Plan and to provide additional definition and schedule information on a monthly basis.

2.4 CRTS ACTION ITEM LIST AND COMMENTARY

This report provides a listing of thirty CRTS action items [Attachment (1)] with a detailed commentary on each [Attachment (4)]. This list is intended to serve as a record of all questions raised and of all known problems, other than ODRs and NCRs. For each item the list includes an item number, description, source, status and schedule for resolution, if appropriate.

A commentary will be provided on each item covering chronology, generic implications, causes and corrective actions as appropriate. This report contains all commentaries and final inspection totals [see the commentary to CRTS Action Item 28].

To understand the significance of each item it is necessary to read the attendant commentary. The major concerns are summarized in Section 3.

WIRE AND CABLE PROGRAM REPORT
(Continued)

2.5 CRTS RELATED ODRS AND NCRS

CRTS related ODRs and NCRs are now listed separately [Attachments 2 and 3] with descriptions, causes, corrective actions and reference to the CRTS Action Item Commentaries, where appropriate.

3. MAJOR CONCERNS

ISSUES	CONCERNS
Procedures	The level of control exercised on cable installation.
Sampling Plan	Accuracy of CRTS data on cable locations.
Data Base Completeness	Omission of cables from data base.
Raceway Fill	Control of cable tray fill [weight and ampacity questions].
Design Control	Mixing of instrument cables [with power & control] in design process.
CRTS Discrepancies	Control and entry of data into CRTS.
Records	Control of documents of record.
Miscellaneous Problems	Completeness of licensee action in resolving problems.
Root Causes	Identification and correction of all identified root causes.

Status of each issue is, in summary, as follows:

3.1 PROCEDURES

Procedures in place during the original construction period are addressed in Item 7 of the CRTS Action Item List. Procedures in place from 1975 through 1986 are addressed in the commentary to CRTS Action Item 25.

3.2 SAMPLING PLAN

This issue is fully addressed in the commentary to Item 1 of the CRTS Action Item List.

3.3 DATABASE COMPLETENESS

The "completeness" issue of the CRTS data, centers on the data concerning the telephone and security cables. This issue, although real, has no significant safety implications. The issue also includes questions concerning the verification of CRTS software. Items 10, 11, 12, 13 and 14 of the CRTS Action Item List cover the completeness issue.

3.4 RACEWAY FILL

The cable tray fill and weight questions have been reviewed. Percentage fill and weights for all cable trays have been checked. Although some relatively minor questions remain to be answered, no significant problems have been found. Changes are planned to USAR which will reconcile differences between the USAR and Nuclear Engineering Procedures and will clarify design limits. Enhancements planned to the CRTS software will, when in place, automatically prevent fill and weight limits from being exceeded.

These questions are addressed in Items 2 [partial], 6 and ODR 86-125.

3.5 DESIGN CONTROL

The design control issue is more complex than the raceway fill issue, but problems are limited to a relatively small number of instrument cables which mix with power and control cables and violate design criteria. No evidence has been found of a programmatic failure following a review of the original 14,000 cable population. Checking of the 9000 cables added after commercial operation continues, but is not expected to change the outcome of the evaluation.

The question of a possible generic design problem in the original 14,000 cable population is addressed in Item 5 of the CRTS Action Item List. Other specific mix questions are addressed in Items 2 [partial], 9 and by ODR 87-307 and NCRs S-6523, S-6561, S-6562, S-6563, S-6564, S-6565 and S-6566.

3.6 CRTS DISCREPANCIES

The large number of CRTS discrepancies, listed by the SMUD contractor [Impell] in Task 271, is another complex question. Although the large number is initially disquieting, upon examination none have any safety significance as detailed in the commentary on CRTS Action Item 2. One example of this is the total of 763 reported mixes of Class 1 with Class 2 or 3 cables. Almost all the 763 cables are in the original cable population which permitted mixing and none violated safety criteria. All of the 1967 Class 1 discrepancies and some Class 2/3 discrepancies have been carefully analyzed, with documentation, without finding any significant concerns. The reason

for this, detailed in the commentary, is that the Impell review process itself generated the discrepancy lists which then had to be addressed. One benefit of the CRTS discrepancy process is that the total population of 23,000 cables and related raceways has been scrutinized closely and results provide additional confidence in the lack of significant safety concerns in the cable population. This issue is addressed in Item 2 of the CRTS Action Item List.

3.7 RECORDS

Record control at Rancho Seco is a simpler issue. The customary industry documents of record for installed cable and raceway are the signed installation cards. The computer tracking system is used as a convenient source of data while the verification record is the installation card. At Rancho Seco the originals of the installation cards for the initial 14,000 cables and 13,000 raceways have not yet been found, although facsimile record copies do exist. As discussed in the commentary to CRTS Action Item 3, we find that records for the original cables and raceways are apparently complete, although the clerical task of checking each cable and raceway card is not complete. Card records for the cables and raceways installed after commercial operation are mostly complete. Missing cards are identified on NCRs for disposition.

3.8 MISCELLANEOUS PROBLEMS

This issue deals with the completeness of SMUD actions in identifying and resolving all cable and raceway problems. Together, the CRTS Action Item List [Attachment (1)], CRTS ODR List [Attachment (2)], CRTS NCR List [Attachment (3)] and the CRTS Action Item Commentary [Attachment (4)] is the vehicle which records all questions and problems. All identified items with safety significance will be resolved before restart. All identified items with no safety significance will be resolved before the end of the Cycle 8 outage.

All items in the CRTS Action Item List will be reviewed for generic implications before resolution. When a concern has been identified, the basic steps taken by SMUD are:

1) Take immediate action to prevent repetition.

2) Identify the direct cause and take corrective action.

3) Investigate and identify the root cause, and if required, supplement the corrective action.

3.9 ROOT CAUSES

Where applicable, root causes have been established for each item in the CRTS Action Item List. The Incident Investigation/Reviews Group [IIRG] established root causes for significant issues identified during the investigation of problems encountered in the 9,000 cables installed 1975 through 1986. This issue is addressed in Item 15 of the CRTS Action Item List.

4. APPENDICES

1. Sampling Plan for Cable Raceway Tracking System Database (Impell Task 271, SMUD calculation No. Z-ZZZ-E0694, Revision 4, dated December 14, 1987).

2. Rancho Seco Wire and Cable Program Description and Action Plan (District submittal dated April 3, 1987 JEW 87-478).

3. Justification for the Exclusion of the Original Rancho Seco Cable Population from the CRTS Sampling Program (District submittal dated July 24, 1987, GCA 87-338).

4. Prior Use of 95/95 Acceptance Criteria in Nuclear Power Plant Sampling Applications Involving Safety-Class Components and Technical Basis for Rancho Seco Sampling Plan (included in District submittal dated August 18, 1987, GCA 87-400).

5. Cable Discrepancies/Root Cause Investigations of the Cable Issues (District submittal dated November 9, 1987, DTS 87-103).

6. Construction Inspection Data Reports EC-13, dated October 16, 1978 and EC-48, Rev. 1, dated February 22, 1980 (included in District submittal dated December 4, 1987, GCA 87-780).

5. ATTACHMENTS

1. CRTS Action Item List (5 pages)
2. CRTS ODR List (4 pages)
3. CRTS NCR List (9 pages)
4. CRTS Action Item Commentary (115 pages)

Attachment 1

CATS ACTION ITEM LIST

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ITEM NO	DESCRIPTION	SOURCE	ACTION	STATUS/SCHEDULE	REMARKS	OPEN/ CLOSED
1	DEMONSTRATE THAT CATS RECORDED CABLE LOCATIONS MATCH "AS-BUILT".	LER'S 86-10 AND 87-13	SAMPLING PLAN FOR CAIS DATA BASE.	PRIOR TO RESTART	ACTUAL COMPLETION DATE IS DECEMBER 8, 1987.	CLOSED
2	RESOLVE ALL CATS DATABASE DISCREPANCIES.	ACTION PLAN	SEE COMMENTARY.	MAJOR - PRIOR TO RESTART MINOR - CYCLE 8	SEE COMMENTARY FOR INDIVIDUAL ITEMS.	OPEN
3	DEFINE SMUD DOCUMENT OF RECORD CONTROLLING CABLE LOCATION.	ACTION PLAN	REVIEW CRTS, 10-10'S & CARDS AND MAKE DETERMINATION.	COMPLETE	SEE COMMENTARY.	CLOSED
4	DOCUMENT LEVEL OF CONTROL EXERCISED BY SMUD IN INSTALLING CABLE 1975-86.	LER'S 86-16,87-13,DAR 86-125	DETERMINE PROCEDURES AND ORGANIZATIONS INSTALLING CABLE.	SEE COMMENTARY	SEE COMMENTARY.	CLOSED
5	DEMONSTRATE THAT NO BECHTEL GENERIC DESIGN PROBLEM EXISTED.	LER 85-16	REVIEW EES53 DATABASE AND DOCUMENT RESULTS.	CLASS 1 AND AAP 9 COMPLETE NON-CLASS 1 CYCLE 8	SEE COMMENTARY.	OPEN
6	RESOLVE OVERFILL/OVERWEIGHT QUESTIONS; INCLUDING USAR & 50.59.	DAR'S 86-125, 87-204, LER 87-24	COMPLETE REVIEW OF OVERFILLS & OVERWEIGHTS.	PRIOR TO RESTART	SEE COMMENTARY FOR SCHEDULE.	OPEN
7	JUSTIFICATION FOR NOT SAMPLING ORIGINAL CABLE POPULATION.	NRC MEETING MINUTES, MAY 6, 1987	DEMONSTRATE BECHTEL QUALITY PROGRAM SUFFICIENT TO CONTROL CABLE INSTALLATION.	COMPLETE	COMPLETE PER GCA 87-338, DATED JULY 24, 1987.	CLOSED
8	RESOLVE ALL KNOWN PHYSICAL PROBLEMS.	ACTION PLAN	SEE COMMENTARY.	MAJOR - PRIOR TO RESTART MINOR - CYCLE 8	SEE COMMENTARY FOR INDIVIDUAL ITEMS.	OPEN
9	RESOLVE POWER/CONTROL/INSTRUMENT CABLE MIXING CONCERNS.	LER 87-25	AWAITING SMUD ACCEPTANCE OF IMPELL CALCULATIONS.	CLASS 1 - PRIOR TO RESTART NON-CLASS 1 - PRIOR TO END OF CYCLE 8 OUTAGE	16 NON-CLASS 1 INTERFACES TO BE DISPOSITIONED VIA NCR PROCESS PRIOR TO END OF CYCLE 8 OUTAGE.	OPEN

Attachment 1

CNTS ACTION ITEM LIST

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ITEM NO	DESCRIPTION	SOURCE	ACTION	STATUS/SCHEDULE	REMARKS	OPEN/ CLOSED
10	DEMONSTRATE COMPLETENESS OF CNTS; INCLUDING SOFTWARE VERIFICATION AND VALIDATION.	ACTION PLAN	COMPLETE SAMPLING PLAN AND PERFORM SOFTWARE VERIFICATION & VALIDATION.	SAMPLING - PRIOR TO RESTART V & V - CYCLE 8	SEE ITEM 1.	OPEN
11	SHOW TO WHAT EXTENT SECURITY CABLES DOCUMENTED IN CNTS.	ACTION PLAN DDR 87-409 APRIL 9, 1987	REVIEW CNTS FOR SECURITY CABLES.	COMPLETE	COMPLETE AUGUST 28, 1987.	CLOSED
12	COMPLETE SECURITY CABLE DOCUMENTATION.	ACTION PLAN DDR 87-409 APRIL 9, 1987	REVIEW CNTS FOR SECURITY CABLES.	CYCLE 8	SEE COMMENTARY.	OPEN
13	SHOW TO WHAT EXTENT COMMUNICATION CABLES DOCUMENTED IN CNTS.	ACTION PLAN DDR 87-409 APRIL 9, 1987	REVIEW CNTS FOR COMMUNICATION CABLES.	COMPLETE	SEE COMMENTARY.	CLOSED
14	COMPLETE COMMUNICATION CABLE DOCUMENTATION.	ACTION PLAN DDR 87-409 APRIL 9, 1987	REVIEW CNTS FOR COMMUNICATION CABLES.	CYCLE 8	SEE COMMENTARY.	OPEN
15	FORMAL AND COMPLETE ROOT CAUSE EVALUATION OF ALL CABLE PROBLEMS.	NRC LETTER TO SNUD- MAY 1, 1987	IIA6 TO PERFORM ROOT CAUSE ANALYSIS.	PRIOR TO RESTART	COMPLETE.	CLOSED
16	DEFINE MAJOR/MINOR/INSIGNIFICANT DEFECTS.	NRC MEETING MINUTES, MAY 6, 1987	SUPPLEMENT DECISION TREE WITH FORMAL DEFINITIONS.	COMPLETE	SEE COMMENTARY.	CLOSED
17	REVISE [illegible].	ACTION PLAN	PROVIDE DEFINITIONS AND RESOLVE DISCREPANCIES.	CYCLE 8	REFER TO ITEMS 6 AND [illegible]	OPEN
18	ISSUE NEAP 4127.	LER 85-16	RESOLVE DISCREPANCIES.	COMPLETE	CNTS ELECTRICAL CONFIGURATION CONTROL PROCEDURES; ACTUAL IS JUNE 15, 1987.	CLOSED
19	PROVIDE BASIS FOR ACCEPTABILITY OF 95-95 AS SUFFICIENT ASSURANCE OF SAFETY	NRC MEETING MINUTES, MAY 6, 1987	DEVELOP JUSTIFICATION; COMPARE WITH OTHER PLANTS.	COMPLETE	SEE COMMENTARY.	CLOSED

Attachment 1

CNTS ACTION ITEM LIST

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ITEM NO	DESCRIPTION	SOURCE	ACTION	STATUS/SCHEDULE	REMARKS	OPEN/ CLOSED
20	RESOLVE NRC CONCERNS ABOUT POSSIBLE BIASING OF SAMPLE.	NRC MEETING MINUTES, MAY 6, 1987	RESOLVE BIAS QUESTION.	COMPLETE	SEE COMMENTARY.	CLOSED
21	PROVIDE NRC WITH LOCATION OF CABLE PULL CARDS.	NRC MEETING RAC 87-20, JANUARY 7, 1987	DETERMINE LOCATION OF CABLE PULL CARDS.	COMPLETE	SEE ITEM 3; DEFINITION OF MISSING CARDS.	CLOSED
22	PROVIDE NRC WITH FUTURE PLANS FOR CABLE PULL CARDS.	NRC MEETING RAC 87-20, JANUARY 7, 1987	DEVELOP FUTURE PLANS.	COMPLETE	SEE ITEM 3.	CLOSED
23	REDUNDANT CABLING IN THE SAME FIRE AREA.	LER 86-10 JUNE 16, 86 LER 87-13 MARCH 6, 87	DETERMINE CAUSE/S.	PRIOR TO RESTART	1. LER 86-10: NCR S-5597; EDN R-0765, REV. 0 ISSUED TO CORRECT FIELD CONDITION; 2. LER 87-13: NCR S-6374; WR 128636 ISSUED TO CORRECT FIELD CONDITION; 3. IIRS REPORT RLF DTS 87-103, NOVEMBER 9, 1987.	CLOSED
24	PROVIDE DESCRIPTION OF THE INSTALLATION PROCEDURES AND PRACTICES USED AT RANCHO SECO FOR THE ORIGINAL CABLE POPULATION OF 14,000 CABLES.	NRC LETTER TO SMUD, JUNE 8, 1987	NEED TO PROVIDE REPORT.	SEE ITEM 7	REFERENCE GCA 87-338, JULY 24, 1987.	CLOSED

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ITEM NO	DESCRIPTION	SOURCE	ACTION	STATUS/SCHEDULE	REMARKS	OPEN/ CLOSED
25	DOCUMENT A THOROUGH ENGINEERING EVALUATION OF THE PROCEDURES AND SPECIFICATIONS USED TO INSTALL CABLE IN THE PERIOD 1975-1986.	NRC LETTER TO SMUD, JUNE 8, 1987	NED TO PROVIDE REPORT.	COMPLETE - SEE COMMENTARY	REFERENCE GCA 87-780, DECEMBER 4, 1987.	CLOSED
26	PROVIDE DESCRIPTION OF THE EVENTS AND CIRCUMSTANCES LEADING TO THE MISROUTING OF CABLE DESCRIBED IN LER'S 85-16, 86-10, 87-13, 87-26.	NRC LETTER TO SMUD, JUNE 8, 1987	IIRS TO PROVIDE.	COMPLETE	REFERENCE: DTS 87-103, NOVEMBER 9, 1987.	CLOSED
27	PROVIDE DESCRIPTION OF THE EVENTS AND CIRCUMSTANCES LEADING TO THE DISCREPANCIES DISCOVERED BETWEEN THE "AS-BUILT" CABLE ROUTES AND THE ROUTES RECORDED IN CATS.	NRC LETTER TO SMUD, JUNE 8, 1987	IIRS TO PROVIDE.	COMPLETE	REFERENCE: DTS 87-103, NOVEMBER 9, 1987.	CLOSED
28	PROVIDE THE BASES FOR ACCEPTABILITY OF A 95/95 LEVEL OF ASSURANCE REGARDING CABLE ROUTING. (COMPARED WITH OTHER ACCEPTED HOMOGENOUS POPULATIONS)	TELECON WITH MARK CARUSO, AUGUST 14, 1987	PROVIDE JUSTIFICATION.	REF ITEM 19 ALSO	SEE COMMENTARY.	CLOSED
29	PROVIDE AN ITEMIZED LISTING AND DESCRIPTION OF CHANGES IN PROCEDURES AND CONTROLS FOR CABLE DESIGN AND INSTALLATION WHICH HAVE BEEN MADE IN RESPONSE TO THE IDENTIFIED CABLE DEFICIENCIES.	NRC LETTER TO SMUD, AUGUST 14, 1987 (KALMAN)	NED TO PROVIDE.	COMPLETE	SEE COMMENTARY.	CLOSED

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ITEM NO	DESCRIPTION	SOURCE	ACTION	STATUS/SCHEDULE	REMARKS	OPEN/ CLOSED
30	REVIEW OF CORRECTIVE ACTIONS AGAINST ROOT CAUSE EVALUATIONS.	NRC LETTER TO SMUD, AUGUST 14, 1987 (KALMAN)	NEED TO PROVIDE.	COMPLETE	SEE COMMENTARY.	CLOSED

Attachment 2

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CRIS RELATED QDR'S
REV. 2

ITEM NO	QDR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
1	86-125	CLASS 1 AND 2 RACEWAY OVERFILL.	FEBRUARY 27, 1986	INADEQUATE PROCEDURAL GUIDANCE.	SEE COMMENTARIES TO CKTS ACTION ITEMS 2 AND 6.	CLOSED
2	86-221	SEVEN APPENDIX "R" CABLES NOT INSTALLED IN FIRE WRAPPED CONDUIT 44154.	MAY 22, 1986	PERSONNEL ERROR.	1. NCR S-5597. 2. LER 86-10. 3. SEE COMMENTARY TO CRTS ACTION ITEM 23.	CLOSED
3	87-066	E-1010'S ARE NOT BEING PROCESSED AND CONTROLLED IN ACCORDANCE WITH PROCEDURES MEP 4109 AND MEP 4112.	JANUARY 17, 1987	UNKNOWN.	ALL CHANGES TO CRIS RELATED DRAWINGS WILL BE PER THE REFERENCED PROCEDURES AS DIRECTED BY MEMO EEBS 87-005, DATED MAY 1, 1987.	CLOSED
4	87-109	CABLE ROUTING DISCREPANCY.	FEBRUARY 3, 1987	ACCEPTABLE ALTERNATIVE.	CRTS CORRECTED TO REFLECT "AS-BUILT".	CLOSED
5	87-120	CABLE IN DIFFERENT TRAY RISER THAN AS SHOWN IN CKTS.	FEBRUARY 2,1987	ACCEPTABLE ALTERNATIVE.	NCR S-6362 ISSUED.	CLOSED
6	87-127	APPENDIX "R" CABLE IN WRONG FIRE ZONE.	FEBRUARY 4,1987	PERSONNEL ERROR.	1. NCR S-6374. 2. LER 87-13 3. SEE COMMENTARY TO CKTS ACTION ITEM 23.	CLOSED
7	87-135	FIVE ADDITIONAL APPENDIX "R" CABLES IN WRONG FIRE ZONE.	FEBRUARY 6, 1987	PERSONNEL ERROR.	SEE CORRECTIVE ACTION FOR QDR 87-127.	CLOSED

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CRIS RELATED QDR'S
REV. 2

ITEM NO	QDR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
8	87-171	CABLE ROUTING DISCREPANCY; LIMIT SWITCH COVERS SWAPPED.	FEBRUARY 9, 1987	PERSONNEL ERROR.	WORK REQUEST 127363.	CLOSED
9	87-204	POWER CONTROL CABLE TRAY FILL LIMIT OF 40% MAY VIOLATE USAR CABLE TRAY SUPPORT.	MARCH 27, 1987	UNKNOWN.	REVISE USAR; SEE COMMENTARIES TO CATS ACTION ITEMS 5, 6 AND 17.	CLOSED
10	87-259	CABLE ROUTING VERIFICATION DOCUMENT DISCREPANCY.	FEBRUARY 23, 1987	PERSONNEL ERROR.	1. NCR S-6457.	CLOSED
11	87-260	CABLE ROUTING DISCREPANCY; LIMIT SWITCH COVERS SWAPPED.	MARCH 4, 1987	PERSONNEL ERROR.	WORK REQUEST WR127135	CLOSED
12	87-274	MEP DIGITAL CABLE ROUTING INSTRUCTIONS CONFLICT WITH USAR SECTION 8.2.2.11.H.3 CABLE ROUTING RESTRICTIONS.	MARCH 10, 1987	INADEQUATE PROCEDURAL IMPLEMENTATION OF USAR REQUIREMENTS.	1. LER 87-26 2. REVISION OF MEP 5204.22 AND 5204.43 TO PROVIDE ADDITIONAL GUIDANCE ON ROUTING REQUIREMENTS FOR POWER/CONTROL/ INSTRUMENTATION CABLE (COMPLETE).	CLOSED
13	87-275	TEN INSTRUMENTATION CABLES ROUTED IN	MARCH 10, 1987	REFER TO DIRECT CAUSES FOR NCR'S	1. REFER TO CORRECTIVE ACTIONS FOR	CLOSED

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CRTS RELATED QAR'S
REV. 2

ITEM NO	QAR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
		POWER AND CONTROL TRAYS; SEVENTEEN POWER CABLES ROUTED IN INSTRUMENTATION TRAYS.		S-6562, S-6563, S-6564, S-6565, AND S-6566.	NCR'S S-6562, S-6563, S-6564, S-6565 AND S-6566. 2. SEE COMMENTARY TO CRTS ACTION ITEM 9.	
14	87-284	CABLE ROUTING DISCREPANCY.	FEBRUARY 6, 1987	ACCEPTABLE ALTERNATIVE.	CRTS CORRECTED TO REFLECT "AS-BUILT".	CLOSED
15	87-307	NINE CONTROL CABLES ROUTED IN CLASS 1 INSTRUMENTATION CABLE TRAYS.	MARCH 19, 1987	DESIGN ERROR.	1. ECN P-1786 TO REROUTE CABLES. 2. SEE COMMENTARY TO CRTS ACTION ITEM 9.	CLOSED
16	87-322	CRTS CABLE VERIFICATION WORK REQUEST WR 127022 TO BE CLOSED WITHOUT CORRECTIVE ACTION TO RESOLVE DRAWING DISCREPANCIES.	MARCH 23, 1987	PERSONNEL ERROR.	DRAWING CHANGE ONLY TRANSMITTAL P-1536 ISSUED TO INCORPORATE "AS-BUILT" CABLE ROUTING.	CLOSED
17	87-409	630 TELEPHONE AND SECURITY SYSTEM CABLES INSTALLED IN PLANT WITH INCOMPLETE DESIGN DOCUMENTATION.	APRIL 9, 1987	CONFLICTING PROCEDURES.	1. COMPLETE DESIGN DOCUMENTATION PRIOR TO COMPLETION OF CYCLE 8 OUTAGE. 2. SEE COMMENTARIES TO CRTS ACTION ITEMS 11, 12, 13 AND 14.	OPEN
18	87-412	RPS AND SFAS CABLES ROUTED IN CABLE TRAYS CONTRARY TO USAR SECTION 8.2.2.11.H.2 WHICH REQUIRES DEDICATED CONDUIT.	MARCH 7, 1987	INADEQUATE PROCEDURAL IMPLEMENTATION OF USAR REQUIREMENTS.	REVISE USAR; SEE COMMENTARY TO CRTS ACTION ITEM 17.	CLOSED

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CRIS RELATED DDR'S
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ITEM NO	DDR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
19	87-502	USAR AND NLP CONTRADICT ON INSTRUMENTATION CABLE TRAY FILL LIMITS.	MAY 4, 1987	INADEQUATE PROCEDURAL IMPLEMENTATION OF USAR REQUIREMENTS.	REVISE USAR; SEE COMMENTARY TO CNTS ACTION ITEM 17.	OPEN
20	87-604	CONTROL CABLE IM4171C INSTALLED IN CONFLICT WITH INSTALLATION CARD AND CNTS AND IS ROUTED IN 2 CLASS 1 INSTRUMENTATION TRAYS.	MAY 21, 1987	DESIGN ERROR.	1. ECN P-1786 TO REROUTE CABLE. 2. SEE COMMENTARY TO CNTS ACTION ITEM 9.	CLOSED
21	87-723	10 CLASS 1 POWER AND CONTROL CABLES ROUTED IN CLASS 1 INSTRUMENTATION CABLE TRAYS.	JUNE 16, 1987	DESIGN ERROR.	1. ECN'S P-1785 AND P-1786 TO REROUTE CABLES. 2. SEE COMMENTARY TO CNTS ACTION ITEM 9.	CLOSED
22	87-735	1 CLASS 1 POWER CABLE ROUTED IN CLASS 1 INSTRUMENTATION CABLE TRAY (INCLUDED IN DDR 87-723).	JUNE 18, 1987	SEE DIRECT CAUSE FOR DDR 87-723.	SEE CORRECTIVE ACTION FOR DDR 87-723	CLOSED
23	87-860	CLASS 1 CABLE IL1A2104D RUNS IN NON-CLASS 1 CABLE TRAY 744CC/.	AUGUST 14, 1987.	CONSTRUCTION ERROR.	EXTEND CONDUIT L44053 TO FLOOR SLOT #8F575 BY ECN P-1590.	CLOSED

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CRYS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
1	S-5263	DECAY HEAT RCS PRESSURE INTERLOCK FROM PT-21099 INSTRUMENTATION CABLE ROUTED IN POWER AND CONTROL RACEWAYS.	JANUARY 16, 1986	PERSONNEL ERROR.	1. EDM'S R-0459 AND R-1295. 2. ISSUE NEAP 4127. 3. CNTS DATA BASE VERIFICATION.	CLOSED
2	S-5270	WRONG ID ON CONDUIT IN AUX-22	JANUARY 20, 1986	UNKNOWN.	RESOLVED BY IMPELL TASK 271.	CLOSED
3	S-5597	7 APPENDIX "R" CABLES IN WRONG FIRE ZONE.	MAY 22, 1986	PERSONNEL ERROR.	1. EDM R-0765. 2. WIRE AND CABLE ACTION PLAN. 3. REVISION TO MAITS TO DEFINE CABLE INSPECTION REQUIREMENTS. 4. SEE COMMENTARY TO CNTS ACTION ITEM 23.	CLOSED
4	S-5671	4KV CABLE ROUTED DIFFERENT THAN AS SHOWN BY DRAWINGS AND CNTS.	JULY 9, 1986	UNKNOWN.	RESOLVED BY IMPELL TASK 271.	CLOSED
5	S-5968	DECAY HEAT SYSTEM RCS PRESSURE INTERLOCK FROM PT-21092 INSTRUMENTATION CABLE ROUTED IN INSTRUMENTATION RACEWAYS WITH POWER AND CONTROL CABLES.	OCTOBER 13, 1986	DESIGN ERROR.	1. EDM R-1295. 2. SEE COMMENTARY TO CRYS ACTION ITEM 9.	CLOSED
6	S-6278	E-1010'S ARE NOT BEING PROCESSED IN ACCORDANCE WITH PROCEDURES NEP 4109 AND NEP 4112.	JANUARY 19, 1987	UNKNOWN.	ALL CHANGES TO CNTS RELATED DRAWINGS WILL BE PER THE REFERENCED PROCEDURES AS DIRECTED BY NUMO EEGS 87-005, DATED MAY 1, 1987.	CLOSED

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CRYS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
7	S-6286	CABLE JACKET DAMAGE.	JANUARY 21, 1987	UNKNOWN	CABLE REPAIRED PER WORK REQUEST WR 132118. CONSTRUCTION SAFETY MEETING HELD ON 3/5/87 TO DISCUSS CABLE PROTECTION AND DAMAGE PREVENTION.	CLOSED
8	S-6362	CABLE IN DIFFERENT TRAY RISER THAN AS SHOWN IN CATS.	FEBRUARY 3, 1987	ACCEPTABLE ALTERNATIVE.	DRAWING CHANGE ONLY TRANSMITTAL R-1536 ISSUED TO INCORPORATE "AS-BUILT" CABLE ROUTING.	CLOSED
9	S-6374	7 APPENDIX "R" CABLES IN WRONG FIRE ZONE.	FEBRUARY 4, 1987	PERSONNEL ERROR.	1. WORK REQUEST WR 128646 REROUTES CABLES PER EXISTING DESIGN DOCUMENTS. 2. SEE CORRECTIVE ACTION FOR NCR S-5597.	CLOSED
10	S-6454	CABLE TERMINATION DISCREPANCY.	FEBRUARY 24, 1987	UNKNOWN.	WORK REQUEST 132121 CORRECTS DISCREPANCY.	CLOSED
11	S-6455	CABLE TERMINATION DISCREPANCY.	FEBRUARY 23, 1987	UNKNOWN	REWORKED PER WORK REQUEST WR 132117.	CLOSED
12	S-6457	HV-21505 POWER CABLE IN WRONG CONDUIT.	FEBRUARY 23, 1987	UNKNOWN.	DRAWING CHANGE ONLY TRANSMITTAL R-1536 ISSUED TO INCORPORATE "AS-BUILT" CABLE ROUTING.	CLOSED
13	S-6458	CABLE JACKET DAMAGE.	FEBRUARY 20, 1987	UNKNOWN.	NONE REQUIRED; DUPLICATE OF NCR S-6286.	CLOSED

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CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
14	S-6479	CONDUIT CARDS ASSOCIATED WITH ECN'S A-2980 AND A-3065 WERE RETURNED WITHOUT BEING SIGNED BY THE FIELD ENGINEER NOR BY QC.	FEBRUARY 24, 1987	PERSONNEL ERROR.	NCR REQUIRES DISPOSITION.	OPEN
15	S-6460	DEBRIS IN TRAYS.	FEBRUARY 20, 1987	UNUSUAL	NONE REQUIRED; SURVEILLANCE REPORT NEL-855 INDICATES DEBRIS IN TRAYS IS AN ISOLATED INCIDENT.	CLOSED
16	S-6523	CRTS CABLE TRACKING; UNACCEPTABLE INTERMIXING OF POWER/CONTROL/INSTRUMENTATION.	MARCH 10, 1987	REFER TO SUPERCEDING NCR'S.	NCR IS REPLACED BY NCR'S S-6561, 6562, 6563, 6564, 6565, 6566.	CLOSED
17	S-6547	CABLE CARDS RETURNED WITHOUT Q.C. SIGNATURES.	MARCH 18, 1987	PERSONNEL ERROR.	10 CARDS WERE FOUND. FOR THE REMAINING MISSING CARDS (10) CABLE INSTALLATION VERIFICATION BY FIELD ENGINEER AND QUALITY CONTROL INSPECTOR VERIFIED BY QC SIGNATURE ON THE APPLICABLE WORK REQUESTS.	CLOSED
18	S-6549	CABLE CARDS RETURNED WITHOUT Q.C. SIGNATURES.	MARCH 18, 1987	PERSONNEL ERROR.	NCR REQUIRES DISPOSITION.	OPEN
19	S-6561	9 CONTROL CABLES IN CLASS 1 INSTRUMENT TRAY.	MARCH 20, 1987	COMPLETE.	1. ECN A-1786 2. REVISION TO MEP 5204.22 AND 5204.43 TO PROVIDE ADDITIONAL GUIDANCE ON ROUTING REQUIREMENTS FOR POWER/CONTROL/INSTRUMENTATION CABLES (COMPLETE). 3. SEE COMMENTARY TO CNTS ACTION ITEM 9.	CLOSED

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CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
20	S-6562	14 POWER CABLES IN CLASS 1 INSTRUMENT TRAY.	MARCH 20, 1987	INADEQUATE DEFINITION OF POWER/CONTROL/INSTRUMENTATION SERVICE LEVELS.	NCR DISPOSITIONED TO ACCEPT.	CLOSED
21	S-6563	RAD MONITOR POWER CABLE IN CLASS 1 INSTRUMENT TRAY.	MARCH 20, 1987	PROPOSED CABLE, NEVER INSTALLED IN PLANT.	NONE REQUIRED.	CLOSED
22	S-6564	HV-20609 AND HV-26513 POWER CABLES IN INSTRUMENTATION TRAYS.	MARCH 19, 1987	UNKNOWN.	REFER TO CORRECTIVE ACTION FOR NCR S-6561.	CLOSED
23	S-6565	BATTERY CHARGER CABLES IN POWER/CONTROL RACEWAYS.	MARCH 19, 1987	ACCEPTABLE ROUTING; CABLES ARE CONTROL CABLES AND ARE ROUTED AS SUCH.	NONE REQUIRED.	CLOSED
24	S-6566	DHS CROSS-TIE FLOW TRANSMITTER IN POWER/CONTROL RACEWAYS.	MARCH 19, 1987	INADEQUATE DEFINITION OF POWER/CONTROL/INSTRUMENTATION SERVICE LEVELS.	1. ECN P-1786 2. REVISION TO M&P 5204.22 AND 5204.43 TO PROVIDE ADDITIONAL GUIDANCE ON ROUTING REQUIREMENTS FOR POWER/CONTROL/INSTRUMENTATION CABLES (COMPLETE). 3. SEE COMMENTARY TO CATS ACTION ITEM 9.	CLOSED
25	S-6584	CABLE IN DIFFERENT CONDUIT THAN AS SHOWN BY CATS.	APRIL 1, 1987	ACCEPTABLE ALTERNATIVE.	DRAWING CHANGE ONLY TRANSMITTAL P-1863 ISSUED TO INCORPORATE "AS-BUILT" CABLE ROUTING.	CLOSED

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CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
26	S-4594	RHS/SHRS CABLES ROUTED IN CABLE TRAY VERSUS CONDUIT AS REQUIRED BY USAR.	APRIL 7, 1987	INADEQUATE PROCEDURAL IMPLEMENTATION OF USAR REQUIREMENTS.	NCR DISPOSITIONED TO ACCEPT. REVISE USAR AS SHOWN IN COMMENTARY TO CRTS ACTION ITEM 17.	CLOSED
27	S-6800	CABLE 1Z1B1448 AS-BUILT ROUTING CRTS TRAY #44V10.	JULY 1, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-1981 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
28	S-6830	CABLE 1R1B147C CRTS ROUTING CRTS TRAY #39BAB.	JULY 11, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2000 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
29	S-6850	CABLE 1R1C725D CRIS ROUTING CRTS TRAY #43V10.	JULY 17, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2013 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
30	S-6860	CABLE 1R1B144E AS-BUILT ROUTING CRTS CABLE TRAY #44V10.	JULY 18, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2014 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
31	S-6880	CABLE 1P1B00F ROUTED THROUGH ENBED #03102 INSTEAD OF #03104. CRTS LISTED VIA #43039 SHOULD BE #43091. CONDUCTOR C21 PER CRTS IS C12 IN THE FIELD.	JULY 23, 1987	CONSTRUCTION ERROR.	DCD R-2033 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS. WIRE MARKER TO BE REPLACED BY WORK REQUEST.	OPEN
32	S-6882	CABLE 1R1C725C CRTS ROUTING CRTS TRAY #43V10.	JULY 25, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2030 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED

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CRYS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
33	S-6864	2 CLASS 1 CABLES RUN IN NON-CLASS 1 CABLE TRAY 744CC7.	JULY 26, 1987	CONSTRUCTION ERROR.	EXTEND [illegible] L44053 TO FLOOR SLOT H8F575 B. IDN R-1590.	CLOSED
34	S-6894	CABLES 1M1A121D AND 1M1A137E CKTS ROUTING OMITS VIAS L44V20 AND L44BT2, AS-BUILT ROUTING OMITS VIA L44W63.	JULY 28, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2029 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
35	S-6939	CABLE 1Y1DA920A PULL CARD DOES NOT MATCH E-1010 DCN, CRTS ROUTING OR AS-BUILT.	AUGUST 10, 1987	UNKNOWN.	NEW PULL CARD SIGNED CONFIRMING CABLE ROUTING.	CLOSED
36	S-6957	CABLES 1K1504A1D AND 1R1C2104A1 ARE ROUTED THROUGH A2B100 VERSUS A2B031 PER CRTS, E-1010 DCN AND PULL CARD.	AUGUST 14, 1987	CONSTRUCTION ERROR.	DCD R-2108 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS. NEW PULL CARDS ISSUED CONFIRMING CABLE ROUTING.	CLOSED
37	S-6963	CABLE 1M1B117D CRTS ROUTING OMITS VIA M29B87.	AUGUST 17, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2112 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CKTS FOR CABLE PLUS SEVEN OTHERS. NEW PULL CARDS ALSO ISSUED.	CLOSED
38	S-6967	CABLE 1M1B17JC AS-BUILT ROUTING OMITS VIAS M44V12, M43V12 AND M43V11 AND SUBSTITUTES M44V10 AND M43V10.	AUGUST 19,1987	ACCEPTABLE ALTERNATIVE.	DCD R-2186 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CKTS. NEW PULL CARDS ALSO ISSUED.	OPEN
39	S-6972	CABLE 1G1D6B2U AS-BUILT ROUTING INCLUDES CABLE TRAYS MB1S5 THRU MB1Y5 AND MB1J1 NOT SHOWN BY CKTS AND OMITS VIAS MB1B1, MB1M1 AND MB1L1.	AUGUST 20, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2119 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED

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CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
40	S-6991	CABLES 1Y1DA621A, 1M1C215A2 AND 1Y1DA621C ARE ROUTED THROUGH CONDUIT A28031 VERSUS A28100.	AUGUST 25, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2119 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS.	CLOSED
41	S-6999	CLASS 1 POWER AND CONTROL CIRCUITS ARE MIXED WITH INSTRUMENTATION CIRCUITS IN MANHOLES MH46 AND MH47.	AUGUST 21, 1987	UNKNOWN.	NCR REQUIRES DISPOSITION.	OPEN
42	S-7003	CABLE 1M1A152F AS-BUILT ROUTING DIFFS VIAS L44W62 AND L44BT1.	AUGUST 26, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2132 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS. NEW PULL CARDS ALSO ISSUED.	CLOSED
43	S-7028	1 CABLE ROUTED DIFFERENT THAN AS SHOWN BY CRTS.	AUGUST 27, 1987	CONSTRUCTION ERROR.	CABLE PULLED BACK AND ROUTED THROUGH CORRECT VIA PER EDN R-2233.	CLOSED
44	S-7029	4 CABLES ROUTED DIFFERENT THAN AS SHOWN BY PULLCARD.	AUGUST 31, 1987	ACCEPTABLE ALTERNATIVE.	ISSUE NEW PULL CARDS FOR SIGNATURE BY QC.	CLOSED
45	S-7042	CABLE 1I2U108LF ROUTED THROUGH TRAYS 744V29 AND 743V29 AND CRTS CABLE TRAY 744V30.	SEPTEMBER 4, 1987	ACCEPTABLE ALTERNATIVE.	DCD A-5415Y ISSUED TO INCORPORATE AS-BUILT ROUTING IN CRTS. NEW PULL CARDS ALSO ISSUED.	CLOSED
46	S-7044	CABLE 1Z1B145A CRTS ROUTING DIFFS TRAY MH1P3.	SEPTEMBER 5, 1987	ACCEPTABLE ALTERNATIVE.	NCR REQUIRES DISPOSITION.	OPEN

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CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
47	S-7063	CABLE ROUTING FOR 1M1B006 CKTS CABLE TRAY MA3V11.	SEPTEMBER 9, 1987	PICEPTABLE ALTERNATIVE.	NCR REQUIRES DISPOSITION.	OPEN
48	S-7071	CABLE 1M1CS36VC CKTS ROUTING CKTS CABLE TRAY MA4AY1.	SEPTEMBER 9, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2293 ISSUED TO INCORPORATE AS-BUILT ROUTING INTO CRTS. NEW PULL CARDS ALSO ISSUED.	CLOSED
49	S-7079	CABLE 1M1A151F ROUTED DIFFERENT FROM PULL CARD, E-1010 BOM AND CKTS. CABLE 1G1DGA1E PULL CARD DIFFERENT FROM AS-BUILT, E-1010 BOM AND CKTS.	SEPTEMBER 11, 1987	ACCEPTABLE ALTERNATIVE.	DCD R-2214 ISSUED TO INCORPORATE AS-BUILT ROUTING IN CKTS. NEW PULL CARDS ALSO ISSUED.	OPEN
50	S-7097	JUNCTION BOXES H732738 AND H732739 HAVE THEIR COVERS AND LABELS INTERCHANGED.	SEPTEMBER 16, 1987	CONSTRUCTION ERROR.	NCR DISPOSITIONED TO REWORK COVERS. NEW INSTALLATION CARDS ALSO ISSUED.	OPEN
51	S-7439	CLASS 1 POWER/CONTROL CABLE TRAYS OVERFILLED IN EXCESS OF 40% USAR FILL LIMIT.	NOVEMBER 19, 1987	UNKNOWN.	NCR REQUIRES DISPOSITION.	OPEN
52	S-7440	INTERMIXING OF CLASS 1 DIGITAL INSTRUMENT CABLES IN CLASS 1 POWER/CONTROL RACEWAYS.	NOVEMBER 11, 1987	ACCEPTABLE ALTERNATIVE.	NCR DISPOSITIONED TO ACCEPT.	CLOSED
53	S-7490	DISCREPANCIES BETWEEN CKTS AND AS-BUILT NOTED DURING WORKABLE WALKDOWN.	DECEMBER 3, 1987	UNKNOWN.	NCR REQUIRES DISPOSITION.	OPEN

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To CCA 88-001

CRIS RELATED NCR'S
REV. 2

ITEM NO	NCR NO.	DESCRIPTION	DATE	DIRECT CAUSE	CORRECTIVE ACTION	OPEN/ CLOSED
54	S-7533	CONDUIT CARDS ASSOCIATED WITH ECN'S A-2580 AND A-3043 WERE RETURNED WITHOUT BEING SIGNED BY THE FIELD ENGINEER NOR BY QC.	DECEMBER 16, 1987	UNKNOWN.	NCR REQUIRES DISPOSITION.	OPEN

CRTS ACTION ITEM COMMENTARY

ITEM NO. 1

DESCRIPTION Demonstrate that the CRTS recorded cable locations match "as-built."

COMMENTARY

CHRONOLOGY

Employee allegations and statements as early as 1983 indicated possible deficiencies in the CRTS data with the possibility of both missing and inaccurate information. SMUD Nuclear Engineering Department [NED] actions were pulled together into a single Action Plan in January, 1987. SMUD IIRG assumed responsibility for the root cause analysis of the CRTS problems and related LERs in April 1987.

In July 1986, NED authorized a contractor [Impell] to institute a review and evaluation of the CRTS program which would identify data discrepancies, evaluate and document their significance, and report to SMUD. Approximately 43,000 manhours have been expended on this effort through 1987, and work will continue through the Cycle 8 Outage. Completion of this effort is Item 2 of the CRTS Action Item List.

In early December 1986, NED made a decision to signal trace a sample of safety-related cables installed from 1975 through 1986. This program is detailed in the Sample Plan [Appendix (1)]. The plan is designed to statistically insure that the overall quality level achieves at least a 95% compliance with a 95% confidence level. A decision was also made not to signal trace a sample of the original 14,000 cables on the basis that the original designer/constructor Bechtel Power Corporation [BPC] had exercised an acceptable level of control. The supporting rationale for this decision is referenced in Item 7.

By late June 1987, the finding of ten major defects in Lot 1 initiated a complete inspection of all 397 cables. Cable tracing was completed on December 8, 1987 with 152 completely checked and 245 inspected in the rerouted portions. Two additional major defects were identified as described in NCR S-0884, bringing the total number of Lot 1 defects to twelve. During the final checking and revision of the Sample Plan [Appendix (1)] cables deleted from the plant [after the populations were established] were deleted, from each lot, as follows:

	Lot 1	Lot 2	Lot 3	Lot 4
Was	422	1702	190	78
Is	397	1462	176	78

ITEM NO. 1
CONTINUED

Additionally, in Lot 2, 76 Class 2 [Appendix "R"] cables and 3 Class 1 [Appendix "R"] cables were found to be pre-commercial operation vintage. Three [3] of the 76 were included in the Lot 2 inspection total of 91. Deleteing 79 pre-commercial cables reduces the Lot 2 total to 1383. Three more cables were traced in Lot 2 in December and were found to be correct [no defects]. Final inspection totals and statistical inferences are given in Table 1 of the commentary to CRTS Action Item 28. Sampling of Lots 2, 3 and 4 is complete.

Appendix 1 [SMUD Calculation Z-ZZZ-E0694] has been revised to remove deleted cables and also to remove 79 pre-1975 vintage Appendix "R" cables from Lot 2. The revised [and final] totals for inspection are given in the commentary to CRTS Action Item 28.

Population Lot 4 consists of a group of 78 cables which were all signal traced. This was done because the signal tracing uncovered seven Appendix "R" cables which were documented as rerouted from Fire Area 36 to Fire Area 31, when this had not been done, as described in LER 87-13.

These cables were part of the group of 28 cables installed under one ECN. This group includes the seven cables found with incorrect routes in LER 86-10. All cables in this group [28] have now been traced with the fourteen cables described having incorrectly recorded routes. The direct and root causes of LER 86-10 and 87-13 have been addressed by the SMUD IIRG. See the Item 4 commentary.

GENERIC IMPLICATIONS

With the completion of the Sampling Plan activity, SMUD has established a 95% confidence that the CRTS database is 95% accurate with respect to the location of the 2034 safe shutdown/safety-related cables installed from 1975 through 1986. This is viewed by SMUD as acceptable and comparable with industry norms as described in the commentary to CRTS Action Item 28.

The SMUD evaluation of the level of control exercised in installing the original 14,000 cables indicates a level of confidence at least equal to the 95/95 target for the 9000. See Item 7 of the CRTS Action Item List.

New procedures and planned CRTS enhancements will be adequate to control the validity of CRTS "as-built" data. The "completeness" issue concerning CRTS data is a separate question and is addressed in Items 10, 11, 12, 13 and 14 of the CRTS Action Item List.

ITEM NO. 1
CONTINUED

CAUSES

The root cause of the problems related to the CRTS and its use is that neither Nuclear Engineering management nor the CRTS Supervisor were adequately involved in the CRTS. Root Cause evaluations are referenced in the commentary to CRTS Action Item 4. Corrective actions are described in the commentary to CRTS Action Item 29 and are reviewed against Root Causes in the commentary to CRTS Action Item 30. From the sampling plan results the "as-built" record appears adequate.

CORRECTIVE ACTIONS

The current process mandates that the installation of safety cables [Class 1 and Appendix "R"] is witnessed by the QC inspector; this corrects a major deficiency in past practice. A new procedure, NEAP 4127 "Cable and Raceway Tracking System" was issued in June, 1987 and controls the methods by which changes are made to the CRTS database and the issuance and processing of all installation cards. Corrective actions have been reviewed against the IIRG root cause evaluations [See the commentary to CRTS Action Item 30].

ITEM NO. 2

DESCRIPTION Resolve all CRTS database discrepancies.

COMMENTARY

CHRONOLOGY

Since July 1986, a SMUD contractor [Impell] has been performing a review and evaluation of the CRTS data for the total population of 23,000 cables. This review has been conducted under control of the Impell QA Program and all results have been documented and submitted to SMUD for acceptance.

Progress reports have been issued, the most current of which is Report No. 25 dated October 9, 1987. The large number of discrepancies reported is not a cause for concern. Many are not real discrepancies, but are "bookkeeping" corrections. Still others are caused by incorrectly applying current criteria to cables which were installed to older criteria. These "discrepancies" are therefore incorrectly reported, and no discrepancy actually exists.

As explained in the Action Plan, SMUD will have reviewed, evaluated and made disposition, with documentation, all Class 1 and Appendix "R" discrepancies prior to restart. Class 2 and Class 3 discrepancies will be dispositioned in the same manner after restart, but before the end of the Cycle 8 outage.

GENERIC IMPLICATIONS

Each discrepancy has to be evaluated separately. The evaluations may be summarized as follows. Note that the Action Plan totals have, in some cases, changed as indicated:

Class 1, Item 1.0 - Intermixing of Class 1/2/3 Cables (Total 763)
None of the 763 discrepancies are valid. The total breaks down as follows:

669 Are part of the 14,000 original cables and are correctly installed. This is because the original criteria allowed mixing, provided that no Class 2/3 cables "bridged" redundant Class 1 separation groups.

82 Are either deleted or are routed in "special" raceways so that no mixing occurs.

12 Were installed post-1975 but under the original plant criteria. All may be grouped with the 669.

ITEM NO. 2
CONTINUED

Class 1 Item 2.0 - Overfilled Trays (Power and Control) Total 38
The 38 cable trays were reviewed to determine their fill at the time of commercial operation and their current fill, with the results given below. The 38 were checked for both ampacity derating and also for weight.

Tray	EE-553 10/14/75 % Fill	CRTS 11/7/87 % Fill	Tray	EE-553 10/14/75 % Fill	CRTS 11/7/87 % Fill
L43AZ3	44	37	M41F1	36	39
L44AK1	45	44	M41G1	34	36
L44AU1	41	38	M41H4	36	32
L44BF1	36	35	M41M3	42	39
L44BM2	17	39	M41P1	34	36
L44BN2	34	42	M41X1	39	39
L44BY3	47	39	M41Y1	39	39
L44CF1	45	44	M41Z1	31	37
L44P1	39	35	M43V10	47	36
L44P2	39	40	M43V11	34	34
L44V36	49	39	M44AU1	39	36
M39BA7	40	39	M44AY1	34	36
M40AM2	36	39	M44AY4	49	44
M40AQ2	37	38	M44V10	61	53
M41AA1	30	33	M44V11	36	40
M41AD1	34	37	M44V70	38	36
M41AE1	32	34	M45B1	48	40
M41AF1	32	34	M45V10	38	35
M41BD1	35	31	M45V8	48	31

An issue raised by the Resident NRC Inspector concerned the documentation of ampacity and weight checks. The specific question was, "Did SMUD perform 10CFR50.59 reviews of overfilled trays?" The review process for the original 14,000 cables and the later 9,000 added cables was as follows:

Original Installation

Power and control cable trays filled in excess of 40% were checked to verify that the cable loading was not in excess of 50 pounds per linear foot. Instrumentation cable trays filled in excess of 60% were checked to verify that the cable loading was not in excess of 50 pounds per linear foot. Instrumentation cable tray fill between 40% and 60% was accepted based upon a generic calculation. In addition, ampacity checks were made on all power and control cable trays filled in excess of 40%. No documentation of the design checking has been found in Bechtel or SMUD files. Retention of such documentation was not a common practice. As detailed later in this commentary, all fills and weights have now been checked and documented.

ITEM NO. 2
CONTINUED

Cables Installed After Commercial Operation

Power and control cable trays filled in excess of 40% were dispositioned as described for the original installation, the cable loading was verified to be less than 50 pounds per linear foot, and the ampacity was checked. The results were not documented by calculation, and no formal reviews were performed to verify that weight limits were met. Instrumentation cable trays filled in excess of 50% were checked to verify that the cable loading was not in excess of 50 pounds per linear foot. Instrumentation cable tray fill between 40% and 50% was accepted based upon a generic calculation. The results of the instrumentation cable tray weight checks were also not documented, and no formal 50.59 reviews were performed.

Results

By July 1, 1987, all cable trays and conduits had been reviewed for fill and for weight problems. Percent fill is a feature of the CRTS program. Weight calculations were performed by a separate program run on a PC using data "dumped" from the main computer. Results are as follows:

Instrument Tray Fills

The USAR limit is 40% versus the Nuclear Engineering design criteria which has a 50% fill limit for instrument cable trays. All trays have been checked for weight, regardless of fill level. No trays were found to exceed the USAR limit of 50 pounds per linear foot. Visual checks are being performed for "heaped" or "mounded" conditions indicating possible problems during a design basis earthquake. At this time, no significant problems have been found. The USAR fill limit will be changed, (see CRTS Action Item 17).

Power and Control Tray Fills

The USAR limit is 40%. All trays have been checked for weight, regardless of fill level. One Class 2 cable tray is overweight by 1.16 lbs, assuming that the cables in the tray run the entire length of the tray. However, because cables enter and leave the cable tray along the length of the tray, in no case is the cable tray support loading in excess of 50 pounds per linear foot. In order to resolve the apparent overweight and to allow future cable additions to the tray without having to revise calculations justifying the adequacy of the cable tray, the cable tray will be made into two cable trays by ECN R-2015, issued on October 2, 1987. No other trays have been found with "real" fills in excess of 50 pounds per linear foot. A few additional "false" fills have been found, which are in the process of correction. "False" fills occur when long tray sections include all cables in the weight calculations and exceed 50 pounds per linear foot, even if some of the cables only run a short distance in

ITEM NO. 2
CONTINUED

the raceway section, whereas the weight borne between supports does not exceed 50 pounds per linear foot. Documentation is provided by Impell under Task 334. Ampacity checks have been made on all power and control cable trays with fills in excess of 40%. No ampacity problems have been found.

Summary of Overfilled Tray Review

No significant problems have been found to date. Final checks are required to check special conditions to verify that their impact is minimal:

- Weight contribution from telephone/security cables.
- Weight contributions from fire wrapping and cable tray covers.

The final cable tray checking, to be performed prior to restart, was performed on December 28, 1987. Only one cable tray exceeds the 50 pounds per linear foot limit [X44RF1] and this tray is acceptable, since it is at grade elevation and is supported by concrete pads.

Causes of Overfilled Trays

No significant problems have been found, and there appears to have been a reasonable degree of conservatism in the original design. Nevertheless, the lack of documented reviews in the period 1976 to 1986 is an omission in the design process which should not have occurred. The direct cause was a lack of procedural guidance. Enhancements planned for the CRTS software will, in the future, automatically block cable additions which exceed fill and weight limitations.

Class 1, Item 3.0 - Overfilled Conduits (Power/Control) (Total is 108, Was 107)

All 108 are either incorrectly recorded fills, because the "as-built" conduit is larger than recorded, or are acceptable for other reasons (very short length). Quite obviously, conduits cannot easily be overfilled, unlike trays, and all 108 have documented dispositions indicating a complete lack of either fill or ampacity problems.

Class 1, Item 4.0 - Overfilled Conduits (Instruments) (Total is 14, Was 13)

All 14 are dispositioned as false fills or similar. No ampacity problems exist with instrument cables.

Class 1, Item 5.0 - Raceway Connections (Total is 293, Was 200)

The CRTS program established "linkages" or "nodes" to check that connecting raceways in cable vias did, in fact, connect. When nodes were missed by designers making the drawing changes, each missed node generated a discrepancy report for each cable using the via. All missing nodes have been checked and the "bookkeeping" errors corrected.

ITEM NO. 2
CONTINUED

Class 1, Item 6.0 - Duplicated Numbers (Total is 2, Was 35)

These are two "bookkeeping" errors, both of which have been dispositioned as having no significance.

Class 1, Item 7.0 - Document Discrepancies (Total is 555, Was 551)

The 555 are a miscellany of minor data discrepancies dealing with entries covering equipment numbers, raceway numbers, cable codes, cable data (conductor size/number) and others. All have been checked and the data corrected as needed. No data questions remain open.

Class 1, Item 8.0 - Tagging/Identification Discrepancy (Total is 0, Was 7)

The original seven items are now reported in the Item 5.0 totals.

Class 1, Item 9.0 - Missing/Unsigned Construction Cards (Total is 174, Was 53)

The total of 174 missing/unsigned Class 1 cards is made up [Ref. Impell Calculation 271-101-107] as follows:

NCR #	# of cards	Problem	Status
S-7533	41	Class 1 raceway cards w/o sig	Open
S-6549	26	Class 1 pull cards w/o sig	Work Request w/Elec Maint
S-6547	15	Class 1 term cards w/o sig	Closed 11-27-87
S-6459	59	Class 1 raceway cards w/o sig	Open
	28	Resolved in calc 271-101-107	Closed 04-15-87
	5	Terminations included in error in calculation 271-101-107	N/A
Total	174		

The 125 open items are milestoned for completion prior to Restart. The microfilming process [described on page 11 of Attachment 4] is largely complete with about 8000 cards left to microfilm. The work has, so far, found approximately 100 cards which are missing signatures. Of these, thirteen [13] are Class 1 and are listed on an NCR for disposition prior to restart.

ITEM NO. 2
CONTINUED

The following Non-Class 1 discrepancies have all been dispositioned without finding any safety problems.

Non-Class 1, Item 1.0 - Intermixing of Power/Control/Instrument Cables (Total is 400; Was 125)

The USAR wording requires separation of instrument cables from power and control cables for RPS and ESFAS. USAR does not clearly address mixing for other systems and does not address or define what constitutes instrument, control, and power cables.

SMUD Nuclear Engineering Procedures (NEP's, Criteria and Guides) also did not clearly define instrument, control, and power cables. However, various types of signals (analog, digital) were discussed, and digital signal cables permitted to mix with control cables.

The NEP's have been revised to define the separation required between instrument and power and/or control cables and to define the instrument circuits requiring separation. Details are given in the commentary in CRTS Action Item 9.

The 400 reported Non-Class 1 mixes have been dispositioned as follows:

367	Accepted as meeting NEP's.
16	To be rerouted.
17	Which require drawing changes to clarify service level.
400	Total

The original design process used twisted shielded pair (TSP) or coax/triax cables for all circuits considered as instrumentation. This has led to some confusion, since no cable service levels are established in CRTS. A future CRTS enhancement will identify service levels for all cables.

Non-Class 1, Item 2.0 - Overfilled Trays (Power and Control) (Total is 153, Was 131)

All trays have been checked for weight. Only one tray exceeded the 50 pounds per linear foot USAR limit, as discussed previously. Ampacity checks have been made on all cable trays with fills over 40%. No ampacity problems have been found.

Non-Class 1, Item 3.0 - Overfilled Trays (Instrument) (Total is 18, Was 19)

All trays have been checked for weight. None exceed the 50 pounds per linear foot USAR limit.

ITEM NO. 2
CONTINUED

Non-Class 1, Item 4.0 - Overfilled Conduit (Power and Control) (Total is 644, Was 639)

All 644 are either incorrectly recorded, because the "as-built" conduit is larger than recorded in CRTS, or are acceptable for other reasons. No ampacity problems exist.

Resolution of Minor CRTS Data Discrepancies

A number of minor Non-Class 1 data discrepancies exist as reported in Impell Status Report 9, dated January 12, 1987. These are summarized below. None have any safety significance. These data discrepancies will be resolved after restart but not later than the Cycle 8 scheduled outage.

Non-Class 1

1.0	Overfilled Conduits (Instrument/Telephone)	151
2.0	Raceway Connections	1390
3.0	Duplicated Numbers	33
4.0	Document Discrepancy	1594
5.0	Tagging/Identification Discrepancy	130
6.0	Missing/Unsigned Construction Cards	92
Subtotal		3390

Security

7.0	Raceway Connections	177
8.0	Duplicated Numbers	29
9.0	Documentation Discrepancy	276
10.0	Tagging/Identification Discrepancy	4
11.0	Missing/Unsigned Construction Cards	88
Total		3964

Causes of Discrepancies

The enhancement of the CRTS software generated the list of discrepancies. The direct cause of the discrepancies was the database conversion and errors entered into the database in the 1980 to 1982 timeframe. The root cause of the CRTS problems has been determined by the IIRG. The level of control exercised is addressed in Item 4 of the CRTS Action Item List.

CORRECTIVE ACTIONS

Major [safety-related] discrepancies will be reviewed and dispositioned, with documentation, prior to restart. Minor [non-safety-related] discrepancies will be reviewed and dispositioned, with documentation, prior to the end of the Cycle 8 outage. Disposition of each discrepancy will include verification that plant design documents, the CRTS database and the "as-built" plant configuration are all in agreement.

ITEM NO. 3

DESCRIPTION Define SMUD document of record controlling cable location.

COMMENTARY

CHRONOLOGY

In a January 7, 1987 meeting, the Region V Electrical Inspector [Mr. Andy Hon] asked where cable pull cards are now kept and what will be done with cable pull cards in the future. To answer the question concerning SMUD future actions required defining the SMUD document of record for cable locations. Answers to the two original questions and the additional definitions are as follows:

1. NRC Question: Where are cable pull cards now kept [January, 1987]?

   District Response: The cable pull cards, together with equipment and raceway installation cards, were kept in either locked metal card files in an office area of the "Bechtel Building," which is a temporary on-site construction office, or in boxes in trailers used as temporary offices.

2. NRC Question: What will be done with cable pull cards in the future [After January, 1987]?

   District Response: The cable and raceway installation cards are now being kept in a "vault" in the "Bechtel Building." The record documents are a mixture of original cards and facsimiles when the originals cannot be found. The vault is a secure, locked room with cement walls and a Halon fire protection system.

   At this time, records are being checked to see how many cards are missing. When original cards are not found, facsimiles from the construction records will be substituted to create a complete record.

   A duplicate record is being created on microfilm. As of December 31, 1987 approximately 29,000 cards have been microfilmed and returned to the Bechtel Building vault. This process will continue until a complete duplicate record is established.

ITEM NO. 3
CONTINUED

Additional Information

1. INSTALLATION VERIFICATION RECORDS FOR INSTALLED CABLE AND RACEWAY

The present Installation Verification Records for installed cable and raceway are the "pull cards," "termination cards," and "raceway installation" cards, respectively. As of November 30, 1987, 183 Class 1 cable pull cards (originals or facsimiles) have not yet been located. Full details of missing cards (all types) are given in Section 4 of this commentary.

2. ENGINEERING RECORDS FOR DESIGNED CABLE AND RACEWAY

These records are the input documents to the CRTS program. They are designated as "forms" and are engineering drawings by SMUD definition. Originally, new forms were issued for changes. As of June 15, 1987, all new cable and raceway input documents have been handled as Drawing Change Notices. Originals of input documents are being marked to show changes instead of issuing new forms. [Reference memo EEGS 87-005, from E. J. Gough to the Electrical Engineering staff, dated May 1, 1987]

CRTS input drawings/forms are as follows:

E-1008 Raceway Input Document
E-1010 Scheme Cable Input Document
E-1026 Raceway Code Input Document
E-1027 Cable Code Input Document
E-1028 Electrical Equipment Input Document

3. CRTS PROGRAM AND DATA BASE

The function of the CRTS program and database is twofold:

a. An engineering design tool which is used by the design group to perform design checks and calculations. Currently, the CRTS program checks for:

* Raceway continuity
* Percentage fill
* Mixing of redundant separation channels
* Verifies raceway service levels for compatibility

The CRTS is being enhanced to perform:

* Weight calculations
* Checks on mixing of instrument cables with power and control cables

ITEM NO. 3
CONTINUED

b. A convenient data source which is used for engineering design information. Typical uses of the CRTS generated information are.

* Identification of cable routes
* Calculation of totals of combustible materials (Btu totals)
* Weight calculations for cable tray sections

c. Installation Status.

GENERIC IMPLICATIONS

Plant cables provide many diverse functions. The cables of safety systems provide both power supply and control functions, as well as important indications to operators. The control and separation of redundant safety groups of cables and of all cables required for safe shutdown are important safety factors. The existence of reliable and accurate records concerning the location of the cables is essential to plant safety.

With the completion of the Action Plan, SMUD will have established a record file of installation cards (originals and facsimiles) and a duplicate microfilm record. SMUD will also have confirmed that the CRTS database is accurate to an acceptable confidence level.

With adequate maintenance of both records and CRTS data, the necessary level of control will exist.

CAUSES

Difficulties in tracing records indicate a need for greater management interest in record storage and an increased awareness on the part of SMUD employees of the importance of records.

CORRECTIVE ACTIONS

Replacement Cards: The detailed procedure for the replacement of missing CRTS cards was provided in Revision 1 to NEAP 4127, issued effective December 14, 1987.

Current Process: A new procedure (NEAP 4127) was issued in June, 1987. This procedure is considered adequate to ensure that all cards are returned to CRTS.

4. TOTAL NUMBERS OF MISSING CARDS

The following are details of missing cards as of November 30, 1987:

ITEM NO. 3
CONTINUED

Cable Raceway Tracking System (CRTS)

ANALYSIS OF 2,480 MISSING CABLE CONSTRUCTION CARDS

November 30, 1987

	Nuclear(1) Operation	Nuclear(2) Engineering	Both(3) Depts.	(4) Pre-ECN
Total Missing Cards	1184 - 48%	1057 - 43%	51 - 2%	188 - 7%
'Pull' Cards	181 - 7%	239 - 10%	23 - 1%	14 - 0.4%
'From' Termination Cards	488 - 20%	230 - 9%	14 -0.5%	23 - 1%
'To' Termination Cards	453 - 18%	278 - 11%	14 -0.5%	23 - 1%
'Delete' Cards	62 - 3%	310 - 13%	0 - 0%	128 - 5%

Total Cables in Data Base (CRTS Revision Level 1608)	22,826
Total Cables Having Missing Cards	1,472
Fraction of Cables Having Missing Cards	6.45%

Total Missing 'Pull' Cards	457 - 18% *
Total Missing 'Termination' Cards	1523 - 61%
Total Missing 'Delete' Cards	500 - 20%
Total Missing Cable Cards	2,480 - 100%

(1) Nuclear Operations [NO] initiated ECN.

(2) Nuclear Engineering [NE] initiated ECN.

(3) NO/NE jointly initiated ECN.

(4) Proposed cables entered 1976-1980, no ECN.

* Missing Class 1 'Pull' Cards 183 (7% of all missing cards)

ITEM NO. 4

DESCRIPTION Document the level of control exercised by SMUD in installing cable 1975-86.

CHRONOLOGY

Questions concerning the completeness of CRTS data, missing installation cards, and conflicting procedures have been raised beginning in 1983. The existence in 1978 of Quality Control Instruction QCI 107, which required the destruction of installation cards, raised questions concerning records. Employee allegations and statements to the SMUD Ombudsman also tended to indicate some possible problems in controlling the installation process. LER 86-10 identified seven Appendix "R" cables which should have been relocated but were not.

The SMUD IIRG has completed their investigations and forwarded a summary of their Root Cause Reports in DTS 87-103 dated November 9, 1987.

CRTS ACTION ITEM	DESCRIPTION		FORECAST
23	Determination of the cause of the redundant cabling in same fire area (LER 86-10) and the determination of the cause of redundant instrument cables routed through same fire area (LER 87-13).		Complete
25	Document a thorough engineering evaluation of the procedures and specifications used to install cable in the period 1975-1986.		Complete
26	Description of the events and circumstances leading to the misrouting of cable described in LER's.	LER 85-16 LER 86-10 LER 87-13 LER 87-26	Complete Complete Complete Complete
27	Description of the events and circumstances leading to the discrepancies discovered between the "as-built" cable routes and the routes recorded in CRTS.		Complete

Refer to Appendix 5 for a summary of the Root Cause investigations.

ITEM NO. 5

DESCRIPTION Demonstrate that no Bechtel generic design problem existed.

COMMENTARY

CHRONOLOGY

With the discovery of a misrouted RCS pressure transmitter instrument cable as being a possible cause of the August and December 1985 spurious closures of the Decay Heat System (DHS) valve HV-20002 (LER 85-16), and the further identification that the misrouting of the instrument circuit occurred during the original design of the plant, investigation of the original cable population was begun for any evidence of a generic design problem.

GENERIC IMPLICATIONS

The original Rancho Seco cable population consisted of nearly 14,000 cables, routed in 13,000 raceways. The original Rancho Seco EE-553 circuit and raceway schedules were reviewed for any evidence of a generic design problem in the original cable population. Since the present CRTS database has been reviewed for raceway fills and weights, channel separation and channel "bridging," and would have identified any such problems in the original cable population, only intermixing of power, control, and instrumentation cables was examined in the original cable population.

The EE-553 raceway schedules were reviewed for any indication of a generic problem concerning power/control/instrumentation intermixing. Approximately 3200 pages were manually reviewed, representing approximately 13,000 raceways. Approximately 10 cases of Class 1 intermixing were identified and approximately 60 cases of Non-Class 1 intermixing were identified (Table 1), with no evidence of a generic intermixing problem. It should be noted that of the 10 Class 1 cable intermixes, that 8 no longer exist in the plant. The remaining 2 cables provide tachometer indication signals to local panels of the Bruce GM Diesels [Reference Drawings E204 sheet 65 and E334 Sheets 1, 4 and 5] and have no safety features actuation or reactor protection function.

The Class 2 Appendix "R" cables listed in Table 1 have been reviewed. On the basis of this review, the Class 2 control cables 1M2C327I, 1M2D228D and 1M2D229D are the only Appendix "R" circuits. These cables are routed in a four-foot-long, Non-Class 1 instrumentation tray X45V20 to test panel H3TP.

ITEM NO. 5
CONTINUED

The distance [4 feet] and the shielding on the low level instrumentation cables indicate no unacceptable cross-couplig [noise] is possible to the control cables. The converse is also true and the Class 2 shielded instrument circuits will not see unacceptable noise levels. Therefore, the above cables can remain as routed and no corrective action is required. The remaining Non-Class 1 cables will be reviewed by the end of the Cycle 8 outage.

CAUSES

Both the FSAR and USAR require separate cable tray, conduit, and penetration systems for 600-volt power and control cables and for instrumentation cables. The cable scheme numbering system used at Rancho Seco requires a "1" in the first location of the cable scheme number to designate Rancho Seco Unit 1. A digit in the second location of the cable scheme number designates a power cable; a letter in the second location of the cable scheme number designates either a control cable or an instrumentation cable. Without a method to differentiate the scheme cable number of a control cable from that of an instrumentation cable, intermixing may have occurred.

CORRECTIVE ACTION

Upon the consolidation of SMUD efforts to resolve Rancho Seco wire and cable problems (Action Plan, JEW-478, April 3, 1987), Bechtel was asked to review the 1975 cable and raceway schedules for any evidence of a widespread problem concerning the intermixing of power, control, and instrumentation cables. The intermixing of instrumentation cables in power and control raceways was identified by examining the 1975 EE-553 raceway schedules for any shielded cables in power and control raceways. In order to identify the power and control cables intermixed with instrumentation cables in instrumentation raceways, the 1975 EE-553 raceway schedule was examined for non-shielded cables in instrumentation raceways. The results are given in Table 1.

In order to prevent any further occurrences of power, control, and instrumentation intermixing, SMUD has directed, by memo, that an additional column be added to the "1010" drawings and DCNs to indicate the service level of the cable being added. For each added cable, the new column will indicate either "P", "C", or "I" for power, control or instrumentation service, providing the physical designer with the necessary information to properly route newly added cable. [Reference memo EEGS 87-005, from E. J. Gough to the Electrical Engineering staff, dated May 4, 1987.] Additional service level designators are under consideration and include "T" [Telephone], "S" [Security] and "IE" [Instrumentation - Exempt - may mix with P and/or C cables].

ITEM NO. 5
CONTINUED

Table 1

Original Cable Population Power/Control/Instrumentation Intermixing

Class 1 Intermixing

Power Cable in Instrumentation Raceway

None

Control Cable in Instrumentation Raceway

1M1A131D *
1M1A131E *
1M1B139D *
1M1B139E *

Instrumentation Cable in Power and Control Raceway

1G1Q886CS
1G1Q886DS
1R1C260AA *
1R1C260AB *
1R1C260BA *
1R1C260BB *

Non-Class 1 Intermixing

Power Cable in Instrumentation Raceway

112E07A	112GS1GC *	112SDPS6A *
112E11D	112GS1GF *	112SDPS1B *
112E11E	112GS1GG *	112SDPS2B *
112E09CN	112J11EA *	112SDPS3B *
112E09CO	112SDPS1A *	112SDPS4B *
112E09DI *	112SDPS2A *	112SDPS5B *
112F15Z	112SDPS3A *	112SDPS6B *
112GS1GA *	112SDPS4A *	112D230B
112GS1GB *	112SDPS5A *	113C109A

* Cable deleted, no longer installed in plant

ITEM NO. 5
CONTINUED

Table 1 (cont.)

Control Cable in Instrumentation Raceway

1A3A265D3	1I2B360CA	1M2C327I
1A3B470A1	1I2B360T	1M2D202B *
1A3B470A2	1I2B365CA	1M2D224I
1A3B470A4	1I2B365X	1M2D228D
1A3P200B2	1I2G996D	1M2D229D
1A3P200B6	1I2N150LF	1M2E203B *
1A3X520B		
1A3X520H		

Instrumentation Cable in Power and Control Raceway

1I2G201	1I2R301B	1R2I460B
1I2G202	1I2R520AB	1R2PBTPA
1I2G203	1I2R520AF	1R2T250A
1I2G204	1I2R520AJ	
1I2G417	1I2R532AB	

* Cable deleted, no longer installed in plant

ITEM NO. 6

DESCRIPTION Resolve overfill/overweight questions; including USAR and 50.59.

COMMENTARY

CHRONOLOGY

In February 1986, ODR 86-125 was prepared as a result of an investigation following allegations of raceway overfilling. The ODR examined instrument cable tray overfilling, because instrument trays are filled to a higher level than power and control trays, and determined that for the cable tray with the highest fill, that the cable loading did not exceed 50 pounds per linear foot. In addition, it was verified that the actual cable tray loading was used in the fire hazard analysis and also that the cable tray heat derating was acceptable with respect to the cable ampacity. As a result of the above investigation, 38 Class 1 overfilled trays and 150 Non-Class 1 overfilled trays were identified and subsequently reviewed for overweight, as described in the commentary to CRTS Action Item 2.

ODR 87-204 was initiated in February 1987 as a result of concerns that cable trays with fills less than 40% might, in certain unique circumstances, exceed the cable loading of 50 pounds per linear foot. LER 87-24 was also initiated to determine the reportability of the identified problem.

GENERIC IMPLICATIONS

The Rancho Seco USAR limits the fill of redundant cable trays to 40%, so as not to exceed the cable loading of 50 pounds per linear foot used in the cable tray support design. Cable trays do exist whose fill exceeds 40% and were dispositioned during the original design process. Power and control cable trays filled in excess of 40% were checked to verify that the cable loading was not in excess of 50 pounds per linear foot. In addition, an ampacity check was performed. Instrumentation cable trays filled in excess of 60% were checked to verify that the cable loading was not in exress of 50 pounds per linear foot. Cable tray fill between 40% and 60% was accepted based upon a generic calculation. Although the above calculations were performed during the original design process, the calculations have not been found.

ITEM NO. 6
CONTINUED

Power and control cable trays filled in excess of 40% after commercial operation were dispositioned as described for the original installation. For instrumentation cable trays filled in excess of 50%, the cable loading was verified not to exceed 50 pounds per linear foot. The results of the weight checks performed after commercial operation were not documented, and no formal 50.59 reviews were performed. As of May 1987, all cable trays have been reviewed for fill and weight problems, with only one Class E power and control cable tray requiring physical modification as described in the commentary to CRTS Action Item 2.

The USAR limit is 40% for power and control tray fills. All trays have been checked for weight (regardless of fill level). Only one tray has been found with an "apparent" fill in excess of 50 pounds per linear foot requiring physical modification. "False" fills have been found where a long tray section includes all cables in the weight calculations (and exceed 50 lbs), whereas the weight borne between supports does not exceed 50 lbs. Ampacity checks have been made on all power and control cable trays with fills in excess of 40%. No ampacity problems have been found.

The USAR limit is 40% for instrument tray fills and is at variance with the Nuclear Engineering criteria which has a 50% fill limit for instrument cable trays. All trays have been checked for weight (regardless of fill level). No instrumentation trays were found to exceed the USAR limit of 50 pounds per linear foot. Visual checks are being performed for "heaped" or "mounded" conditions indicating possible problems during a design basis earthquake. At this time, no significant problems have been found. The USAR wording will be revised, (see commentary to CRTS Action Item 17), and the fill limits will be defined in the NEP's.

In summary, no significant problems have been found to date. Final checks on weight contributions from telephone/security cables and weight contributions from fire wrapping are required to verify that their impact is minimal.

DC w/atch:

General Manager	MS 41
Chief Executive Officer, Nuclear	MS 209 (2)*
Executive Assistant	MS 209
Director, Nuclear Quality	MS 271
Manager, Nuclear Training	MS 296
Manager, Nuclear Licensing	MS 286
Manager, Nuclear Engineering	MS 208-6
Public Information	MS 204
Manager, Maintenance	MS 254
Manager, Operations	MS 255
Manager, Nuclear Chemistry	MS 244
Manager, Plant Performance	MS 258
IIRG	MS 298
NAC (6)	MS 209
Fourth Floor Files	MS 43
Licensing Files	MS 286
PRC Files	MS 286
RIC Files	MS 224
NOV/NOD Files	MS 286

*1 w/enclosure + 1 w/o enclosure

ITEM NO. 6
CONTINUED

CAUSES

As evidenced by the discovery of only one "apparent" problem concerning overfilled cable trays, the original 40% fill limit was a very conservative requirement in the original plant design. However, the absence of documented 50.59 reviews for those cable trays whose fill was exceeded [post-commercial operation] is a cause for concern. The direct cause of both overfill and overweight conditions lacking the documentation validating their acceptability was a lack of procedural guidance.

CORRECTIVE ACTION

Immediate corrective action has been to review all cable tray weights regardless of fill level [see commentary on CRTS Action Item 2]. Additionally, for new design work [added cables], all power and control trays which exceed 40% fill are checked for weight and ampacity; all instrument trays whose fill exceeds 50% fill are checked for weight. NEAP 4127 requires all DCNs which generate error reports [e.g. cable tray fills above 40%] to be referred back to NED for review and documented analysis. In addition, the 50.59 review concern will be resolved through the NCR process, with a forecast completion date of January 8, 1988.

Until the CRTS software is enhanced to provide automatic "blocking" of cable additions to specific raceways, those trays which require "blocking" are controlled by a list of controlled trays issued in an ERPT and referenced in Modifications Procedure/Inspection Standard MP/IS 307 and Electrical Design Criteria E5104.2 [Reference EEGS 88-002 dated January 6, 1988].

Issues to be resolved post-restart, but before the end of the Cycle 8 outage are as follows:

* Resolve the concern of security and communication cables [Class 2 and 3] on raceway fill and weight.

* Resolve the concern of firewrapped cables on raceway fill and weight.

* Resolve the concern of coiled cables, not connected to equipment, on raceway weight.

* Resolve the concern of cable tray covers on cable tray weight.

ITEM NO. 7

DESCRIPTION Justification for not sampling the original cable population.

COMMENTARY

CHRONOLOGY

As a result of employee allegations as far back as 1983, and with the June 1986 identification of seven misrouted Appendix "R" cables, a decision was made in December 1986 to signal trace a sample of safety-related cables installed after commercial operation in 1975. The original cable population of 14,000 cables was excluded from the sampling plan because the design, installation and inspection of the original cable population by Bechtel Power Corporation, Rancho Seco A & E and Constructor was governed by a quality program sufficient to control the physical design and installation of the original cable population.

SUMMARY

Justification for excluding the original cable population was presented by SMUD during the June 1987 NRC inspection visit in the form of a report. The report, titled "Justification For Not Sampling The Original Rancho Seco Cable Population," was formally transmitted by GCA 87-338, dated July 24, 1987. The report demonstrates that Bechtel had in place and used a rigorous quality program sufficient to control the physical design of the original cable population. In contrast to those cables installed after commercial operation, the original cable population was installed while the plant was in a construction mode, under a uniformly consistent set of rules and procedures. The procedures did not vary during the design, installation, and inspection of the original cable population, and as shown, in Appendix 3, these procedures were rigorously followed by a relatively stable and well-trained workforce. The justification for not sampling the original cable population was transmitted by GCA 87-338, dated July 24, 1987, and is Appendix 3 to the Wire and Cable Program Report.

ITEM NO. 8

DESCRIPTION Resolve all known physical problems.

COMMENTARY

CHRONOLOGY

Physical problems related to the Rancho Seco cable and raceway installation have been identified by LERs 85-16, 86-10, 87-13, 87-24 and 87-26. In addition, Impell, under Task 271, has identified, with documentation submitted to SMUD, additional CRTS database discrepancies, although not all are physical problems [See commentary to CRTS Action Item 2]. The identified physical problems are of the following types:

Overfilled/Overweight Cable Trays (LER 87-24)

Refer to commentaries to CRTS Action Items 2 and 6 for discussion.

Intermixing of Power/Control/Instrumentation Cables (LER 85-16 and 87-26)

Refer to commentaries to CRTS Action Items 2, 5 and 9 for discussion.

Lack of Configuration Control (LER 86-10 and 87-13)

Refer to commentaries to CRTS Action Items 1, 4 and 23 for discussion.

Lack of Redundant Class 1 Channel Separation

No identified problems of this type have been found to date.

Lack of Class 1/Non-Class 1 Separation

As described in the commentary to CRTS Action Item 2, none of the 763 intermixes of Class 1, 2, and 3 cables are valid discrepancies. The cables were either installed under the original plant criteria, which allowed mixing, or are deleted or routed in "special" raceways so that no mixing occurs.

CAUSES

Refer to commentary to CRTS Action Item 15.

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CORRECTIVE ACTIONS

The following corrective actions have been taken to resolve known Rancho Seco cable and raceway physical problems, and to prevent their recurrence:

Overfilled/Overweight Cable Trays

Immediate corrective action taken as a result of ODR 86-125 and LER 87-24 was the review of all cable tray weights, regardless of fill level. As a result of the cable tray weight review, one Class 2 power and control cable tray was found to be overweight. ECN R-2015 will be issued in October to divide the tray into two trays to resolve the apparent overweight. Corrective action to prevent recurrence has been the revision of procedure NEAP 4127, "Cable Raceway Tracking System," to require that data contained in DCNs to CRTS-related drawings be "error free" when input to the proposed CRTS database. Should an error report indicate an overfill condition, then the DCN is returned to the originator for resolution. In addition, the USAR will be revised to reconcile discrepancies in fill limits for instrumentation cable trays to be consistent with NEP 5204.22, [See commentary to CRTS Action Item 17].

Intermixing of Power/Control/Instrumentation Cables

Immediate corrective action taken as a result of the identification of an SFAS instrument cable routed through power and control raceways in LER 85-16 was the review of the CRTS database for further intermixing [see commentary to CRTS Action Items 2 and 9], as well as the examination of the original cable population for a generic intermixing problem [see commentary to CRTS Action Item 5]. The intermixing identified by LER 85-16 has been corrected by ECNs R-0459 and R-1295. Further intermixing has been identified by CRTS database reviews, as identified in LER 87-26, and by cable signal tracing as identified by ODRs 87-604 and 87-723 and are corrected by ECNs R-1785 and R-1786. Sixteen Non-Class 1 intermixes requiring relocation were identified by Impell as documented by CPRs CPR-0611, 610, 885, 638, 640, 622, 642, and CONs CON-584 and 742 contained in Impell Calculation No. 271-101-109, Rev. 0. The Non-Class 1 intermixes will be documented by NCR and will be resolved prior to the end of the cycle 8 outage. Corrective action to prevent recurrence of power/control/instrumentation cable intermixing has been the revision of Design Guides NEPM 5204.22, "Cable System Design, General," and NEPM 5204.43, "Instrumentation Systems Shielding and Grounding and Surge Protection," to clearly define the

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physical separation requirements for power, control, and instrumentation circuits and to provide definitions of the cable service levels [See commentary to CRTS Action Item 9]. In addition, the USAR will be revised to remove any ambiguity as to the applicability of intermixing restrictions to RPS and SFAS in USAR section 8.2.2.11.K [See commentary to CRTS Action Item 17].

Lack of Configuration Control

Immediate corrective action taken, as a result of the identification of the cable misroutes in LER 86-10, was to initiate the Rancho Seco cable sampling to establish a level of confidence in the cable installation. The LER 86-10 cable misroutes were corrected by ECN R-0765, which is construction complete. The additional cable misroutes identified during the cable sampling activities and documented by LER 87-13 were rerouted by work request.

Corrective action taken to prevent the recurrence of cable misroutings has been to revise the Modification Procedure/Inspection Standard MP/IS 307, "Cable Installation," to require the use of design drawings of the latest revision when installing cable, and the requirement that the cable routing information on the E-1010 series drawing match that on the applicable cable installation card. Witnessing requirements for cable pulls have also been clarified in MP/IS 307 to require that cable installation verification shall consist of witnessing the installation of the cable.

Lack of Class 1/Non-Class 1 Separation

No corrective action necessary, as none of the 763 intermixes of Class 1, 2 and 3 cables are valid discrepancies.

ITEM NO. 9

Description Resolve power/control/instrument cable mixing concerns.

Commentary

Chronology

LER 85-16 Rev. 0 was the first documented evidence that instrument cables had been mixed with power and/or control cables at Rancho Seco. Since this discovery, additional "mixing" has been found and details are provided in the commentaries to CRTS Action Items 2 [partial] and 5.

Generic Implications

The concern is the avoidance of unacceptable noise levels caused by cross-coupling between adjacent conductors in instrument circuits. The level of noise is a concern for analog circuits and some digital circuits. No concern attaches to cable insulation levels since all power, control, and instrument cables have 600 volt insulation ratings and additional protection in the form of a protective outer jacket.

The ability of a circuit to tolerate noise is a function of the equipment connected to it. The type of equipment and the provision of noise "filtering" components both play a part.

The original design approach at Rancho Seco was typical of plants of similar vintage. The raceway design for the original 14,000 cables provided two service levels for 600 volt class cables [NEPM 5103 Section 5.4.5.1] (1.b) 480 Volt (and below) power, DC and control and (1.c) instrumentation. No explicit definitions existed for either power, control, or instrument circuits. Service levels were indicated for raceways as follows:

> For Class 1 power and control raceway, the raceway designator begins with either the letter L, M, P or W for Channel A, B, C, or D, respectively. For Non-Class 1 power and control raceway, the raceway designator begins with the numeral 7.
>
> For Class 1 instrumentation raceway, the raceway designator begins with either the letter A, B, C or D for Channel A, B, C or D, respectively. For Non-Class 1 instrumentation raceway, the raceway designator begins with the letter X.

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Conduit is differentiated from cable tray by having all digits after the first letter or number; cable tray is identified by having both letters and numbers after the first letter or number raceway designator.

For example:

L27AF1 - Channel A	Power and Control	Cable Tray
M47223 - Channel B	Power and Control	Conduit
727BA1 - Non-Class 1	Power and Control	Cable Tray
732007 - Non-Class 1	Power and Control	Conduit
A32AB2 - Channel A	Instrumentation	Cable Tray
D44301 - Channel D	Instrumentation	Conduit
X44AD3 - Non-Class 1	Instrumentation	Cable Tray
X56032 - Non-Class 1	Instrumentation	Conduit

Scheme cable numbers did not indicate the service level [P, C or I] for cables; however, a standard practice was used which identified all 600 volt shielded cables [twisted shielded pairs, coax, triax, etc.] as instrument cables. This practice allowed latitude to the designers in classifying circuits as "instrument" when the circuits were shielded. For example, with this approach, low amperage (0.5 amp) 120 Volt power supplies could be installed using shielded, twisted pair cable and run with signal cables. When a field component (e.g., flow transmitter) was provided with only one entry [conduit hub] this was an obvious practical approach, meeting the equipment supplier's intent.

For safety circuits, an unacceptable noise level is a plant safety issue. For this reason, the USAR wording requires separation of instrument cable from power and control cables for RPS and SFAS, while not explicitly addressing other systems. In practice, the design intent has always been to maintain the same separation for all systems. Design Guides written in 1984 and later have attempted to provide more explicit direction with the result that the design intent for the original 14,000 cables and cables installed later has become blurred.

Causes

The direct cause for each identified problem [CRTS Action Items 2 (partial), and 5] will be addressed in each individual commentary. Not all identified problems are, upon examination, real problems. A major cause of both real and incorrectly identified "mix" problems is an inadequate definition of design intent in both USAR and design documents.

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CONTINUED

A description of the events and circumstances leading to the discrepancies identified in LER 87-26 has been prepared by IIRG [See Appendix 5].

Corrective Actions - Physical Rework

The physical reworking of cables because of mix problems is identified in the following:

Manholes. Underground manholes are concrete structures, below grade, which serve to provide convenient pulling areas for cables run in underground duct. Manholes are used to "marshal" i.e. redirect cable. Mix problems in manholes were investigated by a SMUD contractor [Impell] under Task 346. Non-conformances were recorded in NCR S-6999 for manholes MH006, MH046, MH047, MH048, and MH049. The non-conformances were analyzed and the results recorded in Engineering Report ERPT-0293. The mixing in MH046, MH047, MH048, and MH049 was identified as mixing of Class 1 digital inputs to the Class 2 IDADS multiplexers and was accepted since noise filtering is adequate to limit noise to acceptable levels.

Rework was required in manhole 006 and is scheduled for completion prior to the heat-up milestone [January 18, 1988]. A minimum separation of three (3) inches is established between power/control cables and instrument cables. Installation specification IS-E-5304.6 Addendum 2 was issued on September 18, 1987 to impose the 3" minimum separation in manholes.

LER 85-16. Seven cables required relocation. NCRs S-5203 and S-5966 were issued. ECNs R-0469 and R-1295 detail the work.

LER 87-26. Twenty-eight cables required relocation. NCRs S-6561, S-6562, S-6563, S-6564, S-6565, and S-6566 were issued. ECN R-1765 and ECN R-1766 detail the work. ECN R-1765 was issued on July 23, 1987 and was completed with a closure date of October 28, 1987. ECN R-1766 was issued on June 29, 1987, and is complete with a closure date of November 23, 1987.

CRTS Database Discrepancies [CRTS Action Item 2]

Sixteen Non-Class 1 power, control, and instrumentation intermixes requiring relocation were identified by Impell as documented by CPRs CPR-0617 610, 885, 638, 640, 622, 642, and CONs CON-504 and 742 contained in Impell Calculation No. 271-101-169, Rev. 0. The Non-Class 1 intermixes will be documented by NCR and resolved prior to the end of the Cycle 6 outage.

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Corrective Actions - Changes to USAR and Design Process
CRTS Database

Since July 1987, the cable input documents [Form E-1010] have been required to carry a designation "P" [Power], "C" [Control], or "I" [Instrumentation] to indicate service level and assist in routing the cable in raceways of the proper service level.

Additional service level designators are under consideration and include "T" [Telephone], "S" [Security] and "IE" [Instrument-Exempt may mix with P and/or C cables].

A CRTS software enhancement is planned [CRTS Action Item 10] which will:

* Add a field for cable service level [P, C, I, etc.]
* Add a program feature to check cable service level against raceway service level.

Revisions to Design Documents

The physical separation requirements for power, control and instrument circuits have been defined as follows:

Separate conduits, ducts, penetrations, and cable trays should be provided for the following types of circuits:

(1) Medium voltage (6.9kV) circuits.

(2) Medium voltage (4.16kV) circuits.

(3) Low voltage power (480V) circuits from 480V switchgear, with maintained spacing in trays.

(4) Low voltage power (480V and below), control, and annunciator window input circuits, and selected shielded instrument circuits approved by the Electrical and I & C Supervising Engineers.

(5) Instrument circuits requiring separate routing.

In vertically stacked trays, cable trays should be arranged in the order given above with the medium voltage cables in the highest position in the stack.

Control cables may be pulled with low voltage power cables, except when their respective conductor sizes differ too greatly.

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The instrument circuits requiring separate routing are the following:

(1) All signal circuits from process instruments such as thermocouples, RTDs, transmitters, neutron flux detectors, accelerometers, level elements, radiation monitors, etc.

(2) All signal input circuits to computer and Anatec multiplexers, except for selected circuits which the Electrical and I & C Supervising Engineers specifically approve in writing for routing through power and control raceways.

(3) All low energy level circuits (analog or digital), interfacing between instrument cabinets, and signal output circuits from instrument cabinets which control the plant equipment or device.

(4) All circuits requiring coaxial, twinaxial, triaxial, and fiberoptic cables. (Class 1 ex-core detector cables such as those for source range and power range ion chamber circuits must be run in dedicated rigid steel conduits.)

(5) All low level and higher level analog circuits as addressed in Electrical Design Guide NEPM 5204.43, sections 5.5.4 & 5.5.5.

(6) All signal circuits to panel mounted instruments that are part of a process instrument loop and shown on instrument loop diagrams.

(7) All other circuits designated by the Instrument and Control Group as instrument circuits.

Revisions to the following Engineering Design Documents were completed in July 1987. These revisions are being applied to all new cable work.

NEPM 5204.22 Design Guide - Cable System Design, General
NEPM 5204.43 Design Guide - Instrumentation Systems Shielding and Grounding and Surge Protection

Revisions to USAR

See commentary to CRTS Action Item 17.

ITEM NO. 10

Description — Demonstrate completeness of CRTS, including software verification and validation [V & V].

COMMENTARY

CHRONOLOGY

General background and initial actions concerning the CRTS program are described in CRTS Action Item 1 [as-built verification] and 2 [data discrepancies]. The completeness question has two issues:

1. Installed But Unrecorded Cables: Whether the CRTS data base includes all cables installed in the CRTS listed raceways.

2. Dependable CRTS Program: Whether the CRTS software is complete, reliable, and error free.

Generic Implications

1. Installed But Unrecorded Cables

Cables of two specific systems have been identified as having incomplete cable records:

Security System - CRTS Action Item 11; approximately 180 cables of a total population of 2000 not in CRTS.

Communication System - CRTS Action Item 13; approximately 450 cables, of a total population of 1500, not in CRTS. [Refer to referenced Action Items for additional detail.]

The possibility has also been raised as to whether procedures existed which permitted cables [other than security/communication] to be installed without entries being made in the CRTS database.

The procedure question has been investigated by IIRG. An IIRG report has been issued [Reference DTS 87-103 dated Nov. 9, 1987] which indicates no evidence that other cables [than the security/communication cables identified] were installed without the CRTS database being updated.

As of October 1987, the problem of unrecorded cables appears confined to some security and communication systems without generic impliction for other systems. Security and communication cables are installed only in non-safety-related raceway, which lessens the level of concern.

Concerns with installed but unrecorded cables exist related to raceway weight, raceway fill, and to the quantity of combustible material in open cable trays. However, the quantities are small and without significant safety impact.

2. Dependable CRTS Program

The CRTS software program was written by Control Data Corporation [CDC] for SMUD. The program was run from 1980 through 1986 on a CDC mainframe computer in Kansas City. The program is currently run on a CDC Cyber 180-830 computer installed at the Rancho Seco jobsite. Maintenance and enhancement is provided by CDC. The CRTS data is downloaded to a network of four personal computers for ease of handling by CRTS personnel.

The CRTS software program is not a verified program meeting Nuclear Quality Standards. However, subroutines written for and executed on the PC network are verified under a contractor [Impell] Q.A. program.

The CRTS software program inventories cable and raceway data and performs design checks. The CRTS database is also a source of data for other calculations [e.g. combustible loadings of cable insulation] and a source of information on cable routes. The dependability of the CRTS software is therefore of safety significance to the plant, and the software requires verification to the requirements of the SMUD Quality Program.

The design documents issued for construction have included both the input documents as well as the CRTS generated installation cards. This process provides verification of the cable route, since any difference between design intent [input document] and CRTS record [output cards] is readily apparent.

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The original software program used [EE553] is a Bechtel Program which has been consistently maintained, enhanced, and verified by its owner. The CRTS software was written by CDC for SMUD, but received no verification beyond that accorded to commercial software. The current software has forty-five modules, some of which show evidence of problems ["bugs"]. The database is not impacted, but reports generated from the data contain errors.

Corrective Actions

1. Immediate Actions - Pre Restart

At the end of September 1987 forty-one software bugs have been identified. Four personnel have been added [1 Programmer and 3 Engineers - 2 on V&V and 1 on data discrepancies]. All software bugs will be tracked, through resolution, on a database established for that purpose. All problems which impact restart commitments have been identified and corrected.

2. Future Actions - Post Restart

SMUD Information Management Services [IMS] is preparing a schedule and budget for the provision of upgraded [enhanced] CRTS software, including verification and validation.

Part of this process is making a decision to either:

- Enhance and verify the existing CRTS software or
- Purchase new software - with verification.

The schedule will show the upgraded software verified and in place before the end of the Cycle 8 Outage.

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A listing of future CRTS enhancements has been provided by the CRTS group as follows:

Software Enhancement List

These enhancements are in a format for policy decision-making. Once given initial approval, then the enhancements must be translated into software specification format, then given final approval before software enhancement implementation.

"Needed," Sorted by CRTS Staff Recommended Priority

N1. Add a new type of CRTS report, for all report options that gives the "proposed" database only. Type 3 is recommended for this option, to complement TYPE = 1 "as-built" database only, and TYPE = 2 "as-built and proposed," now in use.

N2. Revise raceway fill logic to be consistent with NEPs and to have complete software control over overfill disallowances, and implement use of "justification codes" for overfill situations. Precedence of "deleting" cables prior to "insertion" of other cables must be enforced to keep fills below NEP limits. "Sparing" cable logic is to be revised so as not to inflate the overfill calculation if an existing included cable is merely having its scheme designation changed. [Presently, the computer tracks both "old" and "new" names and counts both in fill calculation, which unnecessarily inflates the result.]

N3. Add a new feature for cable weights for "tray" raceways, to keep fills within USAR limits; "justification codes" for overweight situations. New software has to handle "split" trays, where a partition separates a tray into "instrumentation" and "power/control" sections -- unit weight for such occurrences has to be combined to meet the USAR 50 pound per linear foot limit.

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N4. Provide a utility feature to search the entire CRTS database for every violation of its current cable-raceway-equipment design logic, at CRTS operator initiation. This should be incorporated immediately after the two items above. Thereafter, as each new logic feature is done, the utility feature should be revised to incorporate each new logic feature.

N5. Revision to Quality Class 1, 2, and 3 intermixing input screening. Class 1 screening is adequate. Non-Class 1 screening needs revising to make use of "justification codes" for presently acceptable configurations that may violate newer, non-applicable requirements.

N6. Revision to service level intermixing input screening to disallow power/control/instrumentation cable intermixing in same raceways. Use of "justification codes" for violations of updated logic.

N7. "Reserved" element tracking, i.e., organizing the cable numbers, raceway numbers, and equipment designations reserved by designers so that when ECN/DCN packages get to the CRTS staff, there are no conflicts among the various packages. The reserved element tracking will become an adjunct database to the existing "proposed" and "as-built" CRTS databases now used by CRTS software. [As a productivity measure, this is being implemented at the microcomputer level presently.]

N8. Appropriate, limited read-only access to CRTS database via computer terminal placement within Design City [Trailer 2] and among Modifications [Construction] personnel. This would free time now used to answer many questions by CRTS staffers, to do other necessary CRTS work. Designers and constructors could interrogate the CRTS database on their own.

N9. Add the capability to generate a "repull" card when an existing, installed cable is rerouted, in order to differentiate between new installation of cable and revision to an existing cable's route.

ITEM NO. 10
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"Desired," Sorted by CRTS Staff Recommended Priority

D.1 Additional cable and raceway enhancements to assist construction personnel -- new database fields: type of service, cable jacket, conductor diameter [versus "overall" diameter], bending radius, pulling tension, sidewall pressure, unit weight, etc.

D.2 10 CFR 50 Appendix "R" supplementary information, i.e., fire protection features, such as fire area in which CRTS element resides, Appendix "R" wraps on raceways, whether a given cable is related to safe-shutdown considerations, whether a cable is associated with "spurious operations equipment," etc.

D.3 Change of CRTS database principle from "position" orientation to "complete history audit trail" orientation.

ITEM NO. 11

DESCRIPTION Show to what extent security cables are documented in CRTS.

COMMENTARY

CHRONOLOGY

ODR 87-409, dated April 9, 1987, reports that 630 telephone and security system cables are installed in the plant with incomplete documentation. Approximately 180 cables of a total population of 2000 security cables are not in CRTS.

All security cables are recorded in one of three data bases:

1. EE-553 (KL)
2. CRTS
3. PC Data Base

All security cables are in Non-Class 1 raceway.

GENERIC IMPLICATIONS

The concern with the incomplete documentation of the plant security cables is due to potential impacts upon cable tray weight, fill, and combustible content, as well as separation and mix concerns. However, since the security cables are in either dedicated conduit or in Non-Class 1 raceways, there is no significant impact upon safety cables. Resolution of this problem will be completed by the end of the Cycle 8 outage.

CAUSES

The cause of the incomplete security cable documentation has not yet been determined.

CORRECTIVE ACTIONS

The immediate action to prevent further undocumented security cable additions to the plant has been to require all design work to be reviewed by the Nuclear Engineering Department. Additional actions may be taken later after further investigation of causes.

ITEM NO. 12

DESCRIPTION Complete security cable documentation.

COMMENTARY

To be performed prior to the end of the Cycle 8 outage.

ITEM NO. 13

Description Show to what extent communication cables are documented in CRTS.

Commentary

Chronology

ODR 87-409, dated April 9, 1987, reports that 630 telephone and security system cables are installed in the plant with incomplete documentation. The communication cables include those from the following systems:

PA - Public Address	[Dedicated Conduit]
SP - Sound Powered	[Dedicated Conduit]
CBX- Computer Based Exchange [ROLM]	[Non-Safety Tray and Conduit]

CBX cables include circuits for VHS radio and microwave link.

Communication cables are shown on series 700 drawings and ECNs.

Generic Implications

The concern with the incomplete documentation of the plant communication cables is due to potential impacts upon cable tray weight, fill and combustible content, as well as separation and mix concerns. However, since the communication cables are in either dedicated conduit or in Non-Class 1 raceways, there is no significant impact upon safety cables. Resolution of this problem will be completed by the end of the Cycle 8 outage.

Causes

The cause of the incomplete communication cable documentation has not yet been determined. A potential cause is that since the communication cables were installed by the Electrical Maintenance Department, conflicting procedures may have led to incomplete communication cable documentation.

Corrective Actions

The immediate action taken to prevent further undocumented communication cable additions to the plant has been to require all design work to be reviewed by the Nuclear Engineering Department. Additional actions may be taken later after further investigation of causes.

ITEM NO. 14

DESCRIPTION Complete communication cable documentation.

COMMENTARY

To be performed prior to the end of the Cycle 8 outage.

ITEM NO. 15

DESCRIPTION Formal and complete root cause evaluation of all cable problems.

COMMENTARY

Thorough Root Cause evaluations have been performed for the major cable problems. Reports summarizing these investigations and providing the causes have been previously transmitted [DTS 87-103, dated November 9, 1987] under separate cover to the NRC.

ITEM NO. 16

DESCRIPTION Define major/minor/insignificant defects.

COMMENTARY

CHRONOLOGY

The Sample Plan [Appendix (1)], prepared by Impell under SMUD Task 271, provides in Figures 9.1, 9.2 and 9.3 a flowchart methodology to classify the types of defects discovered by the circuit tracing walkdowns into major, minor or insignificant defects. The NRC requested, in the May 6, 1987 meeting between the District and the NRC, that the District provide formal, written definitions of the types of defects.

Major, minor, and insignificant defect definitions were given verbally to NRR during a site visit June 15 through 18, 1987. Definitions [see below] will be included in the next revision of the Sampling Plan. The following was explained to NRR.

The word "defect" is used in the Sampling Plan to describe a cable route which is checked and found to differ from the CRTS recorded route. Defects are classified as either "major," "minor," or "insignificant."

The classification is determined by reference to a set of decision diagrams included as Figures 9.1, 9.2 and 9.3 in the Sample Plan [Appendix (1)]. For the convenience of reviewers, the following definitions will also be included:

Major Defect

A major defect is a cable route which differs from the CRTS recorded route and the difference constitutes a violation of the plant safety or design criteria. Corrective action is required.

Minor Defect

A minor defect is a cable route which differs from the CRTS recorded route and the difference does not constitute a violation of the plant safety or design criteria. The corrective action is to correct the engineering record with no change to plant configuration.

Insignificant Defect

An insignificant defect is a cable route which differs from the CRTS recorded route only to the extent that typographical errors exist in the recorded data. The corrective action is to correct the errant data.

ITEM NO. 17

DESCRIPTION Revise USAR

COMMENTARY

CHRONOLOGY

The investigations into the direct cause of a number of CRTS problems has identified the need to revise and clarify the wording used in Sections 5 and 8 of the USAR in a number of areas, as follows:

1. Section 5.1.2.1.8.C.1.(b) [Cable Tray and Bus Duct Supports]

The criteria for cable tray supports limits the loading imposed on the tray to 50 pounds per linear foot. In fact, the 50 pounds per linear foot is a minimum figure, and supports have been designed which accept higher pounds per linear foot values. This change is made for clarification:

Existing Text

"1. (b) Cable tray loading of 50 pounds per linear foot is used throughout regardless of tray width or anticipated weight of wire and cable. In no case does actual weight of wire, cable and tray exceed this figure."

Revised Text

"1. (b) A standard cable tray live loading of 50 pounds per linear foot is used throughout regardless of tray width or anticipated weight of wire and cable. Some cable tray supports are designed for loads which exceed 50 pounds per linear foot. In no case does the actual weight exceed the design limit."

2. Section 8.2.2.11.H

This section provides criteria for the separation of redundant cables of safety circuits, but is unclear because it mixes general criteria for all safety circuits with specific criteria for RPS and ESFAS circuits, and does not clearly indicate what is general criteria and its applicability. This change is made for clarification:

Existing Text

"H. The separation of redundant cables of the reactor protection system and safety features actuation system circuits is accomplished by spatial separation in accordance with the following criteria:"

Revised Text

"H. The separation of redundant cables of safety systems is accomplished by spatial separation in accordance with the criteria given in this section. Specific criteria applicable only to Reactor Protection System [RPS] and Engineered Safety Features Actuation System [ESFAS] cables is included."

3. Section 8.2.2.11.H.1

As a result of NCR S-6594 and LER 87-26, the District has performed a Safety Analysis, 50.59 log No. 1020, which requires the following change to the USAR text:

Existing Text

"1. Separate cable tray conduit and penetration systems are....."

" ...Class I instrumentation circuits are routed in rigid metal conduits as explained in (2) below."

Revised Text

"1. Separate raceway (cable tray, conduit and penetration) systems are ..."

" ...Class I instrumentation circuits are routed in metal raceway as explained in (2) below."

4. Section 8.2.2.11.H.2

As a result of NCR S-6594 and LER 87-26, the District has performed a Safety Analysis, 50.59 log No. 1020, which requires the following change to the USAR text, because the Babcock & Wilcox design interface criteria for RPS and ESFAS cables requires separate "raceway" and does not specifically require separate "conduit."

Existing Text

"2. Reactor protection system and safety features actuation system instrumentation each have their channels routed in separate conduits and are physically separated from each other throughout the plant."

Revised Text

"2. Reactor protection system and safety features actuation system instrumentation each have their channels routed in separate raceways and are physically separated from each other throughout the plant."

5. Section 8.2.2.11.H.5

As a result of NCR S-6562 and LER 87-26, and per the Safety Analysis, 50.59 log No. 1002, the USAR will be changed as follows:

Existing Text

"5. Power and control circuits are not mixed with instrumentation circuits in any raceway for any system."

Revised Text

"5. Power and Control circuits are not mixed with instrumentation circuits in any raceway for any system unless an engineering analysis for acceptability is performed."

6. Section 8.2.2.11.H.9

Per the disposition of LER 87-24, the following change to the USAR has been committed to because both weight and ampacity considerations are different for power and control cables versus instrument cables. The following text change to USAR Section 8.2.2.11.H.9 is planned to provide clarification and agreement with NEP 5204.22:

Existing Text

"9. The maximum percentage fill in redundant trays is 40 percent and wherever possible, it is kept at a much lower value."

Revised Text

"9. The maximum fill in trays is limited to prevent exceeding the cable ampacity rating in accordance with IPCEA No. P-46-426 and ICEA No. P-54-440, and the designed weight of cable on the tray supports."

Cable tray fill limitations are typically imposed because of the following:

- All cable trays - Load bearing capacity of tray and supports
- Power cable trays - Ampacity ratings of cables

ITEM NO. 17
CONTINUED

The current status of these items at Rancho Seco are as follows:

Load Bearing Capacity of Cable Trays

All tray weights [without regard to percent fill] have been checked against the 50 pound per linear foot USAR limit and were again checked on December 28, 1987 with results as described in the commentary to CRTS Action Item 2. An enhancement is planned to the CRTS software to calculate cable tray weights for all future design changes, without regard to fill level.

Ampacity Rating of Cables

The ampacities for 600 volt 90°C power and control cables routed through randomly filled cable trays are based on either the number of conductors [IPCEA No. P-46-426] or percent fill per ICEA No. P-54-440, typically 40% of a 4" tray.

Scheduled USAR Revision

These changes are scheduled for inclusion in the next annual update of the USAR in July 1988.

ITEM NO. 18

DESCRIPTION Issue NEAP 4127.

COMMENTARY

CHRONOLOGY

The identification of concerns regarding CRTS completeness and missing CRTS cards, followed by the further identification of cable installation problems associated with LERs 85-16 and 86-10, led to the overall review of Rancho Seco cable installation procedures and practices as described in the Action Plan and this report. Initial direct cause determination, confirmed by the preliminary root cause evaluations, has identified that the lack of a formal procedure, by which proposed changes to the CRTS database are made, and describing and controlling the issuance and return of cable and raceway construction cards, was a contributing factor in cable and raceway installation and documentation problems. It should be noted that no specific cabling problem appears to have been directly associated with or caused by the CRTS computer program itself, but that problems arose through not formalizing the procedure by which cable additions, modifications, and deletions are made to the plant, and controlled and inventoried by the cable and raceway construction cards and the CRTS database.

GENERIC IMPLICATIONS

Lack of a formal procedure to control changes to the CRTS database and hence control cable and raceway additions, modifications, and deletions to the plant, was a factor in the following types of cable problems at Rancho Seco:

Cable Tray Overfills and Overweights

Prior to June 1987, formal procedures for the engineering review and acceptance of overfilled cable trays did not exist. Rancho Seco cable tray supports are designed to support, as a minimum, a cable loading of 50 pounds per linear foot. The USAR specifies a cable tray fill limit of 40% so that the cable tray support design of 50 pounds per linear foot is not exceeded. In the past, undocumented engineering reviews were made when cable additions to cable trays exceeded the cable tray fill limit. Neither the informal checks nor the supervisory approvals were proceduralized, and no documentation is available to show that such reviews have been made.

ITEM NO. 18
CONTINUED

Presently, NEAP 4127 "Cable and Raceway Tracking System" prevents the issuance of DCNs to CRTS-related drawings [E-1008, 1010, 1026, 1027 and 1028] unless an error-free report can be produced when the data is entered into the proposed database. If a design error is detected, then the DCN is returned to the originating engineer for resolution. Once an error-free report is produced, the DCN is then submitted to the Electrical Supervising Engineer for approval. Should the CRTS error report indicate an overfilled cable tray, the DCN is returned for the engineering review and evaluation of the cable tray's included cables to verify that the cable tray support design basis cable loading has not been exceeded.

CRTS Completeness

The "completeness" issue is discussed in the commentaries to CRTS Action Items 1, 2, 3 and 10. Concerns relate to whether or not CRTS recorded cable locations match "as-built," the resolution of CRTS database discrepancies, cables not recorded in the CRTS database and missing CRTS cards.

The formalization of CRTS procedures in NEAP 4127 provides the definitions and responsibilities sufficient to control future cable and raceway additions, modifications, and deletions to the plant. NEAP 4127 formalizes the flow of DCNs to the CRTS-related drawings, as well as the flow of the CRTS generated cable and raceway installation cards to ensure the retention of completed cards to ensure CRTS cable and raceway locations match the "as-built" and to ensure that CRTS data is entered without errors. By procedure, error reports are run on data to be entered into the proposed database and again, once construction is complete, during the final processing of completed cards, in order to ensure that the proposed data, as well as the "as-built" data, is error-free and reflects the actual plant configuration.

CAUSES

A summary of the overall root cause evaluations is contained in Appendix 5.

CORRECTIVE ACTION

Corrective action has been to issue NEAP 4127 "Cable and Raceway Tracking System," on June 15, 1987, to control changes to the CRTS database and control cable and raceway modifications to the plant.

ITEM NO. 19

DESCRIPTION Provide bases for acceptability of a 95/95 level of assurance regarding cable routing.

COMMENTARY

CHRONOLOGY

The basis for 95/95 is given in the Sampling Plan [Appendix (1)]. Cable sampling started in February 1987 and was completed on October 26, 1987. Following a meeting with SMUD on May 6, 1987, and a subsequent telephone conference call on May 11, 1987, the NRC requested additional information.

SMUD RESPONSE

The additional information requested has been provided in an appendix to the commentary to CRTS Action Item 19 of the July Wire and Cable Program Report, GCA 87-400, dated August 18, 1987, and therefore will no longer be included with this commentary, but will be referred to as Appendix 4 to this submittal of the Wire and Cable Program Report. Following issuance of the SER supplement and final acceptance of the Sampling Plan, the supporting documentation will be maintained in NED files for audit or re-inspection. Appendix 4 will be forwarded to NRR [in final form with inspections complete] with the monthly Wire and Cable Program Report. The appendix has been prepared by a SMUD consultant [Impell] and:

1. Provides information on established precedents.

2. Provides additional information on the technical basis for the Sampling Plan and provides a comparison between the Rancho Seco Sampling Plan and Military Standard 105D and related plans.

ITEM NO. 20

DESCRIPTION Resolve NRC concerns about possible biasing of sample.

COMMENTARY

CHRONOLOGY

Section 9.1 (3), Evaluation Process, of the Rancho Seco Sampling Plan [Appendix (1)] contains the following statement:

"If a deviation does exist between the CRTS database routing and the "as-built" routing, the results are first checked against existing CPRs or CONs to determine if the deviation has already been dispositioned. If this problem has been dispositioned by a CPR or CON, no defect for that lot exists."

The question was raised, by Mr. Faust Rosa, at the May 6, 1987 meeting as to whether the dispositioning of deviations, by CPR or CON, introduced a bias into the sampling.

SMUD RESPONSE

The response to the concern is provided in this commentary. The process described in Section 9.1 (3) is essentially only a correction of minor bookkeeping errors, none of which impacted the cable route. Only seven cables had deviations which were dispositioned as described. All are detailed herein and none had deviations which affected the route. No bias was introduced into the sampling by Section 9.1 (3). This commentary will be added to the Sample Plan in the next revision.

ITEM NO. 20
CONTINUED

TABLE 1

List of Circuit Tracing Walkdown Cables with CONs or CPRs

The following list of cables are part of the CRTS circuit tracing sample cables and have CRTS problems identified as CONs(*) or CPRs(**).

Item	Cable	Work Request Number	CON or CPR Designation
1	1G1Q886AR	108063	CON-0118 CPR-0053
2	1M1A137 C	127745	CON-0001
3	1P1A06 D	126992	CON-1018
4	1R1C260BB	128755	CPR-0865
5	1R1C469CL	127708	CPR-0031
6	1R2IR2H C	127006	CPR-0534 CPR-0672
7	111B314 A	127022	CPR-0866

* Conversion error reports (CONs) were generated for equipment, raceway, and cable problems identified from the June 1980 computer conversion error reports prepared by SMUD's contractor, Control Data Corporation, when Bechtel Power Corporation's EE-553 database was converted to the present CRTS database.

** CRTS Problem Reports (CPRs) were generated for equipment, raceway, and cable problems identified after the June 1980 conversion.

The following describes the problems and resolutions stated on the associated CONs/CPRs and their impact on the circuit tracing walkdown effort.

ITEM NO. 20
CONTINUED

Table 1 (continued)

ITEM 1

Cable: 1G1Q886AR on CON-0118 and CPR-0053

Problems: CON-0118 states that the CRTS raceway vias do not match Bechtel's EE-553 cable routing.

CPR-0053 states that the construction card's first and last vias ("red") do not match CRTS first and last vias ("white").

Resolutions: CON-0118 -- Junction box numbers were removed from CRTS vias and were confirmed by walkdown.

CPR-0053 -- Inspection verified the cable is painted with "red." DCO has been issued to correct CRTS.

Walkdown Impact: None on cable routing.

ITEM 2

Cable: 1M1A137 C on CON-0001

Problem: CON-0001 states that CRTS vias show cable tray L43V36 connecting to L39BN5, but CRTS raceway connections do not show them connecting.

Resolution: CON-0001 -- CRTS Revision Level 1372, 02/16/87, raceway connections show tray L43V36 connecting to L39BN5.

Walkdown Impact: None on cable routing.

ITEM NO. 20
CONTINUED

Table 1 (continued)

ITEM 3

Cable:	1P1A06 D on CON-1018
Problem:	CON-1018 states that "from" termination of cable does not match equipment I.D. schedules.
Resolution:	CON-1018 -- "From" termination is a section of a panel. Panel is listed in equipment I.D. schedule.
Walkdown Impact:	None on cable routing.

ITEM 4

Cable:	1R1C260BB on CPR-0865
Problem:	CPR-0865 states that CRTS shows the cable has a deleted status and removal of the cable is not verified.
Resolution:	CPR-0865 -- Inspection verified the cable is being spared and has been retagged to 1B1PA0101.
Walkdown Impact:	Cable is deleted. New sample cable selected.

ITEM 5

Cable:	1R1C469CL on CPR-0031
Problem:	CPR-0031 states that the pull card is not signed by QC.
Resolution:	NCR was issued, and when dispositioned, the pull card will be signed by QC after inspection.
Walkdown Impact:	None on cable routing.

ITEM NO. 20
CONTINUED

Table 1 (continued)

ITEM 6

Cable:	1R2IR2H C on CPR-0534 and CPR-0672
Problems:	CPR-0534 states that the cable is routed in Class 2 overfilled tray. CPR-0672 states that the construction card has not been received and that the number of conductors does not match design drawings.
Resolutions:	CPR-0534 -- Cables in overfilled tray were analyzed. CPR-0672 -- Resolution of Non-Class 1 problem on unsigned construction cards is not completed.
Walkdown Impact:	None on cable routing.

ITEM 7

Cable:	111B314 A on CPR-0866
Problem:	CPR-0866 states that CRTS shows the cable has a deleted status and removal of the cable is not verified.
Resolution:	Inspection was performed and confirmed that the cable does not exist.
Walkdown Impact:	Cable is deleted. New sample cable is selected.

ITEM NO. 21

DESCRIPTION Provide NRC with location of cable pull cards.

COMMENTARY

Refer to commentary to CRTS Action Item 3.

ITEM NO. 22

DESCRIPTION Provide NRC with future plans for cable pull cards.

COMMENTARY

Refer to commentary to CRTS Action Item 3.

ITEM NO. 23

DESCRIPTION Redundant cabling in the same fire area (LER 86-10 and 87-13).

COMMENTARY

CHRONOLOGY

Refer to Root Cause Investigation 86-10.

GENERIC IMPLICATIONS

LERs 86-10 and 87-13 identified significant concerns with Rancho Seco cable configuration control. LER 86-10 identified seven safety-related instrumentation cables in Fire Area 17 that were not rerouted into fire-wrapped conduit as required by CRTS. LER 87-13 identified seven safety related instrumentation cables that were not moved from Fire Area 36 to Fire Area 31 as required by CRTS. In both cases, the cable rerouting was to have been performed under ECN A-4942, and in fact the subject cables were correctly routed per the original issue of ECN A-4942. However, the routing of the cables was revised several times after the initial issue of ECN A-4942, and the failure to subsequently reroute the cables resulted in LERs 86-10 and 87-13. In addition to the safe shutdown/Appendix "R" concerns that arose as a result of the incorrectly routed cables, additional concerns identified by preliminary root cause investigations include that of adequate control of CRTS cable and raceway installation cards [See commentary to CRTS Action Items 3 and 18] and the failure of the Electrical QC inspectors to verify proper location and routing of the subject cables [Notice of Violation 50-312/87-21/-01].

CAUSES

Refer to the summary of the Root Cause Investigation 86-10 [Appendix (5)] for the root cause findings.

CORRECTIVE ACTIONS

In response to LER 86-10, Rancho Seco began an inspection program of safety-related cables to establish a level of confidence in the cable locations, as well as the CRTS database. Based on the analysis of the misrouted cables in LER 86-10, and the lack of identified cable routing problems in the original plant cable population, the decision was made to sample only those safety-related cables installed after commercial operation in 1975 [justification provided in commentary to CRTS Action

ITEM NO. 23
CONTINUED

Item 7j. As described in the Sampling Plan [Appendix (1)], the post-commercial operation safety-related cables have been divided into four sample populations and the objective has been to demonstrate with a 95% level of confidence that at least 95% of the sampled population is correctly installed in the plant per CRTS. Cable inspection, as part of the Sampling Plan, identified the seven additional cable misroutes described in LER 87-13, and prompted the 100% inspection of the Lot 4 sample population, which is complete with no additional major defects.

Additional cable misroutes were identified as described in ODRs 87-604 and 87-723, and have required the 100% inspection of the Lot 1 sample population, completed on December 8, 1987. Cable rerouting for those misrouted cables identified by LER 86-10 was performed by ECN R-0765 and is construction complete. Cable rerouting for those misrouted cables identified by LER 87-13 was performed by work request 128636 and is also complete. Misrouted cables identified by ODRs 87-604 and 87-723 will be corrected by ECNs R-1785 and R-1786, issued on July 23, 1987 and June 26, 1987 respectively. Construction completion for R-1785 was on October 28, 1987 and closure for R-1786 was on November 23, 1987. Additional corrective action has been to include in the Modification Procedure/Inspection Standard MP/IS 307, "Cable Installation," requirements to ensure that when installing cable, that the design documents are the latest revision, and that the cable routing information on the E-1010 series drawing matches that on the applicable cable installation card. Further requirements have been included in MP/IS 307 by Procedure Change Notice, in order to clarify the requirements for witnessing cable pulls, as follows:

> "Verify the cable is installed in the raceway specified by the applicable E-1010 series drawing. Verification shall consist of witnessing the installation of the cable."

ITEM NO. 24

DESCRIPTION Provide description of the installation procedures and practices used at Rancho Seco for the original cable population of 14,000 cables.

COMMENTARY

Refer to the commentary to CRTS Action Item No. 7.

ITEM NO. 25

DESCRIPTION Document a thorough engineering evaluation of the procedures and specifications used to install cable in the period 1975-1986.

COMMENTARY

CHRONOLOGY

This CRTS Action Item stems from a lack of independent inspection for the installation of approximately 1100 safety cables in the period 1983-1985. This is identified in a draft Notice of Violation, included by NRC Region V, in a letter to SMUD dated July 30, 1987, Subject: NRC Inspection Report.

The concern which exists is that the lack of independent inspection could have resulted in not detecting damage to cable during installation. This engineering evaluation addresses the approximately 9000 cables installed 1975-1986 and covers two areas:

1) Adequacy of cable installation procedures and specifications used 1975-1986.

2) Evidence of cable damage experienced 1975-1986.

The NRC Notice of Violation identifies a SMUD letter dated September 23, 1976 which stated that the Rancho Seco QA program complied with the guidance given in WASH NO. 1284. This document in turn invokes IEEE Standard 336-1971 [ANSI N45.2.4-1972]. IEEE 336-1971 requires in Section 2.3 "Procedures and Instructions" that "Installation, inspection, and test procedures and work instructions shall be prepared and documented for those activities falling within the scope of this standard." Cable installation is covered in Section 4.

This evaluation is made against the 1976 SMUD commitment.

GENERIC IMPLICATIONS

Approximately 14,000 cables were included in the original construction cable installation. Both the NRC and SMUD evaluations [NRC inspection report 50-312/87-21 Section 2.A.(1) and CRTS Action Item 7] accept the adequacy of quality control in the original construction.

The 9000 cables installed 1975-1986 may be summarized by year as follows. The Class 1 cable totals given are approximate and derive from Appendix 1 to the Wire and Cable Program Report. The Class 2/3 cable totals are ratioed from the Class 1 totals.

ITEM NO. 25
CONTINUED

Approximate Cable Distribution by Year

YEAR [ECN closure]	CABLES INSTALLED	CLASS 1 CABLES	NON-CLASS 1 CABLES [3.425 X Class 1]
?	225	51	174
1975	66	15	51
1976	4	1	3
1977	53	12	41
1978	101	23	78
1979	53	12	41
1980	598	135	463
1981	0	0	0
1982	0	0	0
1983	3638	822	2816
1984	828	187	641
1985	3315	749	2566
1986	119	27*	92
	9000	2034	6966

* Includes 25 cables whose ECNs were closed in 1987. ? = Year not confirmed.

The period 1983, 1984, 1985 saw 1758 Class 1 cables installed or over 86% of the total installed 1975 through 1986. A detailed evaluation has been made [year by year] of:

- Installation specifications
- Installation procedures
- Inspection procedures

This evaluation has determined that no Rancho Seco cable installation specifications as such, existed during the years 1975 through 1981. However, the required cable installation attributes were addressed by inspection requirements contained in Construction Inspection Data Reports [CIDRs] included with each work request package. Copies of CIDRs for 1978 and 1980 are included as Appendix 6 of this report. From 1982 onward, installation specifications existed and were adequate. Details are as follows:

ITEM NO. 25
CONTINUED

ADEQUACY OF CABLE INSTALLATION PROCEDURES AND SPECIFICATIONS USED 1975-1986

YEAR 1975

Installation Specifications:	None
Installation Procedures:	EM-145 Rev. 0
Inspection Procedures:	QCI 107 Rev. 0, 1, 2, 3
Industry Guides/Standards:	None
Regulatory Standards:	None

Compliance	YES	NO
Cable Installation Specifications Issued?		X
Material Handling Addressed?		X
Cable Tensile Strength Addressed?		X
Cable Sidewall Pressure Limitations Addressed?		X
Cable Pulling Calculations Addressed?		X
Installation Tension Measurements Addressed?		X
Cable Lubricants Addressed?		X
Cable Bending Limitations Addressed?		X
Installation Procedures Issued?	X	
Inspection Procedures Issued?	X	

YEAR 1976

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 0
Inspection Procedures:	QCI 107 Rev. 3
Industry Guides/Standards:	IEEE 336-1971
Regulatory Standards:	Safety Guide 30

ITEM NO. 25
CONTINUED

Compliance	YES	NO
Cable Installation Specifications Issued?		X
Material Handling Addressed?	X (16)	[See Comment]
Cable Tensile Strength Addressed?	X (11)	
Cable Sidewall Pressure Limitations Addressed?	X (11)	
Cable Pulling Calculations Addressed?	X (11)	
Installation Tension Measurements Addressed?	X (11)	
Cable Lubricants Addressed?	X (13)	
Cable Bending Limitations Addressed?	X (4)	
Installation Procedures Issued?	X	
Inspection Procedures Issued?	X	

Comment: The intent of IEEE 336 and Safety Guide 30 were met in the CIDRs. The # in parenthesis ( ) indicates the CIDR item as follows:

Inspection Item	Inspection Requirement	Method
4.	Bending radius shall be in accordance with manufacturer's recommendations and necessary requirements.	Visual
11.	Pulling tension shall not exceed manufacturer's recommendations.	Visual
13.	Excess lubricant shall be removed from cable immediately after pulling.	Visual
16.	Purchase Order number, Manufacturer's Reel number, DCN number, Work Request number, and Stock Code number shall be recorded on the cable pull card upon receiving cable from the warehouse.	Verify

YEAR 1977

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 0
Inspection Procedures:	QCI 107 Rev. 3
Industry Guides/Standards:	IEEE 336-1971 IEEE 336-1977 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 1976 Response

ITEM NO. 25
CONTINUED

YEAR 1978

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 0, 2, 3
Inspection Procedures:	QAP 29 Rev. 1 QCI 107 Rev. 3, 4
Industry Guides/Standards:	IEEE 336-1977 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 1976 Response

YEAR 1979

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 3
Inspection Procedures:	QAP 29 Rev. 1 QCI 107 Rev. 4
Industry Guides/Standards:	IEEE 336-1977 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 1976 Response

YEAR 1980

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 3
Inspection Procedures:	QAP 29 Rev. 1 QCI 107 Rev. 4
Industry Guides/Standards:	IEEE 336-1977 IEEE 336-1980 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 1976 Response

ITEM NO. 25
CONTINUED

YEAR 1981

Installation Specifications:	None
Installation Procedures:	EM-163 Rev. 3
Inspection Procedures:	EII EC-11 Rev. 0 EII G-2 Rev. 0 EII G-4 Rev. 0, 1* QAP 29 Rev. 1, 2, 3, 4 QCI 107 Rev. 4
Industry Guides/Standards:	IEEE 336-1980 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 197b Response

* Effective Date Not Known

YEAR 1982

Installation Specifications:	CMP Rev. 0, 1, 2
Installation Procedures:	CMP Rev. 0, 1, 2 EM-163 Rev. 3
Inspection Procedures:	EII EC-11 Rev. 0, 1* EII G-2 Rev. 0 EII G-4 Rev. 0, 1* QAP 29 Rev. 4 QCI 107 Rev. 4
Industry Guides/Standards:	IEEE 336-1980 IEEE 422-1977
Regulatory Standards:	Safety Guide 30

* Effective Date Not Known

ITEM NO. 25
CONTINUED

Compliance	YES	NO
Cable Installation Specifications Issued?	X	
Material Handling Addressed?	X	
Cable Tensile Strength Addressed?	X	
Cable Sidewall Pressure Limitations Addressed?	X	
Cable Pulling Calculations Addressed?	X	
Installation Tension Measurements Addressed?	X	
Cable Lubricants Addressed?	X	
Cable Bending Limitations Addressed?	X	
Installation Procedures Issued?	X	
Inspection Procedures Issued?	X	

Comments: The intent of IEEE 336, IEEE 422, and Safety Guide 30 were met.

YEAR 1983

Installation Specifications:	CMP Rev. 2, 3, 4, 5
Installation Procedures:	CMP Rev. 2, 3, 4, 5 EM-163 Rev. 3
Inspection Procedures:	EII EC-11 Rev. 1*, 2, 3 EII G-2 Rev. 0, 1, 2 EII G-4 Rev. 0, 1*, 2 QAP 29 Rev. 4 QCI 107 Rev. 4 QCP 330 Rev. 2, 3, 4
Industry Guides/Standards:	IEEE 336-1980 IEEE 422-1977
Regulatory Standards:	Safety Guide 30
Compliance:	See 1982 Response

* Effective Date Not Known

ITEM NO. 25
CONTINUED

YEAR 1984

Installation Specifications:	CMP Rev. 5, 6
Installation Procedures:	CMP Rev. 5, 6 EM-163 Rev. 3, 4
Inspection Procedures:	EII EC-11 Rev. 3, 4, 5, 6 EII G-2 Rev. 2, 3, 4, 5* EII G-4 Rev. 2, 3 QAP 29 Rev. 4 QCI 107 Rev. 4 QCP 330 Rev. 4, 5
Industry Guides/Standards:	IEEE 336-1980 IEEE 422-1977 IEEE 690-1984
Regulatory Standards:	Safety Guide 30
Compliance:	See 1982 Response

* Effective Date Not Known

YEAR 1985

Installation Specifications:	CMP Rev. 6, 7, 8, 9, 10 NEPM 5304.8C Rev. 0*
Installation Procedures:	CMP Rev. 6, 7, 8, 9, 10 EM-163 Rev. 4 NEP 6307 Rev. 0
Inspection Procedures:	EII EC-11 Rev. 6 EII G-2 Rev. 4, 5 EII G-4 Rev. 3, 4 QAP 29 Rev. 4, 1 QCI 107 Rev. 4, 5 QCP 330 Rev. 5
Industry Guides/Standards:	IEEE 336-1980 IEEE 336-1985 IEEE 422-1977 IEEE 690-1984
Regulatory Standards:	Safety Guide 30
Compliance:	See 1982 Response

* Effective Date Not Known

ITEM NO. 25
CONTINUED

YEAR 1986

Installation Specifications:	NEPM 5304.8C 0*, 1, 2
Installation Procedures:	EM-163 Rev. 3, 4 MP/IS 307 Rev. 0 NEP 6307 Rev. 0, 1
Inspection Procedures:	MP/IS 307 Rev. 0 NEP 6307 Rev. 0, 1 QAP 29 Rev. 1, 2 QCI 107 Rev. 5 QCP 330 Rev. 5
Industry Guides/Standards:	IEEE 336-1980 IEEE 422-1977 IEEE 422-1986 IEEE 690-1984
Regulatory Standards:	Safety Guide 30
Compliance:	See 1982 Response

* Effective Date Not Known

YEAR 1987

Installation Specifications:	IS-E-5304.8 Rev. 0 NEPM 5304.8C Rev. 2, 3
Installation Procedures:	EM-163 Rev. 4 MP/IS 307 Rev. 0
Inspection Procedures:	MP/IS 307 Rev. 0 QAP 29 Rev. 2 QCI 107 Rev. 5
Industry Guides/Standards:	IEEE 336-1985 IEEE 422-1986 IEEE 690-1984
Regulatory Standards:	Safety Guide 30
Compliance:	See 1982 Response

CONCLUSIONS

Of the 9000 cables installed 1975-1986, approximately 1080 [12.5%] were installed 1975 through 1981 without issued cable installation specifications, but with the required inspections covered by CIDRs.

The cables installed after 1981 were covered by installation specifications which were adequate to prevent cable damage. Two conclusions are apparent:

1. 87.5 percent of cables installed 1975-86 were installed while adequate installation specifications and procedures existed. 12.5 percent were installed without installation specifications, but with the inspection attributes covered by CIDRs.

2. The cables installed in the 1983, 84, 85 period were covered by adequate installation specifications and procedures.

REFERENCES AND DOCUMENTATION

The following is a list of the cable installation documents referenced in this commentary. Availability of copies at Rancho Seco is also indicated.

Cable installation related specifications and procedures

CMP — Construction Methods and Procedures, Section III Cable Installation

Initial Release dated 06-04-82
Revision 1 dated 07-16-82
Revision 2 dated 07-29-82
Revision 3 dated 01-28-83
Revision 4 dated 04-06-83
Revision 5 dated 04-25-83
Revision 6 dated 11-16-84
Revision 7 dated 03-27-85
Revision 8 dated 05-08-85
Revision 9 dated 05-15-85
Revision 10 dated 08-26-85
Cancellation - dated unavailable
Note: Revisions 1, 2, 3, 5, 6, 8, and 9 were unavailable.

ITEM NO. 25
CONTINUED

EII EC-11 Engineering and Inspection Instruction Manual - Cable Installation During Construction and Major Modification

Revision 0 dated 08-12-81
Revision 1 dated unavailable
Revision 2 dated 01-29-83
Revision 3 dated 04-30-83
Revision 4 dated 03-20-84
Revision 5 dated 06-28-84
Revision 6 dated 11-01-84
Cancellation date unavailable
Note: Revisions 0 through 5 were unavailable.

EII G-2 Engineering and Inspection Instruction Manual - Site Construction Inspector (Generation Engineering Quality Control)

Revision 0 dated 08-12-81
Revision 1 dated 01-29-83
Revision 2 dated 04-25-83
Revision 3 dated 03-28-84
Revision 4 dated 12-03-84
Revision 5 dated 01-07-85
Cancellation date unavailable
Note: Revisions 0 through 4 were unavailable.

EII G-4 Engineering and Inspection Instruction Manual - Process of Construction Inspection Reports

Revision 0 dated 08-12-81
Revision 1 dated unavailable
Revision 2 dated 04-25-83
Revision 3 dated 03-28-84
Revision 4 dated 11-25-85
Cancellation date unavailable
Note: Revisions 0 through 3 were unavailable.

EM-163 Electrical Maintenance - Installation of Permanent Plant Cables

Revision 0 dated 11-19-75
Revision 1 dated never issued
Revision 2 dated 05-31-78
Revision 3 dated 10-06-78
* Revision 3 dated 10-09-80
Revision 4 dated 09-21-84
* Error was made in assigning revision number.

ITEM NO. 25
CONTINUED

IEEE 336 — IEEE Standard Installation, and Testing Requirements For Instrumentation and Electrical Equipment During the Construction of Nuclear Power Generating Stations

Initial issue 1971
Revised 1977
Revised 1980[1]
Revised 1985[2]

[1] Title revised to: IEEE Standard Installation, Inspection, and Testing Requirements for Class 1E Instrumentation and Electrical Equipment at Nuclear Power Generating Stations.

[2] Title revised to: IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities.

IEEE 422 — IEEE Guide For The Design and Installation of Cable Systems in Power Generating Stations

Initial issue 1977
Revised 1986

IEEE 690 — IEEE Standard For The Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations

Initial issue 1984

IS-E-5304.8 — Installation Specification - Rancho Seco Nuclear Generating Station Installation Specification For Electrical Cable Installation and Termination

Initial issue dated 08-28-87

MP/IS 307 — Modification Procedure/Inspection Standard

Revision 0 dated 12-12-86

NEP 6307 — Nuclear Engineering Procedure - Cable Installation

Initial issue dated 12-28-85
Revision 1 dated 10-17-86
Cancelled as of 12-12-86

ITEM NO. 25
CONTINUED

NEPM 5304.8C Nuclear Engineering Procedure Manual - Electrical Cable Installation and Termination

Initial issue dated unavailable
Revision 1 dated 07-03-86
Revision 2 dated 11-06-86
Revision 3 dated 02-18-87
Cancelled as of 08-28-87

QAP-29 Construction Inspection

Revision 1 dated 06-14-78
Revision 2 dated 02-10-81
Revision [illegible] dated 05-18-81
Revision 4 dated 09-01-81
* Revision 1 dated 06-05-85
* Revision 2 dated 01-01-86
Cancelled 07-28-87
* Error was made in assigning revision number.

QCI 107 Quality Control Instruction - Installation Inspection of Electrical Cable, Wire, and Conduit

Initial issued dated unavailable
Revision 1 dated unavailable
Revision 2 dated unavailable
Revision 3 dated 09-30-75
Revision 4 dated 08-04-78
Revision 5 dated 03-12-85
Cancellation date not available
Note: Revisions 0 through 2 were unavailable.

QCP 330 Quality Control Procedure - Conduit and Cable Inspection

Original dated 02-03-82
Revision 1 dated 03-15-82
Revision 2 dated 05-18-82
* Revision 3 dated 02-03-83
Revision 4 dated 04-20-83
Revision 5 dated 01-18-84
Cancelled as of 09-25-86
* Revision 3 changed title to Cable Installation Inspection Procedure.

Safety Guide 30 Quality Assurance Requirements For the Installation, Inspection, and Testing of Instrumentation and Electrical Equipment

Initial issue 08-11-72

ITEM NO. 25
CONTINUED

Evidence of Cable Damage Experienced 1975-1987

NCRs written during the period 1975-1987 were reviewed for evidence of Class 1 cable damage during or after cable installation [see Table 1]. The review did not uncover a consistent pattern of cable damage during the installation process. The results of the review are as follows:

Twenty-three NCRs were written for damage done during or after the cable installation process. Eighteen of the twenty-three described damage that occurred, or most likely occurred, during the installation process [cable pulling and termination]. Eight of the eighteen described damage or potential damage that occurred while cable was being installed in raceway. The eight NCRs involved a total of twenty-five cables, as shown on Table 2.

Only one NCR [NCR S-3178] described a cable that failed in service during the period 1975-1987. The "B" phase of the 5 Kv power cable feeding the "B" nuclear service raw water pump tripped on ground fault on May 18, 1983. The cause was identified as follows: "cable was damaged on initial installation." A temporary repair of the cable was completed on June 21, 1983 and the cable was placed back in service. ECN A-4905 was issued on February 16, 1984 to replace the entire cable, from the switchgear to the pump. During the replacement of the repaired cable on May 21, 1985, the minimum training radius and the maximum allowable sidewall pressure for the new cable was exceeded as documented on NCR S-4726. The new cable was subsequently replaced in accordance with ECN R-0328.

Conclusions

The evidence of NCRs written during the period 1975-1987 does not indicate a generic problem of cable damage during the cable installation process. Only twenty-five, out of approximately 2000 Class 1 cables installed, were identified as being damaged or potentially damaged during installation. Damaged cables were either replaced or repaired.

References and Documentation

Tables 1 and 2 are lists of the NCRs reviewed for this evaluation.

Table 1

SMUD QA CLASS 1, 2, AND 3 CABLE RELATED NCR's
1974 THROUGH 1987

NCR #	QA CLASS	WRITTEN	DESCRIPTION	OCCURENCE	CAUSE
S1789	1	09-13-79	CABLE JACKET EXPANDED AND DISTORTED	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S1442	1	09-28-79	CABLE JACKET EXPANDED AND DISTORTED	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S2007	1	07-10-80	CABLE DAMAGED	BEFORE INSTALLATION	SHIPPING DAMAGE
S2006	1	07-10-80	CABLE DAMAGED	BEFORE INSTALLATION	SHIPPING DAMAGE
S2652	1	04-27-82	CABLE APPARENTLY WEATHER DAMAGED	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S2665	1	05-11-82	CABLE ENDS NOT PROPERLY SEALED	BEFORE INSTALLATION	LACK OF TRAINING
S2869	1	10-20-82	CABLE JACKETS SEVERELY CRACKED	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S5500	1	04-10-86	CABLE JACKET CUT	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S6068	1	11-10-86	CABLE JACKET BLISTERED	BEFORE INSTALLATION	MANUFACTURING PROBLEM
S6091	1	11-25-86	CABLE JACKET PINCHED	BEFORE INSTALLATION	IMPROPER REEL HANDLING
S6174	1	12-09-86	WOODEN REEL ROTTING	BEFORE INSTALLATION	NOT STORED PROPERLY
S6175	1	12-09-86	CABLE JACKET DAMAGED	BEFORE INSTALLATION	IMPROPER REEL HANDLING
S7242	1	11-17-87	CABLE RECEIVED DAMAGED & IRREGULAR	BEFORE INSTALLATION	NOT KNOWN
S1402	1	11-22-78	CABLE JACKET CUT AND TORN	DURING INSTALLATION - REWORK	CONSTRUCTION AND ENGINEERING ERROR
S1403	1	11-22-78	CABLE BROKEN	DURING INSTALLATION	CONSTRUCTION AND ENGINEERING ERROR
S1404	1	11-24-78	CABLE MINIMUM BEND RADIUS EXCEEDED	DURING INSTALLATION	RACEWAY LIMITATION
S1478	1	11-27-79	POSSIBLE EXCESSIVE PULLING TENSION	DURING INSTALLATION	IMPROPER CONSTRUCTION PRACTICES
S1719	1	07-02-84	EXCESSIVE PULLING TENSION	DURING INSTALLATION	N/A (NCR VOIDED)
S1725	1	07-14-84	CABLE JACKET DAMAGED	DURING INSTALLATION	IMPROPPER RIGGING
S1730	1	07-15-84	EXCESSIVE PULLING TENSION USED	DURING INSTALLATION - REWORK	INCORRECT INSTALLATION TECHNIQUE
S1731	1	07-15-84	UNKNOWN PULLING TENSION	DURING INSTALLATION	IMPROPER MEASURING EQUIPMENT USED
S4462	1	07-22-85	CONDUCTOR INSULATION NICKED OR CUT	DURING INSTALLATION	POOR WORKMANSHIP DURING TERMINATION
S4622	1	08-22-85	CABLE MINIMUM BEND RADIUS EXCEEDED	DURING INSTALLATION - CABLE TERMINATION	DRAFTSMAN ERROR
S4675	1	09-02-85	DAMAGED INSULATION OF MOTOR LEADS	DURING INSTALLATION - TERM. KIT REMOVAL	USING A SHARP TOOL TO REMOVE KIT
S4686	1	09-05-85	MULTIPLE LACERATIONS IN CABLE INSULATION	DURING INSTALLATION - TERMINATION REWORK	REMOVAL OF PREVIOUS TERMINATION KIT
S4726	1	09-21-85	SHP AND MINIMUM BEND RADIUS VIOLATED	DURING INSTALLATION	RACEWAY INSTALLATION, IMPROPER TECHNIQUE
S6895	1	11-26-86	MAXIMUM ALLOWABLE TENSION NOT DEFINED	DURING INSTALLATION	N/A (DATA WAS AVAILABLE)
S6226	1	01-07-87	MINIMUM BEND RADIUS VIOLATED	DURING INSTALLATION	NOT ADDRESSED IN SPECIFICATION
S6246	1	01-14-87	MINIMUM TRAINING RADIUS VIOLATED	DURING INSTALLATION	SMALL CONDULET
S6291	1	01-22-87	CABLE MINIMUM TRAINING RADIUS VIOLATED	DURING INSTALLATION - NCR S5921 REWORK	FAILURE TO ASSURE TRAINING RADIUS MET
S6402	1	02-10-87	CABLE FAILED EM-148 TEST	DURING INSTALLATION	POSSIBLY DAMAGED DURING REROUTING
S6424	1	02-11-87	GREASE ON CABLE JACKET	DURING INSTALLATION	GREASE ON CONDUIT REDUCER
S6431	1	02-12-87	MAXIMUM PULL TENSION EXCEEDED	DURING INSTALLATION	USE OF A CHAIN HOIST
S5779	1	02-26-87	CABLE INSULATION CRACKED EXPOSING WIRE	DURING INSTALLATION	WHILE PERFORMING CABLE SPLICE
S6497	1	03-04-87	CABLE JACKET DAMAGED - POWER SUPPLY HEAT	DURING INSTALLATION	POWER SUPPLY OVERHEATED DURING TESTING
S6512	1	03-07-87	CABLE JACKET ABRADED & CUT	DURING INSTALLATION	NOT KNOWN
S6550	1	03-15-87	MINIMUM BEND RADIUS EXCEEDED	DURING INSTALLATION	NOT FOLLOWING VENDOR DRAWING
S6605	1	03-14-87	CABLE MINIMUM TRAINING RADIUS VIOLATED	DURING INSTALLATION	NOT KNOWN
S6708	1	03-30-87	MINIMUM BEND RADIUS VIOLATED	DURING INSTALLATION	RACEWAY INSTALLATION (NCR VOIDED)

Table 1

SMUD QA CLASS 1, 2, AND 3 CABLE RELATED NCR's
1974 THROUGH 1987

NCR #	QA CLASS	WRITTEN	DESCRIPTION	OCCURENCE	CAUSE
S7014	1	09-11-87	MINIMUM TRAINING RADIUS VIOLATED	DURING INSTALLATION	NOT KNOWN
S7172	1	10-02-87	NUMEROUS UNSUPPORTED CABLES	DURING INSTALLATION	NOT KNOWN
S0027	1	09-25-74	CABLE DETERIORATION	AFTER INSTALLATION	WATER DAMAGE
S0042	1	09-28-74	CABLE DETERIORATION	AFTER INSTALLATION	WATER DAMAGE
63178	1	05-20-83	"B" PHASE OF POWER CABLE FAILED	AFTER INSTALLATION	DAMAGED DURING INITIAL INSTALLATION
54694	1	05-09-85	CABLE JACKET CU"	AFTER INSTALLATION	REMOVING EXCESS SILICONE FOAM
55168	1	10-26-85	CABLE SLICED	AFTER INSTALLATION - TRIMMING FOAM	CABLE NOT SECURED PRIOR TO FOAMING
54113	1	12-10-85	CABLE JACKET CUT IN CONDULET	AFTER INSTALLATION	TRIMMING SMOKE & GAS SEAL SILICONE FOAM
55054	1	05-01-86	CABLE JACKET DAMAGED	AFTER INSTALLATION	SOLDERING IN A CONFINED AREA
56146	1	12-11-86	CABLE JACKET INDENTED	AFTER INSTALLATION	CABLE RESTING ON TRAY SIDEWALL
56492	1	01-22-87	CABLE JACKET AND SHIELDING DAMAGE	AFTER INSTALLATION	REMOVING SILICONE FOAM FROM CONDULET
56403	1	02-19-87	CABLE JACKET TORN	AFTER INSTALLATION	CHIPPING FLAMASTIC MATERIAL
56459	1	02-21-87	CABLE JACKET CUT	AFTER INSTALLATION	WOODEN PLANK PLACED ACROSS TRAY
56804	1	07-14-87	JACKET INDENTED, ROPE SUPPORTING CABLE	AFTER INSTALLATION	NO EDGE PROTECTOR
S7210	1	10-09-87	POWER CABLE FAILS 10 KV MEGGER TEST	AFTER INSTALLATION	CUT IN CABLE IN MANHOLE
S0491	1	10-08-81	CABLE JACKET CUT HALFWAY AROUND CABLE	NOT KNOWN	NOT KNOWN
53474	1	09-16-83	HOLE IN CABLE JACKET AND JACKET CUT	NOT KNOWN	NOT KNOWN
53871	1	05-10-84	CABLE SUPPORTED WITH NYLON ROPE	NOT KNOWN	NOT KNOWN (ORIGINAL PLANT INSTALLATION)
54647	1	04-24-85	CABLE JACKET CUT	NOT KNOWN	NOT KNOWN
54561	1	05-14-85	CABLE JACKET TORN	NOT KNOWN	NOT KNOWN (PROBABLY DURING INSTALLATION)
54727	1	05-21-85	CONDUCTOR JACKET CUT	NOT KNOWN	NOT KNOWN
SC178	1	01-21-86	MOTOR LEADS NICKED	NOT KNOWN	INACCESSIBLE WORK AREA
56286	1	01-21-87	CABLE CUT EXPOSING SHIELD	NOT KNOWN	NOT KNOWN
56467	1	02-22-87	CABLE JACKET CUTS	NOT KNOWN	NOT KNOWN
56468	1	02-24-87	CRACKS IN CABLE JACKET	NOT KNOWN	NOT KNOWN
56652	1	04-24-87	CABLE CONDUCTORS ARMORED & NICKED	NOT KNOWN	NOT KNOWN
56654	1	04-25-87	CABLE CONDUCTOR NICKED	NOT KNOWN	NOT KNOWN
56679	1	05-01-87	CONDUCTOR INSULATION HAS NICKS OR CUTS	NOT KNOWN	NOT KNOWN
SC140	1	07-15-87	OUTER JACKET OF COAX CUT	NOT KNOWN	NOT KNOWN
S7032	1	09-02-87	CONDUCTOR INSULATION DAMAGED	NOT KNOWN	RACKING THE BREAKERS IN & OUT
S7104	1	11-01-87	CONDUCTOR INSULATION DAMAGE	NOT KNOWN	LEVEL SWITCH SCREW-ON LID
S6912	1	02-12-87	CABLE MINIMUM BEND RADIUS VIOLATED	N/A - NO VIOLATION	NONE
S1091	2	12-07-78	CABLE KINKED	DURING INSTALLATION	NOT KNOWN
53954	2	07-09-84	OVERPULL LENGTH EXCEEDED ETC.	DURING INSTALLATION	CRITERIA INTERPRETATION
54091	2	09-20-84	EXCESSIVE PULLING TENSION USED	DURING INSTALLATION - REWORK	NOT KNOWN
54416	2	03-07-85	CABLE MINIMUM TRAINING RADIUS NOT KNOWN	DURING INSTALLATION	LARGE DIAMETER CABLE IN SMALL EQUIPMENT
55176	2	07-10-86	UNACCEPTABLE CABLE INSTALLED	DURING INSTALLATION	NO INSPECTION DURING INSTALLATION
56519	2	01-05-87	CABLE "HUNG-UP" IN CONDUIT	DURING INSTALLATION	NOT KNOWN
56511	2	03-26-87	MINIMUM BEND RADIUS VIOLATED	DURING INSTALLATION	RACEWAY INSTALLATION

Table 1

SMUD QA CLASS 1, 2, AND 3 CABLE RELATED NCR's
1974 THROUGH 1987

NCR #	QA CLASS	WRITTEN	DESCRIPTION	OCCURENCE	CAUSE
S6889	2	07-28-87	MINIMUM TRAINING RADIUS VIOLATED	DURING INSTALLATION	NOT KNOWN (NCR VOIDED)
S6890	2	07-28-87	CABLE BEND RADIUS VIOLATIONS	DURING INSTALLATION	NOT KNOWN
S1011	2	11-06-78	CABLE JACKET AND INSULATION CUT	AFTER INSTALLATION	JACKHAMMER
S3544	2	01-03-80	CONDUCTOR INSULATION DAMAGED	AFTER INSTALLATION	PULL ROPE USED TO INSTALL NEW CABLE
S3979	2	07-20-84	CABLE JACKET AND INSULATION CUT	AFTER INSTALLATION - FIRE STOP REWORK	CHIPPING OUT FIRE STOP MATERIAL
S4771	2	06-04-85	GROUND CABLE CUT	AFTER INSTALLATION	CORE DRILLING
S5272	2	01-28-86	CABLES APPEAR CUT	AFTER INSTALLATION	N/A - CABLES ABANDONED
S5474	2	03-31-86	CABLE JACKET CUT	AFTER INSTALLATION	TRIMMING EXCESS SILICONE FOAM
S7118	2	09-22-87	CONDUCTOR INSULATION BURNED	AFTER INSTALLATION	CONTACT WITH HEATER
S7184	2	11-09-87	CONDUCTOR INSULATION CUT	AFTER INSTALLATION	REWORK OF SMOKE & GAS SEAL
S0762	2	07-10-75	CABLE SHIELDS GROUNDED	NOT KNOWN	ASBESTOS JACKET ABSORBING MOISTURE
S1569	2	01-27-80	CABLE SHEATH DAMAGED	NOT KNOWN	POOR WORKMANSHIP
S1676	2	02-19-80	CABLE MINIMUM BEND RADIUS EXCEEDED	NOT KNOWN	CONSTRUCTION ERROR
S1712	2	02-26-80	CABLE JACKET, SHIELD & CONDUCTOR DAMAGED	NOT KNOWN	ABRADED (APPARENTLY BY A ROPE)
S2381	2	03-27-81	CABLE JACKET TORN	NOT KNOWN	NOT KNOWN
S2980	2	10-27-82	CRACK IN CABLE JACKET	NOT KNOWN	NOT KNOWN
S3154	2	05-10-83	INSULATION STRIPPED OFF SIDE OF WIRES	NOT KNOWN	NOT KNOWN
S7674	2	01-30-84	CABLE DAMAGED AND SHORTED TO TRAY	NOT KNOWN	NOT KNOWN
S4164	2	04-24-85	CABLES HAVE NICKS & SCRATCHES	NOT KNOWN	MCC FRAME HAS SHARP EDGES
S2557	2	05-01-86	LIGHTING CONDUCTOR INSULATION DAMAGE	NOT KNOWN	DAMAGED DURING REMOVAL OF EXCESS FOAM
S6220	2	11-16-86	CABLE JACKET TORN	NOT KNOWN	NOT KNOWN
S6479	2	02-25-87	CABLE ARMOR CUT TO INSULATION	NOT KNOWN	NOT KNOWN
S6568	2	03-23-87	CABLE ARMOR CUT	NOT KNOWN	NOT KNOWN
S6577	2	03-27-87	CABLE JACKET DAMAGED	NOT KNOWN	NOT KNOWN
S6788	2	06-18-87	CRACKED CONDUCTOR INSULATION	NOT KNOWN	NOT KNOWN
S6795	2	06-27-87	CABLE JACKET DAMAGED FROM HEAT	NOT KNOWN	FLEX IN CONTACT WITH HOT TANK
S6907	2	07-26-87	CABLE CUT TO CONDUCTOR	NOT KNOWN	NOT KNOWN
S4998	2	08-26-87	CONDUCTOR INSULATION NICKED & SCUFFED	NOT KNOWN	NOT KNOWN
S7025	2	09-01-87	WATER DRIPPING FROM HOLE IN OUTER JACKET	NOT KNOWN	NOT KNOWN
S7191	2	10-07-87	MOTOR LEADS DAMAGED	NOT KNOWN	DUE TO OVER HEATING
S7298	2	10-22-87	CABLE CONDUCTORS DAMAGED	NOT KNOWN	NOT KNOWN
S7312	2	10-26-87	CUTS & MINIMUM TRAINING RADIUS VIOLATED	NOT KNOWN	NOT KNOWN
S0620	3	06-11-86	CABLE SIDEWALL PRESSURE EXCEEDED	DURING INSTALLATION	NOT FOLLOWING PROCEDURES
S1075	3	08-24-79	CABLES CUT	AFTER INSTALLATION	LACK OF COMMUNICATION
S7170	3	10-02-87	CONDUCTOR INSULATION DAMAGED	AFTER INSTALLATION - REMOVING WIRES	NOT KNOWN
S1621	3	01-22-82	CRACKED CONDUCTOR INSULATION	NOT KNOWN	NOT KNOWN

Table 2

DRAD QA CLASS 1 CABLE INSTALLATION NCR's (RACEWAY RELATED)
1975 THROUGH 1986

NCR #	QA CLASS	WRITTEN	DESCRIPTION	OCCURENCE	CAUSE	# OF CABLES
01[illegible]2	1	11-22-78	CABLE JACKET CUT AND TORN	DURING INSTALLATION - REWORK	CONSTRUCTION AND ENGINEERING ERROR	1
51851	1	11-22-78	CABLE BROKEN	DURING INSTALLATION	CONSTRUCTION AND ENGINEERING ERROR	1
51476	1	11-27-79	POSSIBLE EXCESSIVE PULLING TENSION	DURING INSTALLATION	IMPROPER CONSTRUCTION PRACTICES	6
51725	1	07-14-84	CABLE JACKET DAMAGED	DURING INSTALLATION	IMPROPER RIGGING	1
51716	1	07-15-84	EXCESSIVE PULLING TENSION USED	DURING INSTALLATION - REWORK	INCORRECT INSTALLATION TECHNIQUE	5
52737	1	07-15-84	UNKNOWN PULLING TENSION	DURING INSTALLATION	IMPROPER MEASURING EQUIPMENT USED	6
54726	1	05-21-85	SWP AND MINIMUM BEND RADIUS VIOLATED	DURING INSTALLATION	RACEWAY INSTALLATION, IMPROPER TECHNIQUE	5
54561	1	05-14-85	CABLE JACKET TORN	NOT KNOWN	NOT KNOWN (PROBABLY DURING INSTALLATION)	1
						25

Enclosure
To GCA 88-001

ITEM NO. 26

DESCRIPTION Provide description of the events and circumstances leading to the misrouting of cable described in LERs 85-16, 86-10, 87-13 and 87-26.

COMMENTARY

Refer to Root Cause investigations RC 85-24, RC 86-10 and RC 87-09 [Appendix 5].

ITEM NO. 27

DESCRIPTION Provide description of the events and circumstances leading to the discrepancies discovered between the "as-built" cable routes and the routes recorded in CRTS.

COMMENTARY

See Root Cause Report 87-03 Cable Raceway Tracking System.

ITEM NO. 28

Description Provide the bases for acceptability of a 95/95 level of assurance regarding cable routing. [Compared with other accepted homogenous populations]

Commentary

The basis for acceptability of a 95/95 level of assurance regarding cable routing rests on two arguments:

1) Prior use of 95/95 acceptance criteria in Nuclear Power Plant Sampling Applications.

2) Application of 95/95 acceptance criteria to cable routings.

The response concerning prior acceptance of 95/95 is given in the response to CRTS Action Item 19 and is complete. Final inspection results are given in Table 1 at the end of this commentary.

Application Of 95/95 Acceptance Criteria To Cable Routings

The confidence level established by the 95/95 acceptance criteria is the conditional probability that the percentage of major defects in the total population is less than or equal to five percent.

Two populations [Lots 1 and 4] have been given 100% inspections. The acceptance criteria is applied to Lots 2 and 3, both of which have been sampled with the following results:

	Lot 2	Lot 3
Population Size:	1383	176
Sample Size:	91	51
Major Defects:	0	0

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Statistical inferences using the Likelihood Density Function Method are:

	Lot 2	Lot 3
Maximum liklihood estimate of the percentage of improperly routed circuits in the population:	0%	0%
Conclusion:	With 95.0% confidence, it can be asserted that 97.0% or more of the circuits are properly routed.	With 96.0% confidence, it can be asserted that 95.5% or more of the circuits are properly routed.

[Note: "Confidence" is the conditional probability that the population from which the sample was drawn contains no fewer than 'X' percent acceptable items, given the evidence available from the sample.]

Statistical inferences using Acceptance Sampling Methodology are:

	Lot 2	Lot 3
Acceptance Number	1	0
Conclusion:	With 95.0% confidence, it can be asserted that 95.0% of the circuits are properly routed.	With 95.8% confidence, it can be asserted that 94.9% of the circuits are properly routed.

[Note: "Confidence" is the conditional probability of rejecting a lot containing 'X' percent discrepant items, given that a lot of that quality has been submitted.]

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The establishment of Lot 3 separately from Lot 2 was done in an attempt to establish whether the cards with "questionable" signatures constituted a special class with a common problem. With 29.0 percent of Lot 3 inspected, this is clearly not the case, and the "questionable" signatures have no significance. Therefore, Lots 2 and 3 can be examined statistically by combining the total and sampled populations. This gives a population:

LOT 2 + Lot 3

Population Size: 1559
Sample Size: 142

This allows the examination of the statistical inferences for the combined lots. These figures are:

Statistical inferences using the Likelihood Density Function Method are:

Lot 2 + Lot 3

Conclusion: With 95.1% confidence, it can be asserted that 98.1% or more of the circuits are properly routed.

[Note: "Confidence" is the conditional probability that the population from which the sample was drawn contains no fewer than 'X' percent acceptable items, given the evidence available from the sample.]

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Statistical inferences using Acceptance Sampling Methodology are:
[For an acceptance number of zero]

Lot 2 + Lot 3

Conclusion: With 95.1% confidence, it can be asserted that 98.0% of the circuits are properly routed.

[Note: "Confidence" is the conditional probability of rejecting a lot containing 'X' percent discrepant items, given that a lot of that quality has been submitted.]

A reliability level of 98% for the combined population of 1559 would indicate the possibility of 31 or fewer major defects. This possibility has to be evaluated against the evidence produced by the inspections and other sources:

19 major defects were found; 7 in Lot 4 and 12 in Lot 1. These defects fall into 3 incidents as follows:

1. Seven [7] major defects in Lot 4 were all in one incident and are documented in LER 87-13. The seven cables were to have been moved by ECN A-4942 from Fire Area 36 to Fire Area 31, but were left in place. Associated with this incident are the seven additional cables that were to have been rerouted into fire wrapped conduit in Fire Area 17. The cables were identified by LER 86-10 prior to the start of the Sampling Program, and are not counted as major defects. The misrouted cables could have caused a loss of redundancy if a fire had occurred in either Fire Area 17 or 36. The direct cause of the cable misrouting has been identified as personnel error.

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2. Eleven [11] Major Defects were found to have been caused in a second incident in 1981 when a power and control tray was re-tagged as an instrument tray but without the eleven power and control cables being removed. The direct cause appears to be failure by construction to pull back cable as required by design documents.

3. One [1] Major Defect was caused in 1984 when a Class 1 conduit stopped short of a floor blockout, causing the cable installer to complete the last four feet of the route in a Non-Class 1 cable tray.

Evidence - Other Than Inspections

An examination of all sources [such as LERs, ODRs, NCRs] for major defects in Populations 1, 2, 3, and 4 have found no major defects to add to the total of 19 found by the inspections other than the 7 major defects reported in LER 86-10 which are part of the same incident reported in LER 87-13 and discussed as part of incident #1.

The major defects found are therefore limited to the three incidents described. This fact is strong evidence to suggest that there was no systematic breakdown in the design and/or installation process for cables but rather a limited number [3] of specific incidents. This is taken as an indication that the real number of major defects, which would be found by a 100% inspection, is likely to be less than the statistically inferred totals.

Correlation between earlier precedents [established by NRC] for acceptance of 95/95 sampling of safety related components [such as structural steel welds and concrete expansion bolts] is viewed as follows:

Given a possible discrepant [major defect] population of 31, the following must occur coincidentally to impact plant safety.

1) A major defect or defects have to exist in safety related components.

2) The major defect or defects have to involve a loss of redundancy in safety system.

3) An incident or accident has to cause a coincident failure in redundant safety systems.

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The basis of the NRC acceptance of 95/95 sampling for structural steel weld inspections is assumed to be the low probability of coincident weld failure in supports of redundant systems. The following must occur to cause a loss of redundancy:

1. A defective weld must exist in the welded steel supporting a safety system.

2. A defective weld must also exist in the welded steel supporting the redundant safety system.

3. An incident or accident must cause stresses resulting in weld failures in welded supports for redundant safety systems.

4. The failures must be sufficiently severe to impair safety function [in both sets of equipment] below an acceptable level.

The basis of the NRC acceptance of 95/95 sampling for concrete expansion bolts is assumed to be the low probability of coincident failures in redundant safety related equipment. The following must occur to cause a loss of redundancy:

1. Defects must exist in bolts holding down safety related equipment.

2. Defects must also exist in bolts holding down redundant safety related equipment.

3. An incident or accident must cause stresses resulting in bolt failures in both sets of equipment.

4. The failures must be sufficiently severe to impair safety function [in both sets of equipment] below an acceptable level.

For major defects in the cable routes of safety related cables the possibility of coincident failures in redundant safety systems is more complex. The types of major defects identified at Rancho Seco include:

A. Redundant safety cables in the same fire area [14 cables in 1 incident].

B. Lack of acceptable separation between Class 1 cables and Non-Class 1 cables [2 cables in 1 incident].

C. Lack of acceptable separation between Class 1 instrument cables and Class 1 power/control cable [42 cables in 6 incidents].

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A, B, and C defects have been identified in the Rancho Seco cable populations and are considered viable. Possible scenarios which could impact plant safety are:

1. Major Defect A. A fire causing a loss of redundancy.

2. Major Defect B. An electrical overcurrent condition in a Non-Class 1 cable combined with a single failure in an overcurrent device. This could cause a condition in which a cable failure could impact a Class 1 cable [lacking adequate separation] resulting in a loss of safety function.

3. Major Defect C. An electrical transient in a power cable causing a spurious control or indication signal in an instrument cable [lacking adequate separation].

Scenario 1 postulates a single major defect resulting in a loss of redundancy. This would appear to indicate the need to reduce the possibility of major defects to a minimum. However, for a single incident or accident to cause a loss of redundancy the following must occur:

Major Defect A

1. Redundant safety cables must exist in the same fire area.

2. A fire must be initiated.

3. The fire detection/prevention system must fail.

4. The fire must cause a loss of safety function in both IEEE 383 qualified [fire retardant] cables.

5. Neither loss of safety function is to a "fail-safe" condition.

Major Defect B

1. A lack of acceptable separation must exist between a Class 1 cable and a Non-Class 1 cable.

2. A failure must occur in the Non-Class 1 circuit conductor or component.

3. A failure must occur in a Non-Class 1 circuit protective device.

4. The effects of the two failures must be sufficiently severe to cause a failure in an adjacent Class 1 cable.

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5. The Class 1 failure is not to a "fail-safe" condition.

6. A simultaneous failure must occur in a redundant Class 1 circuit.

Major Defect C

1. A lack of separation must exist between a Class 1 instrument cable and a power or control cable.

2. An electrical transient must occur in the power or control cable causing a "spike" [electromagnetic induction] in the instrument cable.

3. The magnitude of the induced "spike" in the Class 1 instrument cable must be sufficient to initiate a spurious action or indication in the instrument circuit.

4. A simultaneous failure must occur in a redundant instrument circuit.

From the evidence and discussions provided it would appear that:

The number of major defects in Lot 2 and Lot 3 cable routes, that would be found by a 100% inspection is likely to be less than thirty-one [31].

The likelihood of major defects in cable routes causing a loss of redundancy in safety systems is not higher than the likelihood for welds and concrete expansion bolts sampled to the same level.

Conclusion

The confidence/reliability levels for Lot 2 and Lot 3 are as stated above. To closely correlate the sample results from three diverse populations appears impractical. However, based on the logic presented in this commentary, the acceptance of 95/95 for sampling homogeneous populations is considered to be equally valid for cable routes as it is for weld inspections and inspections of concrete expansion bolts.

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Table 1

CRTS Circuit Tracing Results

Description	Lot 1		Lot 2	Lot 3	Lot 4	Lot 2 + 3
	H	S				
Population Size	397		1383	176	78	1559
Sample Size	245	152	91	51	78	142
Circuits Traced	245	152	91	51	78	142
Major Defects	11	1	0	0	7	0
Minor Defects	17	21	4	1	2	5
Insignificant or No Defects	217	130	87	50	69	137
Statistical Infer. LDFM	NA	NA	95.0/97.0	96.0/95.5	NA	95.1/98.1
Statistical Infer. ASM*	NA	NA	95.0/95.0	95.8/94.9	NA	95.1/97.9

Total number of circuits traced = 617
[Actual total was 620 but 3 Lot 2 inspections were not credited]

*For an acceptance number of one [Lot 2] or zero [Lot 3 and Lot 2 + 3].

DEFINITION OF LOTS

Lot 1: Safety related and safe shutdown circuits with rerouted vias between commercial operation and December 22, 1986.

Lot 2: Safety related and safe shutdown circuits without rerouted vias between commercial operation and December 22, 1986.

Lot 3: Safety related and safe shutdown circuits without revised vias and questionable cable pull card signatures.

Lot 4: Safety related and safe shutdown circuits with rerouted vias and questionable cable card signatures.

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DESCRIPTION Provide an itemized listing and description of changes in procedures and controls for cable design and installation which have been made in response to the identified cable deficiencies.

COMMENTARY

The changes in procedures and controls made in response to identified cable deficiencies are part of the corrective actions taken by SMUD. To place the changes in context, each identified cable deficiency is discussed [when appropriate] relative to direct and root causes together with a description and detail of each corrective action.

For convenience in considering corrective actions, they are presented in six groups:

1.0 CRTS Procedures and Cable Design Interface.
2.0 CRTS Procedures and Cable Installation Interface.
3.0 CRTS and Engineering Design Problems.
4.0 CRTS and Data Discrepancies.
5.0 CRTS and Documents of Record.
6.0 CRTS and Software Problems.

1.0 CRTS PROCEDURES AND CABLE DESIGN INTERFACE

Report Ref: CRTS Action Items 1 and 2.

Problem: Missing and discrepant CRTS data.

Direct Cause: The direct cause of problems in the CRTS cable design interface area was a lack of CRTS use procedures.

Root Cause: The root cause of the CRTS problems is that neither Nuclear Engineering management nor the CRTS supervisor were adequately involved in the CRTS. [Root Cause 87-03, Appendix 5.]

Corrective Actions: For a detailed review of corrective actions against root cause evaluations, see CRTS Action Item 30.

Immediate Corrective Actions - Pre Restart

1.1 A procedure [NEAP 4127, Rev. 0, "Cable and Raceway Tracking System"] was issued on June 15, 1987 and controls the method by which proposed changes to the CRTS data base are submitted, approved and incorporated.

1.2 As described in the commentary to CRTS Action Item 6, a NED instruction given on May 1, 1987, and effective on June 15, 1987, requires all CRTS input documents/forms to be handled as Drawing Change Notices [Reference EEGS 87-005, from E. J. Gough to the Electrical Engineering Staff, dated May 1, 1987]. This corrected a practice in which new forms were issued for all changes.

Future Corrective Actions - Pre or Post Restart

1.3 A full time CRTS Administrator [contract employee] has been in place since April 2, 1986 and is responsible for implementation of NEAP 4127. A CRTS Coordinator [Section 4.7 of NEAP 4127] receives and inputs data. SMUD Personnel Department has been advertising for a CRTS Group Leader since June 22, 1987. The Group Leader hired by SMUD will replace the CRTS Administrator after a suitable overlap. The CRTS organization chart [Figure (1)] is shown at the end of this section together with the organization chart for the NED Electrical section [Figure (2)].

2.0 CRTS PROCEDURES AND CABLE INSTALLATION INTERFACE

Report Ref: CRTS Action Items 1, 2, 11, 13 and 23.

Direct Cause: The direct cause of problems in the CRTS/cable installation interface was a lack of CRTS use procedures.

Root Cause: The root cause was a failure to have and/or use procedures for cable design, installation, inspection, and repulling [Root Cause 87-09, Appendix 5].

For a detailed review of corrective actions against root cause evaluations, see CRTS Action Item 30.

Common CRTS problems with past installation practice and corrective actions are as follows:

2.1 Problem: Installation cards not returned to CRTS.

Corrective Action: NEAP 4127 requires cards to be returned to the CRTS Coordinator and held until the ECN is closed. The ECN cannot be closed until cards are returned to CRTS and the data accepted by the CRTS Coordinator.

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2.2 Problem: "As-Built" corrections not reported on cards returned to CRTS Coordinator.

Corrective Action: NEAP 4127 requires Field Problem Reports to be generated if the design cannot be implemented as shown on the design drawings. Only "installed length" dimensions can be noted on the CRTS card; the practice of allowing field engineers to solve design problems and then to note the "as built" changes on the CRTS card is not permitted.

Each related MP/IS [Modification Procedure/Installation Specification] has been revised to reflect the CRTS card handling procedures mandated by NEAP 4127. The revision to the procedures were effective December 22, 1987.

2.3 Problem: MP/IS 307 did not clearly specify that the inspection of a cable routing is a "hold point" or define that verification of routing requires the installation to be witnessed.

Corrective Action: PCN #4 [dated 07-01-87] to MP/IS 307, Rev. 0, makes the route inspection a "hold point" and requires the installation to be witnessed.

2.4 Problem: Rancho Seco has approximately 2500 Appendix R cables [2200 Class 1 and 300 Class 2/3] listed. The list is a "living" document which is revised on a periodic basis as ECNs are closed. The problem has been that no procedural requirement has existed to require QC inspection of Class 2 or 3 Appendix "R" cable routes.

Corrective Actions:

Immediate Corrective Actions -- Pre Restart

2.4.1 Since May 1, 1987 the Quality Department has been reviewing all Work Requests against a list of 300 Class 2/3 cables. All Appendix R cables have their routes insnected and a "hold point" is indicated on the cable pull card.

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2.4.2 As of October 1, 1987 the NED Electrical Engineering physical design group has been identifying all proposed Appendix "R" circuitry via field note on the E-1010 DCNs. [Reference Memo EEGS 87-040, dated September 21, 1987.]

2.4.3 NEAP 4119 [Nuclear Engineering Fire Protection Program Control] has been revised, effective November 11, 1987, to require identification of the Appendix R circuits on the CRTS cable input document [Form E-1010].

2.4.4 As part of the review of procedures associated with the resolution to CRTS Action Item 25, the Quality Assurance Procedures [QAPs] and the Modification Procedures/Inspection Instructions [MP/ISs] associated with cable installation and inspection will be revised to include the requirement to inspect the Class 2 and 3 Appendix R cables to the same requirements as for Class 1 cable installations. The appropriate QAPs and MP/ISs will be revised prior to restart.

Future Corrective Actions -- Post Restart

2.4.5 CRTS software enhancement to create a field in the electrical circuit schedule, as well as the cable cards, to indicate the service level of the cable ["P", "C" or "I"] and to identify the Appendix "R" cables ["R"] will be completed prior to the end of the Cycle 8 outage [see commentary to CRTS Action Item 10]. In addition, the E-1010 form will be revised to allow the above information to be input into the CRTS database.

2.5 Problem: Incomplete security cable and communication cable documentation in CRTS.

Corrective Action: A scoping statement was added to Nuclear Engineering Procedure NEP 4109 "Configuration Control," that requires that all permanent changes to the physical or functional characteristics of Rancho Seco be reviewed and controlled by Nuclear Engineering via the ECN process. This change appears in Revision 7 to NEP 4109, dated July 29, 1987.

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3.0 CRTS AND ENGINEERING DESIGN PROBLEMS

3.1 POWER AND/OR CONTROL CABLE MIXING WITH INSTRUMENT CABLES

Report Ref: CRTS Action Items 9 and 17.

Direct Cause: The direct causes are either:

1. Construction error [ODRs 87-109, 87-723, 87-735, NCR S-5968]

or

2. Design error. [NCRs S-5263, S-6523, S-6561, S-6562, S-6563, S-6564, S-6566, S-6999]

Root Cause: Root cause of intermixing was the failure to have and/or use procedures for cable design, installation, inspection and repulling. [Root Cause 87-09, Appendix 5.]

For a detailed review of corrective actions against root cause evaluations, see CRTS Action Item 30.

Corrective Actions:

Immediate Corrective Actions -- Pre Restart

3.1.1 Issue NED clarification of the physical separation requirements for power, control and instrument [P, C and I] cables. This clarification is included in the commentaries to CRTS Action Items 9 and 17 and covers changes to both NED Design Guides and USAR. No revision is required to the installation specification for cable [IS-E-5304.8] because separation of cables by service level [P, C or I] is defined in the design drawings and not in IS-E-5304.8.

3.1.2 Issue NED direction requiring the identification of all cables on CRTS input documents [Form 1010] as "P" [Power], "C" [Control] or "I" [Instrumentation]. A memo [EEGS 87-006] from E. J. Gough to the Electrical Engineering Staff, dated May 4, 1987, was issued directing the following:

"Effective immediately, each new cable scheme number shall have its service level [power, control and instrumentation (analog or digital)] shown on E-1010s."

3.1.3 Revise NEPM 5204.22 and NEPM 5204.4 to define required separation between power, control and instrument cables in raceways and manholes (PCNs issued on both, dated July 27, 1987).

Future Corrective Actions [Before end of Cycle 8 outage]

3.1.4 CRTS software will be enhanced to screen raceways for service level mixing [P and/or C with I] and block proposed changes which violate Design Criteria.

3.2 CABLE TRAY FILL AND WEIGHT CONCERNS

Report Ref: CRTS Action Items 6 and 8.

Direct Cause: Inadequate procedural guidance.

Root Cause: The root cause of the overweight cable tray problem is the failure to ensure adequate implementation of USAR requirements. [Root Cause 87-05, Appendix 5]

For detailed review of corrective actions against root cause evaluations, see CRTS Action Item 30.

Corrective Actions:

Immediate Corrective Actions -- Pre Restart

3.2.1 All cable tray weights have been calculated regardless of percent fill. This process was again repeated prior to restart, on December 28, 1987, as described in the commentary to CRTS Action Item 2.

3.2.2 NEAP 4127 is issued and governs the CRTS process. Step 5.2.4 requires proposed changes, which violate design limits, to be returned to the originator, as follows:

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"5.2.4 After entry, an error report is generated to ensure that the proposed changes are feasible and do not violate design limits. If the report indicates design errors, the CRTS coordinator notifies the originator. The originator resolves the problems and provides corrected DCNs to the CRTS coordinator."

The design limits imposed by the CRTS program are process controls at this time. CRTS staff are directed to return all DCNs to Engineering when the addition of cables to trays:

- Increases power and control tray fills above 40%.
- Increases instrument tray fills above 50%.

The power and control trays are given a 50.59 review for weight and ampacity limits. Instrument trays are reviewed for weight only. Checked cable trays which exceed limits are redesigned and resubmitted. Checked cable trays which meet design limits are resubmitted to CRTS after the 50.59 review. The weight and dimensional data for the approximately 450 cable codes will be validated against available manufacturers data or validated against a sample or model.

3.2.3 The lack of 50.59 reviews for design work done in 1975-1986 will be resolved through the NCR process with a forecast completion date of January 8, 1988.

Future Corrective Actions [Before end of Cycle 8 Outage]

3.2.4 USAR wording will be revised and clarified as described in the commentary to CRTS Action Item 17.

3.2.5 Following completion of the completeness checks on CRTS content [CRTS Action Items 10, 11, 12, 13 and 14], the impact of any added cables will be reviewed. In addition, the impact of weight contributions from various sources such as cable tray covers and protective fire wraps will be checked against design limits.

3.2.6 CRTS software will be enhanced to automatically block cable additions which exceed design limits. In addition to calculating percentage fill, CRTS will calculate weight per cable tray section. Design changes which exceed the minimum 50 pounds per linear foot limit will not be accepted without a 50.59 review.

4.0 CRTS AND DATA DISCREPANCIES

Report Ref: CRTS Action Item 2

Direct Cause: Inadequate procedural guidance.

Root Cause: The root cause of the problems related to the CRTS and its use is that neither Nuclear Engineering management nor the CRTS Supervisor were adequately involved in the CRTS.

Corrective Actions:

The large number of data discrepancies concerning the Rancho Seco Cable Raceway Tracking Syster originate from a number of sources. Many of these problems have occurred because of a lack of procedural guidance, such as the intermixing of power, control and instrumentation cables, the overfilling of raceways and the misrouting of cables and are discussed elsewhere in this commentary, as well as in separate commentaries within this report. It is important to note that no physical cable problems nor CRTS data discrepancies have been caused by the CRTS program itself, but have all been caused by sources external to the CRTS program, and as described in Section 6.0, the software problems affect solely the ability to generate the various CRTS reports and have not affected the accuracy of the CRTS database, nor has data been lost.

An additional source of potential data discrepancies that must be examined would be the possibility of data discrepancies occurring during the inputting of data into the CRTS database. This question was raised with the CRTS staff and it has been determined that an insignificant number of data discrepancies can be attributed to this source, for the following reasons:

1) The CRTS software performs checking of input data. Errant data such as non-existent cable codes or non-existent raceways [in cable routes] cannot be entered since the self-checking mechanisms in the CRTS program would block such errors.

2) A hardcopy is made of all newly entered data and is checked by the CRTS staff to ensure that the data has been input correctly. In addition, upon ECN closure, when the "proposed" data is changed to "as-built" data, the yellow DCNs to the CRTS related drawings are checked against the data base to verify the accuracy of the database.

3) The Card Control Group, upon receipt of the CRTS generated cards, compares the data on the cards against the DCNs to the applicable CRTS-related drawings (E-1008 and E-1010) to ensure that the data was input correctly into the database.

Individually, each of the above three methods does not provide complete assurance against data input errors, however, together the three methods provide an interlocking mechanism to screen out data input errors to the CRTS database. Of the approximately 8000 total CRTS database discrepancies listed in the Action Plan [Appendix (2)], approximately 2500 are document discrepancies. Of the 2500 document discrepancies, none are as a result of a mismatch between the CRTS-related drawings and the CRTS data base itself

As a result of corrective actions for other CRTS related problems, an increased emphasis has been placed on formalizing the methods by which the CRTS staff performs its work, as well as how the CRTS staff interfaces with the other plant groups, such as the Card Control Group and the Records Information Center. This is being done by a CRTS office procedure, as well as a flow chart [Figure (3)] delineating the CRTS staff interfaces with the Card Control Group and the Records Information Center. Forecast completion for proceduralizing the activities of the CRTS staff is prior to the end of the Cycle 8 outage.

5.0 CRTS AND DOCUMENTS OF RECORD

Report Ref: CRTS Action Items 3 and 22.

Problem: The documents of record [CRTS cards] for cable and raceway installed at Rancho Seco are incomplete.

CRTS input documents [Form 1010, etc.] were not being controlled as Drawing Change Notices.

Direct Cause: Lack of CRTS use procedures.

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Root Cause: The root cause of the problems related to the CRTS and its use is that neither Nuclear Engineering management nor the CRTS Supervisor were adequately involved in the CRTS.

Corrective Actions: Corrective Actions for both Installation Verification Records and Engineering Design Records are as follows:

Installation Verification Records

The installation verification records for installed cable and raceway at Rancho Seco are the signed cable "pull cards" and "raceway installation" cards, respectively. The original cards for the 14,000 cables and 13,000 raceways installed during the construction of Rancho Seco have not been found. Facsimile copies exist as attachments to the Construction Inspection Data Reports (CIDRs), and require sorting and filing to verify completeness. This activity will be performed prior to the end of the Cycle 8 outage.

Presently, after the signed, completed CRTS generated cards are returned to the CRTS group, the cards are microfilmed by the Records Information Center, to be part of the permanent plant microfilm record. The cards are then returned to the CRTS group for storage in the Bechtel Building vault, which is a secure, locked room with cement walls and a Halon fire protection system.

As described in the commentary to CRTS Action Item 3, not all CRTS generated cards have been located. Corrective action is to generate replacement cards, to be checked against the design documents. Checked cards will be stamped "Replacement Card" and will then be signed by the checker. This activity will be completed for Class 1 and Appendix "R" pull cards before restart and for all other cards before the end of the Cycle 8 outage. In addition, NEAP 4127 was issued in June, 1987 and is considered adequate to control the CRTS generated cards in the future; see also Section 2.0 of this commentary.

Engineering Design Record

NEAP 4127, "Cable and Raceway Tracking System," defines the CRTS-related drawings as follows:

E-1008 Shows raceway sections, including attributes and connections.

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E-1010 Shows cables, including termination, cable code, conductors, and vias as applicable.

E-1026 Adds, deletes or modifies a raceway code.

E-1027 Adds, deletes or modifies a cable code.

E-1028 Adds, deletes or modifies an equipment number.

In January 1987, ODR 87-66 and NCR S-6278 document that the E-1010 drawings were not being processed in accordance with Nuclear Engineering Procedures. As corrective action, a memo [EEGS 87-005] from E. J. Gough to the Electrical Engineering Staff, dated May 1, 1987, was issued to require that the CRTS-related drawings be issued and revised per NEP 4103 and NEP 4112, respectively.

6.0 CRTS AND SOFTWARE PROBLEMS

Report Ref: CRTS Action Item 10.

Problem: The CRTS software has 41 identified bugs.

Direct Cause: The direct cause of CRTS software bugs is the lack of verification of the CDC software.

Root Cause: A root cause investigation is not required. The direct cause is considered definitive.

Corrective Actions:

Immediate Actions -- Pre Restart

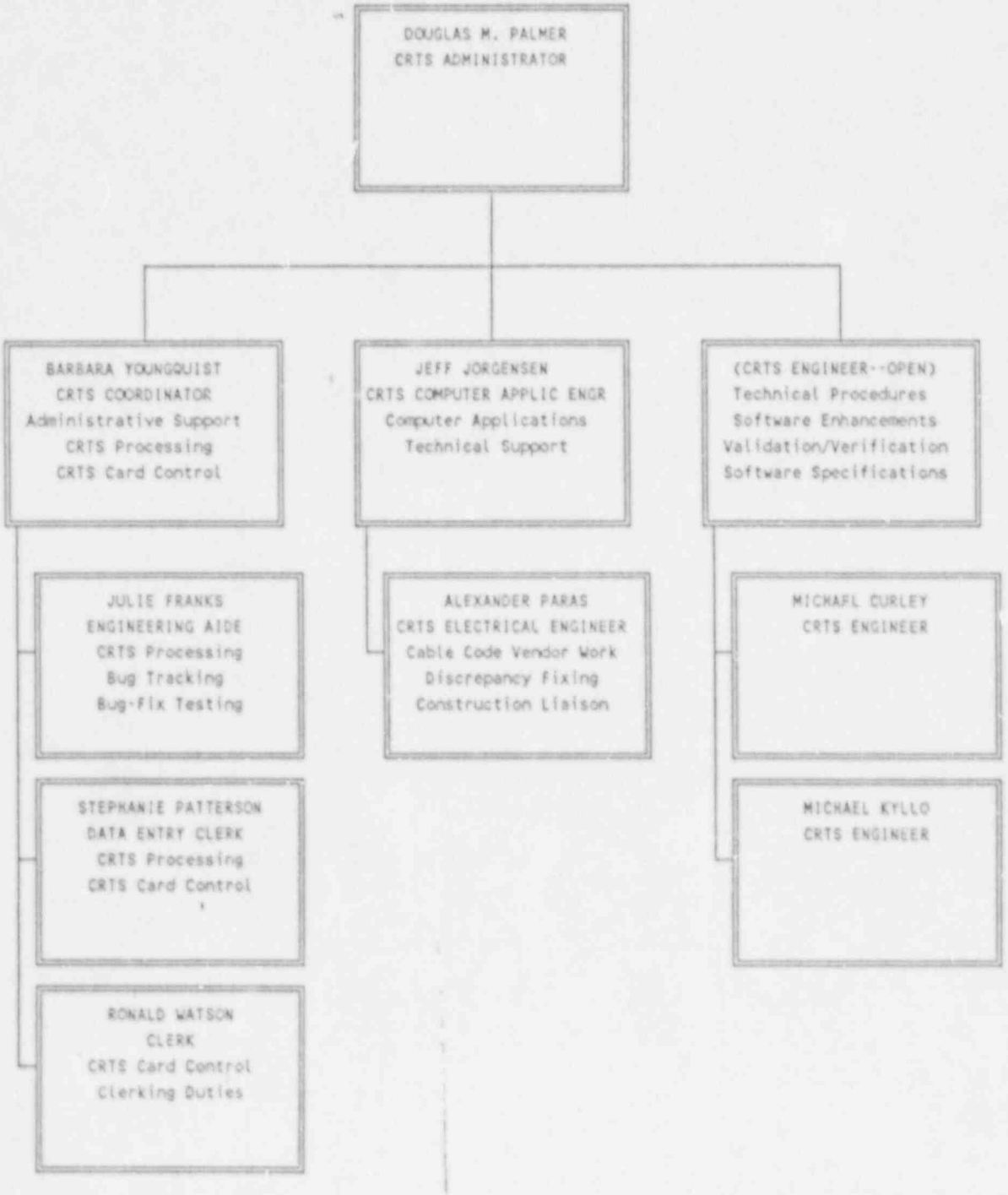
Four personnel have been added to correct software problems. A computer data base has been established to track the forty-one identified bugs to resolution. All bugs which impact restart commitments will be identified and corrected prior to restart.

Future -- Post Restart

SMUD (IMS) is preparing a schedule and budget for providing upgraded CRTS software, including verification. The schedule will show the upgraded software verified and in place before the conclusion of the Cycle 8 outage.

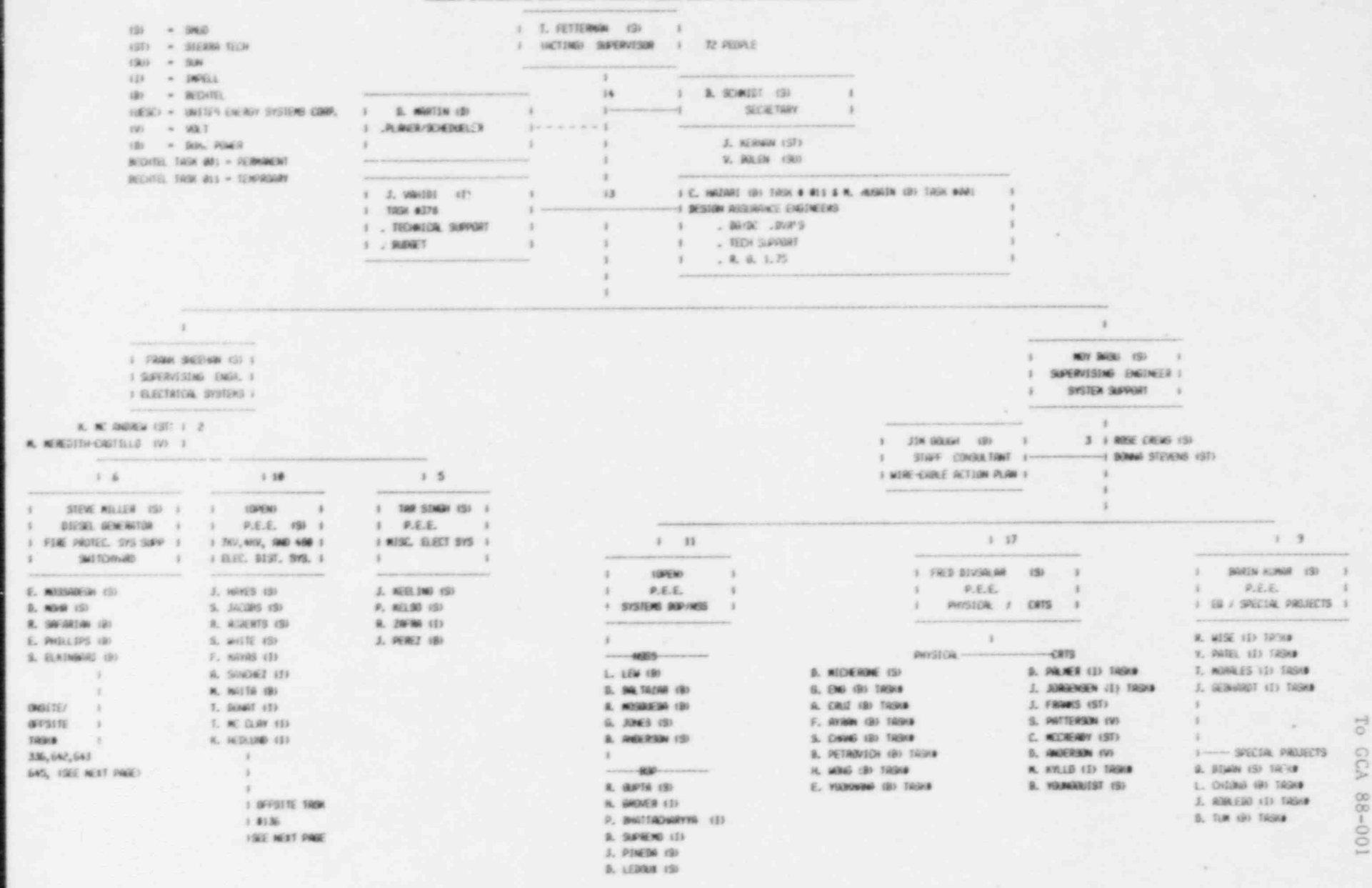
RANCHO SECO NUCLEAR GENERATING STATION
CABLE RACEWAY TRACKING SYSTEM (CRTS)
ORGANIZATION CHART

Enclosure
To GCA 88-001



Effective Date: 09-23-87
Revision Date: 09-28-87
Computer File: CRTS.001

Figure 1



Enclosure
To CCA 88-001

Figure 2
-102-

9 - 9 - 87

CARD FLOW CHART

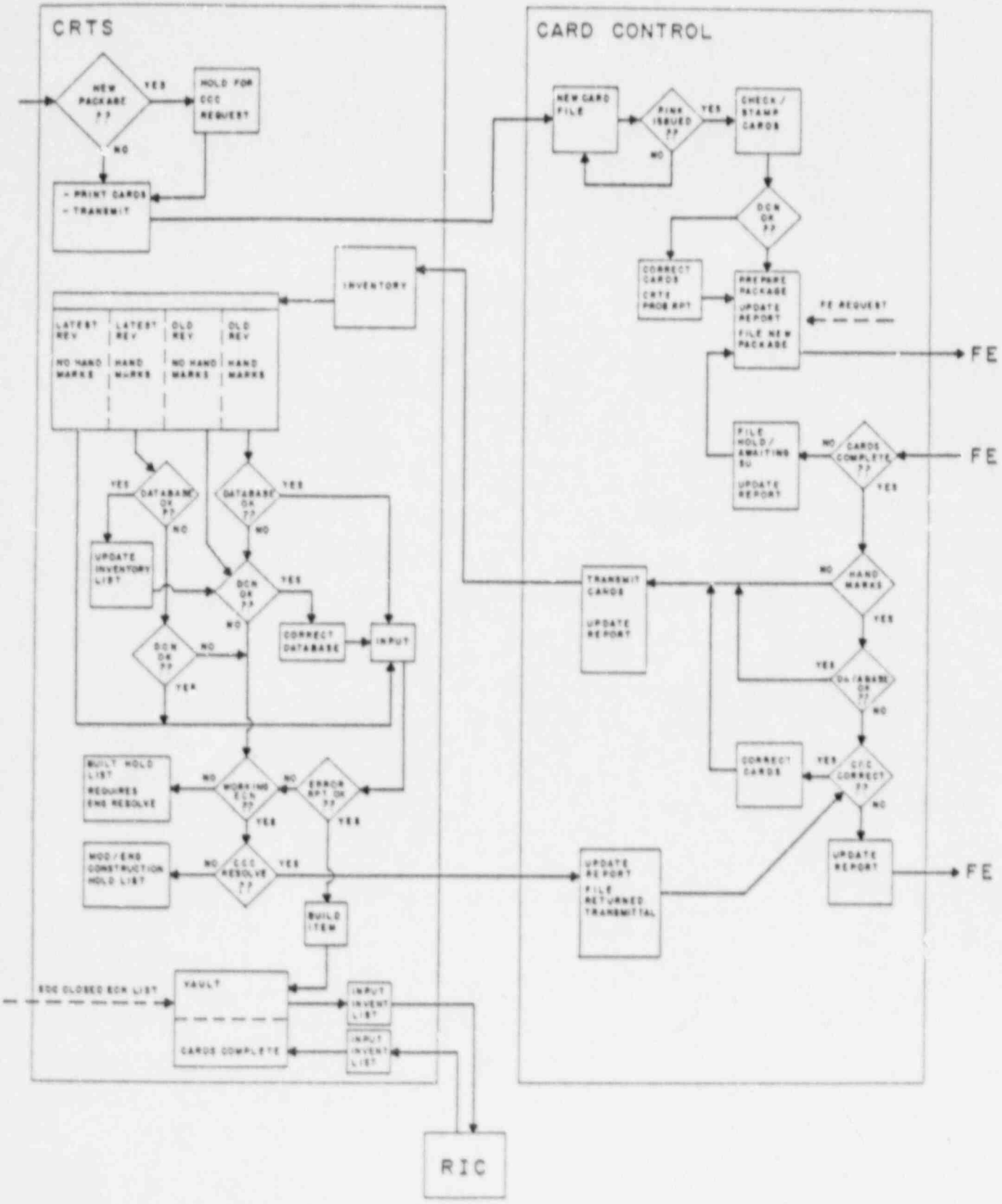


Figure 3

ITEM NO. 30

DESCRIPTION Review of corrective actions against root cause evaluations.

COMMENTARY

A table summarizing direct and root causes is included at the end of this commentary. A detailed review of recommendations contained in each root cause is given in the commentary.

ROOT CAUSE 86-10

Redundant cabling in the same fire area [LER 86-10].

SUMMARY

The direct cause of the failure to reroute the cables is personnel error. Although the construction field engineer was aware of the routing revisions, he did not initiate the field installation of the "C" revision of the cable routing.

The underlying cause is that the Card Control Group [CCG] did not follow Engineering and Inspection Instruction [EII] EC-10 "Processing of Installation Cards."

A contributing cause of this event was Quality Assurance's failure to perform adequate inspections of cable installations.

The root cause is the failure of the Card Control Group cognizant engineer to implement adequate managerial controls. He did not require the use of adequate and formal procedures for the processing of installation cards by the CCG.

Recommendations	Corrective Actions
1.-4. 7. 8. 16. 17. Issue a procedure(s) which establishes instructions for the processing of cable installation cards.	CRTS card control is described in Attachment 1 to NEAP 4127, Rev. 0. Attachment 1 is a CRTS flowchart which illustrates the process from ECN issue to the filing of the CRTS cards following ECN closure.

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Recommendations		Corrective Actions
		A more detailed card handling process is provided in a card flowchart included as part of CRTS Action Item 29 commentary. This flowchart illustrates the decision-making process used by the Card Control Group [see organization chart for CRTS also included with the Item 29 commentary] in handling cards. The Card Flowchart illustrates the work process in place at this time. A written document, to proceduralize the process shown on the Card Flowchart, is being prepared as an Electrical Engineering Instruction [EEI]. The forecast issue date is January 18, 1988.
5.	After the procedure in recommendation number 1 is issued, train the Card Control Group [CCG] personnel on the procedure.	Following issuance of the Card Control EEI, formal training will be conducted for personnel who are either in the Card Control Group or who handle CRTS cards in the interfacing groups [Modifications, Maintenance, Quality Control, etc.] This training will be conducted for new personnel entering these groups in an ongoing process. Training will be conducted under the auspices of the Nuclear Engineering Dept. [NED] with classroom training and with records maintained in both NED files and by the Nuclear Training Group.
9.	Establish a SMUD signature transcription policy.	SMUD Support Services-Records Management Group [RMG] has established policies and practices concerning records management. These policies and practices are defined in a Rancho Seco Administration Manual [RSAP]. RSAP-0601 "Nuclear Records Management" does not permit the transcription of signatures. Section 5.2.9 "Replacing a Lost, Damaged or Contaminated Document" governs the process by which lost or damaged records are replaced.

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	Recommendations	Corrective Actions
9.	(Continued)	"Recreated" originals are allowed for information [data] documents but control measures are imposed on other records which require assessments and evidence to support restored records. RMG has no plans to establish a SMUD signature transcription policy. Transcribing signatures without compliance with RSAP-0601 would be a violation of SMUD administration policy.
11. 12-17.	Evaluate the cable inspection requirements as stated in MP/IS-307 to ensure that the following are adequately addressed: a. Cable pulls are inspected before the cable is terminated as required by the USAR. b. Cables are verified to be routed in accordance with the latest design drawings. c. Clear guidelines exist for the inspection of pulled back and repulled cable.	MP/IS-307 will be evaluated against the findings of the CRTS Action Item 25. "Document a thorough engineering evaluation of the procedures and specifications used to install cable in the period 1976 - 1986." The scheduled issue date for the revised MP/IS-307 was December 11, 1987. However, no changes are required; MP/IS 307 is acceptable "as-is."
6.	Route the cables described in LER 86-10 and LER 87-13 in accordance with the applicable design drawings [completed].	LER 86-10: The cable rerouting for cables identified in LER 86-10 was performed under ECN R-0765 and is construction complete. LER 87-13: The cable rerouting for cables identified in LER 87-13 was performed under Work Request 128636 and is construction complete.

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ROOT CAUSE 87-03

Cable Raceway Tracking System.

SUMMARY

The root cause of the problems related to the CRTS and its use is that neither Nuclear Engineering management nor the CRTS supervisor were adequately involved in the CRTS.

	Recommendations	Corrective Actions
1.	None, NEAP-4127 "Cable and Raceway Tracking System" was issued on June 15, 1987.	Complete
2.	Revise procedure NEP-4109 "Configuration Control" to address the CRTS review of DCNs.	Procedure NEAP 4127, Revision 0 was issued on June 15, 1987, and includes in Section 5.2 the procedure by which DCNs to the CRTS-related drawings [E-1008, E-1010, E-1026, E-1027 and E-1028] are initiated, reviewed and approved. Sections 5.2.2 through 5.2.5 specifically address the CRTS review of the DCNs to the CRTS-related drawings, and no further procedural revision is required.
3.	Review and approve for use a CRTS User's Guide.	An uncontrolled CRTS User's Guide is currently in use by the CRTS Card Control Group (CCG). This document will be superseded by two guides: o Card Control Group CRTS User's Guide o Design Group CRTS User's Guide The former will be the definitive document of the two, and will be used by CCG. The latter will be used by engineers and designers performing physical design work. Both documents are scheduled for issue on January 18, 1988.

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Recommendations		Corrective Actions
4.8	Verify and validate CRTS software.	The corrective actions are described in the commentary to CRTS Action Item 10.
5.9	Develop and implement a schedule to correct all known CRTS deficiencies.	The commentary to CRTS Action Item 2 contains the general commitment that: 1. All safety-related discrepancies will be dispositioned, with documentation, prior to restart. 2. All non-safety-related discrepancies will be dispositioned, with documentation, prior to the end of the Cycle 8 outage. Attachments 1, 2 and 3 of the Wire and Cable Program Report provide an index to CRTS action items, CRTS ODRs, and CRTS NCRs which track all discrepancies and their dispositions.
6.	Include the CRTS system in the Quality Assurance program.	NEAP 4127 was issued on June 15, 1987. NEAPs are controlled by the Rancho Seco Quality Assurance program. This item is complete.
7.	Establish the design basis for the uses of the CRTS system.	A CRTS System Design Basis Document will be written as part of the NED/Electrical Discipline program to furnish design basis documents defining the criteria for and the scope and function of all electrical systems. The CRTS System Design Basis Document is scheduled for issue prior to the end of the Cycle 8 outage.

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ROOT CAUSE 87-05

Overweight cable trays [LER 87-24].

SUMMARY

The direct cause of the overweight cable tray problem is inadequate procedural guidance.

The root cause of the overweight cable tray problem is the failure to ensure adequate procedural implementation of USAR requirements.

	Recommendations	Corrective Actions
1.	Perform 10 CFR 50.59 Safety Analysis Reviews for the redundant [SFAS and RPS] Class 1E cable trays that exceed the USAR fill limit of 40%.	The 50.59 reviews will be performed via the NCR process, with a forecast completion date of January 8, 1988.
2.	Provide calculations to verify the cable tray loading for all overfilled cable trays.	The corrective actions for overfilled cable trays are contained in the commentaries to CRTS Action Items 6 and 8. An additional commitment to check all tray weights [regardless of fill level] prior to restart is contained in the commentary to CRTS Action Item 2. This recheck was performed on December 28, 1987, as described in the commentary to CRTS Action Item 2.
4.	Proceduralize the approval cycle required to exceed the fill limits on cable trays.	CRTS error reports indicating tray overfill conditions cause the DCNs to be returned to the originator for resolution. This is described in the commentary to CRTS Action Item 8. This review process is being proceduralized in an EEI [Electrical Engineering Instruction] scheduled for issue in June 1988.
5.	Resolve the discrepancy between procedure NEP 5204.22 and the USAR.	The USAR revision to provide reconciliation between USAR Section 8.2.2.11.H.9 and NEP 5204.22 is described in Section 6 of the commentary to CRTS Action Item 17.

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Recommendations	Corrective Actions
6. Evaluate adding a subroutine to the CRTS to calculate cable tray weights.	The commentary to CRTS Action Item 10 includes a list of software enhancements. Enhancement N3 will provide a weight calculation for all cable trays regardless of fill level.

ROOT CAUSE 87-09

Unacceptable intermixing of power/control and instrumentation cables [LER 87-26].

SUMMARY

Cable Tray A28AA3 and A28AB3

Direct Cause: Construction error.

Underlying Cause: Construction personnel failure to follow Procedure EC-10.

Contributing Cause: Failure of QC to detect construction error.

Cable Tray A28AN3

Direct Cause: Design error.

Contributing Cause: Lack of a comprehensive service level designator.

Cable Tray A28AA1

Direct Cause: Either a design error or a construction error during construction of the plant.

Contributing Cause: Lack of a comprehensive service level designator.

Routing RPS/SFAS Cables in Tray Rather than Conduit

Direct Cause: Original design error.

Underlying Cause: Lack of training.

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Cables Associated with DHS X-Tie Flow Transmitters

Direct Cause: Design error.

Underlying Cause: Lack of training.

Cables Associated with RCS Flow Transmitters

Direct Cause: Original Design error.

Underlying Cause: Lack of training.

ROOT CAUSE (Overall)

Failure to have and/or use procedures for cable design, installation, inspection, and repulling.

	Recommendations	Corrective Actions
(1)	Revise electrical design procedures to include USAR requirements.	The USAR text is being revised as described in CRTS Action Item Commentary 17. Corresponding revisions to Design Documents NEPM 5204.22 and NEPM 5204.43 were issued on October 5, 1987. Refer to CRTS Action Item Commentary 9 for details.
(2)	Require the witnessing of cable pulls by electrical QC inspectors. [Completed]	Complete. PCN #4 [07-01-87] revised MP/IS 307. See commentary to CRTS Action Item 29 [Section 2.3].
(3)	Evaluate the training given to District supervisors to ensure that they are fully cognizant of their areas of responsibilities.	Supervisors attend numerous training programs provided by SMUD to improve their management skills. There is no formal training on their specific areas of responsibilities. Informal training is provided by the supervisor's respective manager.
(4)	Assure that all QC inspectors receive training on District procedures. [Completed]	Complete.

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	Recommendations	Corrective Actions
(5)	Provide a service level designator for all electrical cables.	Since July 1987, cable input documents are marked "P" [Power], "C" [Control] or "I" [Instrumentation]. Software enhancements are also planned. See CRTS Action Item Commentaries 9 and 10 for details.
(6)	Provide the necessary CRTS software for the verification that intermixing conditions do not exist.	Refer to the commentary to CRTS Action Item 10.
(7)	Evaluate the necessity for a CRTS generated repull card.	Per MP/IS 307, cable installation is performed using both the E-1010 series drawing and the CRTS generated card. Repulls are presently indicated on the E-1010 series drawing via field note. The recommendation to generate a unique CRTS repull card will also be included in the list of CRTS enhancements in the commentary to CRTS Action Item 10.
(8)	Issue procedures for the use of the CRTS. [Completed]	Complete. NEAP 4127 was issued June 15, 1987.
(9) (11) (15)	Establish the design basis for the uses of the CRTS system [RC 87-03, recommendation 7].	See response to RC 87-03 recommendation 7.
(10)	Revise/issue procedures for cable installation to address the pull back and rerouting of cable in revised routings. [RC 86-10, recommendation 11.c]	See response to RC 86-10 recommendation 11.c
(12)	Evaluate the training given to entry level engineers to assure that they receive training on their assigned functions.	New engineers attend an orientation and indoctrination course where specific Licensing Basis Documents [LBD] and pertinent job related references are discussed. System training is also provided and is geared to the job responsibilities of the individual employee.

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	Recommendations	Corrective Actions
(14)	Issue a procedure for the processing of installation cards. [RC 86-10, recommendation 1].	See response to RC 86-10 recommendation 1.
(16)	Ensure that all engineers, including contractors, receive training on USAR requirements for their job function.	All engineers are trained [with documentation] by reading selected NED and project administrative procedures as assigned by the NED Training Coordinator. Additionally, selected SMUD and contract personnel are trained to Rancho Seco LBDs as applicable to 10 CFR 50.59 reviews.

ROOT CAUSE 87-02

Pulled cables stored in safety-related breaker cubicles [LER 87-16].

SUMMARY

The direct cause of the coiled cables being left in all the cabinets, other than A405 and A409, was a planning error: the cable terminations should have been scheduled to occur immediately following the cable pull, but were not.

The direct cause of the coiled cables being left in cabinets A405 and A409 was a design error; the effects of the coiled spare cables on the seismic analysis were not considered.

The Root Cause of cables being left coiled and unrestrained in safety-related breaker cubicle cabinets was inadequate procedures for the installation of electrical cables.

	Recommendations	Corrective Actions
1.	Evaluate the pulling of cables into and the coiling of cables in existing plant equipment. Based on the findings of the evaluation, revise Procedure EM.187 and the commitments made in LER 87-16. Update LER 87-16, as appropriate.	See response to RC 86-10 Recommendation 11. [For recommendations 1, 2, 3, 4 and 5.]

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Recommendations	Corrective Actions
2. Revise EM.187 "Control of Electrical Plant Modifications" to either: 1) provide guidelines for the cable configuration where the cable has been pulled into existing plant equipment and cable termination will not be accomplished immediately after the cable pull or 2) prohibit the pulling into and coiling of cable in existing plant equipment.	
3. Provide guidelines in the Maintenance and Modification Department procedures concerning what types of equipment or what equipment may have cables pulled into and coiled when termination is not scheduled to occur immediately.	
4. Revise MP/IS 307, "Cable Installation," and EM.163, "Installation of Permanent Plant Cables," to describe the process by which cables are declared to be spares.	
5. Revise Procedure AP.44, "Plant Modifications - ECN Implementation," to include the coordination of work between Construction and Electrical Maintenance personnel for electrical modifications.	

Table 1

CAUSES OF CABLE DISCREPANCIES

RC Report and Problem Area	IIRG			NED Direct Cause
	Direct Cause/s	Other Causes	Root Cause	
RC 86-10 Redundant Cables in the Same Fire Area.	Personnel error	CCG did not follow procedure EC-10. QC failure to inspect.	Failure of CCG Cog engineer to implement controls.	o Construction personnel error. o Inadequate card control.
RC 87-03 Cable and Raceway Tracking System Problems.	None stated.	None stated.	NED management and CRTS supervisor not adequately involved in CRTS.	o Various. o See Wire and Cable Program Report. Major cause was a lack of CRTS use procedures.
RC 87-05 Overweight Cable Trays.	Inadequate procedural guidance.	None stated.	Failure to ensure procedural implementation of USAR requirements.	Inadequate procedural guidance.
RC 87-02 Pulled Cables Stored in Safety-related Breaker Cubicle	o Planning error. o Design error.	None.	Inadequate procedures for the installation of electrical cables.	Not a CRTS-related problem. Not a design problem.
RC 87-29 Unacceptable Mixing of Power/Control and Instrument Cables	Various o Construction error. o Design error.	Various o Failure of QC inspection. o Failure to follow EC-10. o Lack of service level indicator. o Lack of training.	Failure to have and/or to use procedures for cable design, installation, inspection, and repulling.	Construction error or design error.