INVESTIGATION OF THE NOVEMBER, 1985 IN-SERVICE CABLE FAILURE AND REPORT ON THE MATERIAL CONDITION OF CABLES SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

THE 4KV CABLE EVALUATION TASK FORCE

May, 1986

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EXECUTIVE SUMMARY

On the morning of November 20, 1985, the Auxiliary Transformer 'C' differential current relay tripped and automatically isolated the transformer which resulted in the loss of a vital AC Bus and caused the operators to trip the unit. A ground alarm had been received in the late evening of November 19, 1985. Efforts to locate the source of the alarm had isolated the source to the 'C' Transformer or its feeder lines. Subsequent DC Overvoltage testing of the 4kV (4160V) cables identified a phase to phase fault in one of the feeder cables from the 'C' Transformer to 4160V Bus 1C.

To facilitate an aggressive effort to investigate the subject in-service cable failure, its implication to the balance of cable at San Onofre Unit 1, and to develop a program to evaluate the material condition of the existing power, control and instrumentation cable to support return to power from the current Unit 1 refueling outage, a special task force was established under the direction of Mr. C. K. Balog reporting to Mr. D. E. Nunn, Manager of Nuclear Generation Services at San Onofre Nuclear Generating Station.

In order to assure that the 4kVTF had the necessary expertise to perform a detailed cable condition evaluation, the services of an independent consultant with extensive experience in cable engineering, manufacturing and testing and engineering support from Bechtel Power Corporation (BPC) were utilized in conjunction with the services of SCE personnel with extensive cable experience, and other senior SCE Engineering personnel. The 4kVTF members are identified in Attachment 3-2. In addition, four independent laboratories were selected by the 4kV Cable Evaluation Task Force to conduct physical analyses and electrical tests to establish cable material condition and identify potential cable failure mechanisms. The SCE Alhambra Shop and Test facilities were also utilized to conduct electrical testing on selected cable samples. These facilities are identified in Section 5.2.

The objectives of the 4kVTF were to determine the mechanism of failure of the 'C' Transformer feeder cable, assume the responsibilities of the Material Condition Review Program (MCRP) with regard to cable (assess cable material condition), evaluate the corrective actions taken to date, investigate and correct the condition and failures of the Unit 1 4kV cable, determine the generic implications of those failures germane to the condition of the balance of power, control, and instrumentation cable, and identify and implement short and long-term recommendations necessary to assure acceptable cable material condition and the continued safe operation of San Onofre Unit 1. The intent was to complete the evaluation to support the return of Unit 1 to service from the the current Cycle 9 refueling outage.

To perform this task, the 4kVTF established an extensive program based on field inspections, field testing, cable sampling, laboratory physical analysis and electrical testing, and onsite physical evaluations.

Initial field inspections revealed some 600V cable exhibiting jacket degradation (cracking). With one singular exception (described in Section 7.3.2), the cable exhibiting jacket degradation was limited to Simplex 600V, single conductor, No. 12 AWG, butyl-rubber insulated, neoprene jacketed power, control, and instrumentation cable (installed in 1965) found in trays located in areas of highest plant ambient temperature (Turbine Plant Mezzanine and Reheater Area). Because of this discovery, cable was divided into three categories for evaluation: 4kV (4160V) cable, Simplex 600V cable exhibiting cracked jackets and the balance of 600V and lower voltage power control and instrumentation cable. For the purposes of this summary, however, 4kV cable will be addressed separately from 600V and lower voltage power, control and instrumentation cable which will be addressed jointly since the evaluation program, conclusions, and recommendations for cracked and noncracked jackets are essentially identical.

4kV (4160V) Cable

All fifty-five (55) circuits of 4160V cable were DC Overvoltage tested after the in-service failure with six (6) circuits failing the testing. Those cables failing, as well as associated cables in the same circuit, were replaced or repaired. Specifically, all feeder cables from the A, B, and C (X and Y winding) Transformers to the 4160V busses, and the cables from the 4160V busses to the South Turbine Plant Cooling Water (TPCW) Pump were replaced. The North TPCW pump cable (one of the six failing) has been acceptably repaired in the interim and will eventually be replaced. Additionally, the cables to both Charging Pumps (which passed DC Overvoltage testing) were replaced as part of the Dedicated Safe Shutdown and Appendix R modifications implemented during the current Cycle 9 refueling outage.

Since the initial evaluation of the failed 4kV cable indicated that the failure was due to long-term exposure to a localized heat source, the 4kVTF conducted extensive plant-wide walkdowns to identify any other potentially detrimental "hot pipe" to cable raceway interfaces. As a result of these walkdowns, the 4kVTF recommended insulating forty-six (46) sections of piping and relocating eight (8) specific conduit. This effort is expected to be completed prior to the return to power from the current Cycle 9 refueling outage.

Extensive samples of the 4kV cable removed from the plant were taken for laboratory physical analysis and electrical testing, as well as on-site examinations performed with a microscope by the 4kVTF. Over eighty individual analyses, tests, and physical examinations and evaluations were performed on as many samples. These samples were chosen as representative of the cable remaining in-service from various service environments and conditions. Additionally, the specific sections of 'C' Transformer cable that failed in-service were sent to an independent laboratory for analysis and evaluation.

The conclusions with regard to the 4kV cable are as follows:

1. The root cause of the in-service failure was long-term exposure to a localized heat source (uninsulated feedwater line and flange) that cause mechanical tearing of the cable insulation when the jacket split.

2. The failure mechanism is not directly applicable to the balance of the 4kV (or 600V and lower voltage) cable remaining in service because it is of a different construction than the failed cable.

3. The balance of cables failing DC Overvoltage testing failed as a result of water ingress between the jacket and insulation caused by marginal termination methods.

4. With proper insulation of the lines identified by the 4kVTF and refurbishment of the flange propagating the November, 1985 event, failure of the replacement cable and cable remaining in service should not occur.

5. Laboratory testing and analysis results have indicated that the material condition of 4kV cables remaining in service is adequate to support operation of San Onofre Unit 1 for the balance of current plant design life.

6. Some limited field testing (DC Overvoltage) is recommended in future outages to ensure acceptable cable material condition.

Simplex 600V, Single Conductor with Cracked Jackets

Extensive field inspections revealed 65 circuits (140 cables) utilizing the subject Simplex cable with cracked jackets. There are over 1800 circuits at San Onofre Unit 1 utilizing such cable, 88 of which are safety-related. Walkdowns confirmed none of the 88 safety-related circuits exhibited cracked jackets.

Cables from seven (7) of the circuits exhibiting cracked jackets were removed as samples representative of the worst condition cables from the worst normal operating environment in the plant for all 600V power, control, and instrumentation service. These samples were sent to an independent laboratory for physical analysis and laboratory testing. The laboratory results indicate that the insulation of the subject cable is in good material and electrical condition.

Additionally, 95% of the circuits exhibiting cracked jackets have been field tested. To date, testing has shown no anomalies in these circuits.

The conclusions, based on laboratory results, evaluation of the Environment Qualification program implications, and other considerations delineated in this report are:

1. Field inspections have identified that the only cable in suspect condition is 600V Simplex, single conductor, No. 12 AWG, neoprene-jacketed cable where the jacket is cracked and only in trays in areas of higher ambient temperatures (Turbine Building Mezzanine and Reheater Area) and the top wireways of the 480V MCCs.

2. The suspect 600V cables are acceptable for continued power, control, and instrumentation service (despite their appearance) for the remaining design life of San Onofre Unit 1 for the following reasons:

    a. The jacket provides mechanical protection only and does not significantly affect the dielectric properties of the cable.

    b. The insulation is in good condition physically and electrically.

    c. Cracked jackets in trays have been found only in Associated or Non-Safety Related (NSR) circuits.

d. 600V cable requires only a minimum amount of insulation to maintain acceptable dielectric properties.

e. The circuits field tested to date have been shown to be acceptable with no anomalies.

f. EG&G, Idaho ECCAD testing performed to date has shown no circuit anomalies.

g. Laboratory testing indicates that the cable insulation in general is acceptable for continued use for the balance of the current plant design life.

3. The laboratory results and the evaluations and conclusions applicable to the suspect 600V cable are also applicable to the balance of 600V and lower voltage cable.

4. The 600V and lower voltage power, control, and instrumentation cable is acceptable for continued operation for the remaining design life of San Onofre Unit 1.

5. Periodic field inspection and testing programs are recommended to ensure continued acceptable cable material condition.

6. The existing Environmental Qualification Condition Monitoring Program should be slightly expanded to monitor plant ambient temperatures in the Turbine Building to verify the temperature parameters delineated in the Unit 1 Retrofit Design Criteria Manual and the Environment Qualification Program.

General

The 4kVTF recommended both near and long-terms actions to ensure acceptable cable material conditions for the balance of plant design life.

The near-term recommendations including cable replacement, field inspections, conduit relocation, insulation of piping and others, have been or will be completed prior to the return to power from the current Cycle 9 refueling outage.

Long-term recommendations, including periodic field testing and inspection, Station Maintenance and Project Construction procedural changes, area temperature monitoring, specific maintenance actions, termination methodology changes, and others, have also been identified for implementation as described in this report.

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

The 4kV Cable Evaluation Task Force (4kVTF), reporting to Mr. D. E. Nunn, Manager of Nuclear Generation Services at San Onofre Nuclear Generating Station, was established to evaluate the 4kV cable failure of November, 1985. Specifically, the objectives of the Task Force were: to assume the responsibilities of the Material Condition Review Program with regard to cable, evaluate the adequacy of any corrective actions taken to date, investigate and correct the conditions and failure(s) of the Unit 1 4kV cable, determine the generic implications germane to the balance of cable utilized at Unit 1, and identify and implement short and long term action plans necessary to assure continued safe operation of San Onofre Unit 1.

This report prepared by the Task Force is meant to deal only with the cable failure initiating the November, 1985 transient as it pertains to the failure mechanism of the cable and to implications germane to the balance of power, control and instrumentation cable as well as providing an assessment of the material condition of cables utilized at San Onofre Unit 1. Assessments directly related to the above subject are also documented.

1.1 DESCRIPTION OF NOVEMBER, 1985 IN-SERVICE 4kV CABLE FAILURE

On the morning of November 20, 1985, the Auxiliary Transformer "C" differential current relay tripped and automatically isolated the transformer which resulted in the loss of a vital AC Bus. This situation caused Station Operators to take action to trip the unit in order to comply with established Operating Procedures. A ground alarm had been received in the late evening of November 19, 1985 and efforts to locate the source of the alarm by systematically removing loads from the "C" transformer feeder busses had isolated the source of the ground alarm to the "C" Transformer or its feeder lines. Subsequent DC overvoltage testing of the 4kV cables identified a phase to phase fault (actually two phase to ground faults resulting in a phase to phase fault on this delta system) in one of the feeder cables from the "C" Transformer to 4160V Bus 1C.

A more detailed discussion of this scenario can be found in Reference 1.5.1.

1.2 DESCRIPTION OF THE STATION ELECTRICAL SYSTEM

The Electrical System at San Onofre Unit 1 consists of a 220kV switchyard system, a 4160 system, a 480V system, a 120V AC system, a 125V DC system and a diesel generator system to provide an onsite 4160V power source.

San Onofre is located at the point of interconnection between Southern California Edison's (SCE's) 230kV system and San Diego Gas and Electric Company's (SDG&E's) 230kV/138kV system. A single line diagram of the switchyard showing the SCE and SDG&E connections, and the interconnection of the switchyard with the Station 4160V system is shown in Figure 1.1 (Main One Line Diagram). The 220kV switchyard is of the double breaker, double bus design and operates with all the breakers normally closed. Plant electrical interfaces to the switchyard are provided by (1) a connection to Auxiliary Transformer C (30,000kVA, 230kV/4360V transformer), and (2) a connection through the main generator step-up transformer (485,000kVA, 230kV/18kV transformer) and then through Auxiliary Transformers A and B (10,000kVA, 18kV/ 4360V transformers). During normal operation the power source of Auxiliary Transformers A and B is the main generator, but power can be delivered to the plant from the switchyard via this path if a second supply is required.

The 4160V system consists of the four busses 1A, 1B, 1C and 2C. Busses 1A and 1B are normally fed from the 18kV output of the main generator. These busses are powered by Auxiliary Transformers A and B, and do not normally power components that are required for the safe shutdown of the plant. Busses 1C and 2C are normally fed from the 220kV switchyard via Auxiliary Transformer C. These busses provide the redundant power sources for both normal operation and Safe Shutdown System components. They also provide power for the 480V system by way of Station Service Transformers 1, 2 and 3.

The 480V, and the 120V AC and 125V DC systems consist of buses and motor-control centers which supply power to lower voltage equipment. 600V cable used for these systems provides instrumentation, control and power circuitry for safety-related systems and other ancillary plant equipment and represents a major portion of approximately three (3) million feet of cable in San Onofre Unit 1.

A more detailed description of the electrical systems at San Onofre Unit 1 can be found in Reference 1.5.1.

1.3 DESCRIPTION OF 4kV CABLE CONSTRUCTION

The "C" Transformer feeder cable that failed in-service was a Simplex cable manufactured in 1965 and identified as "Simplex Anhydrex XX insulated neoprene jacketed" on the legend embossed in the jacket. It is a 5kV rated non-shielded design. The construction details are given in Attachments 1-2 and 1-3. The description for the cable is:

> Three conductors, each a 750 kcmil coated copper, 61 strand conductor, semi-conducting fabric tape, 11/64 inch (.172 inch) Anhydrex XX (butyl) insulation, fabric tape, 4/64 inch (.063 inch) neoprene jacket, cabled together with paper fillers, then two overall fabric core tapes and a .032 x 3/4 inch aluminum interlocked armor.

Note: only the 750 kcmil conductor size cables incorporated fabric tapes over the conductor and between the insulation and jacket. All other 5kV Simplex non-shielded cables in use at San Onofre Unit 1 in November, 1985 are 500 kcmil, 250 kcmil, or 4/0 AWG using semi-conducting extrusion over the conductor and no tape between the insulation and jacket. The significance of the difference in cable construction is addressed in Sections 6.2.4 and 6.5.1.

1.4 TERMINOLOGY

The descriptive terminology used to categorize cables is confusing because cable can be identified by the service of the cable or by the manufacturer's rating of the cable. In this report, two categories of cable are identified, 4kV cable and 600V cable. The subject 4kV cable can be 5kV or 8kV (kilovolt) rated cable used in the 4160V (volt) system. Similarly, 600V (volt) cable is 600V rated cables used in the 480V (volt), 125V, and the 120V systems.

Cables associated with the 4160 Volt system are further categorized by relative size of the stranded conductor given in units of kcmil or AWG sizes. A kcmil is 1000 circular mils and a circular mil is a unit of area equal to the area of a circle having a diameter one mil (one mil equals 0.001 inch). Such a circle has an area $\pi/4$ square mil. The area of a circle, in circular mils, is therefore equal to the square of its diameter in mils. 250, 500, or 750 kcmil 5kV rated cable is common in San Onofre Unit 1. Note: size 4/0 AWG (explained below) can also be utilized for 5kV rated cable.

Cable sizes associated with 600V cable are categorized by the American Wire Gage (AWG). The AWG number is based on the following definitions: the diameter of 0000 AWG cable (often written 4/0) is chosen to be 0.4600 inch and that of No. 36 AWG, 0.0050 inch. There are 38 intermediate sizes (4/0, 3/0, 2/0, 1/0, 1 through 36) which are governed by geometric progression between 0.0050 inch and 0.4600 inch. No. 12 AWG Simplex cable has a nominal diameter of 80.8 mils while 4/0 (four ought) AWG Simplex cable has a diameter of 460.0 mils (211 kcmil).

Throughout the report various other terminology is used that mandates the following brief descriptions:

<u>Terminators</u> – The housing utilized at the 4kV cable to equipment interface to separate the 3 phase conductors in preparation for connection to the equipment.

Termination - The complete end assembly of cable, terminator, boots, lugs, etc. (A drawing of a typical termination can be found in Section 7.0, Attachment 7-1.)

Boots - An environmental seal used to separate single conductors from a multi-conductor cable as part of a termination in preparation for connection to equipment. A sample (Raychem Termination Boot Kit) is shown later in the report (Section 7.0, Attachment 7-4).

Sleeve - As utilized in this report, is the covering placed over bare armored cable directly adjacent to the terminator which is normally made of rubber, PVC or a similar waterproof material for protection of the cable from the environment.

Conductor - The individual current carrying component in cables. Cables have any number of conductors, each constructed in various arrangements (with insulation and/or jackets or shields, etc.). The 4kV cable used at San Onofre Unit 1 has three conductors. (See Attachment 1-2.)

Shield - A layer of conducting or semi-conducting material (usually in the form of a metallic tape) surrounding the insulation of individual conductors in a cable and/or around a multi-conductor assembly. (See Attachment 1-2.)

1.5 REFERENCES FOR SECTION 1.0

1.5.1 Letter, M.O. Medford to A. E. Chaffe dated April 8, 1986; Subject: Docket No. 206 Investigation Report of November 21, 1985 Water Hammer Event, SO1

TABLES

SECTION 1.0

There are no tables for Section 1.0

ATTACHMENTS

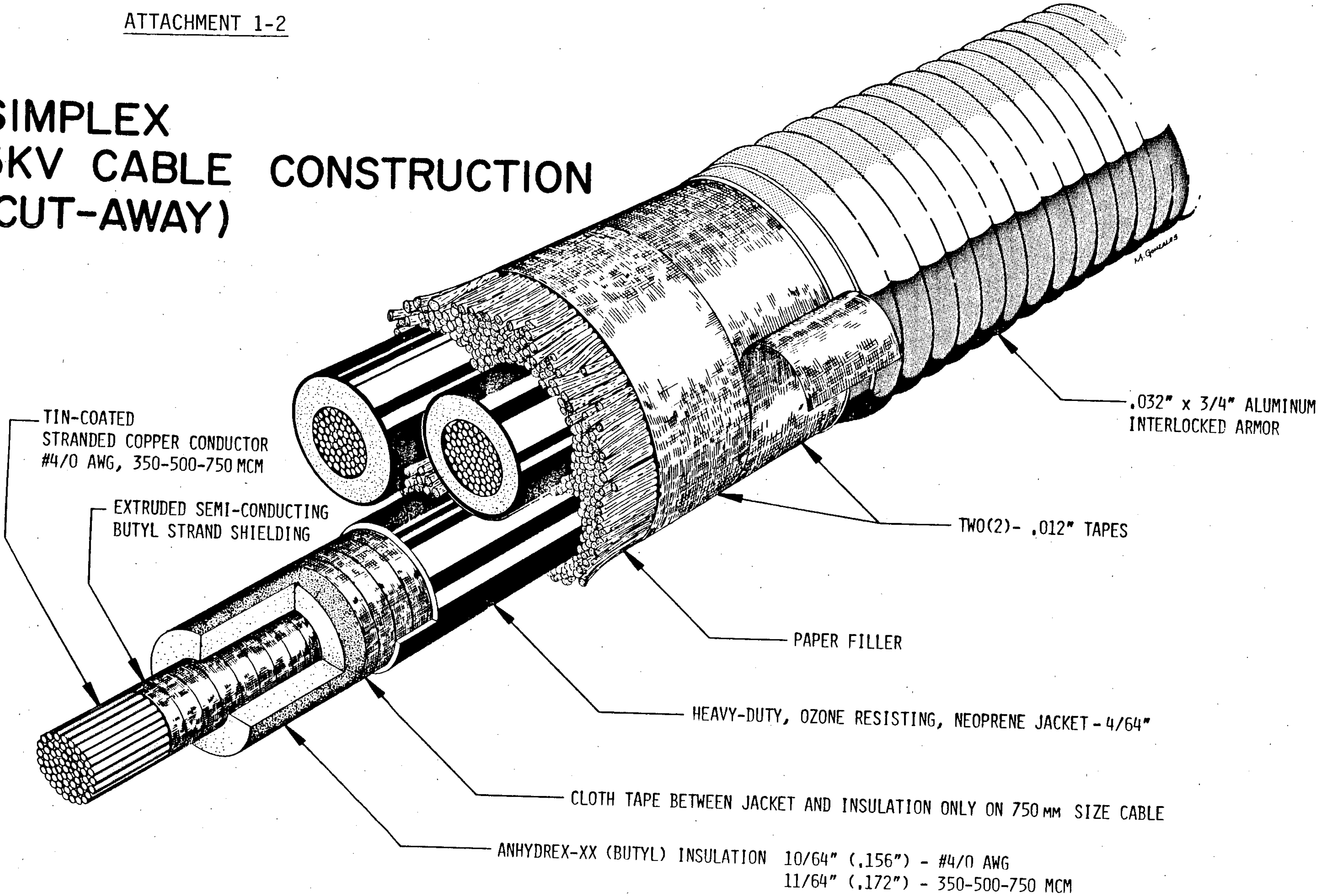
SECTION 1.0

SECTION 1.0

LIST OF ATTACHMENTS

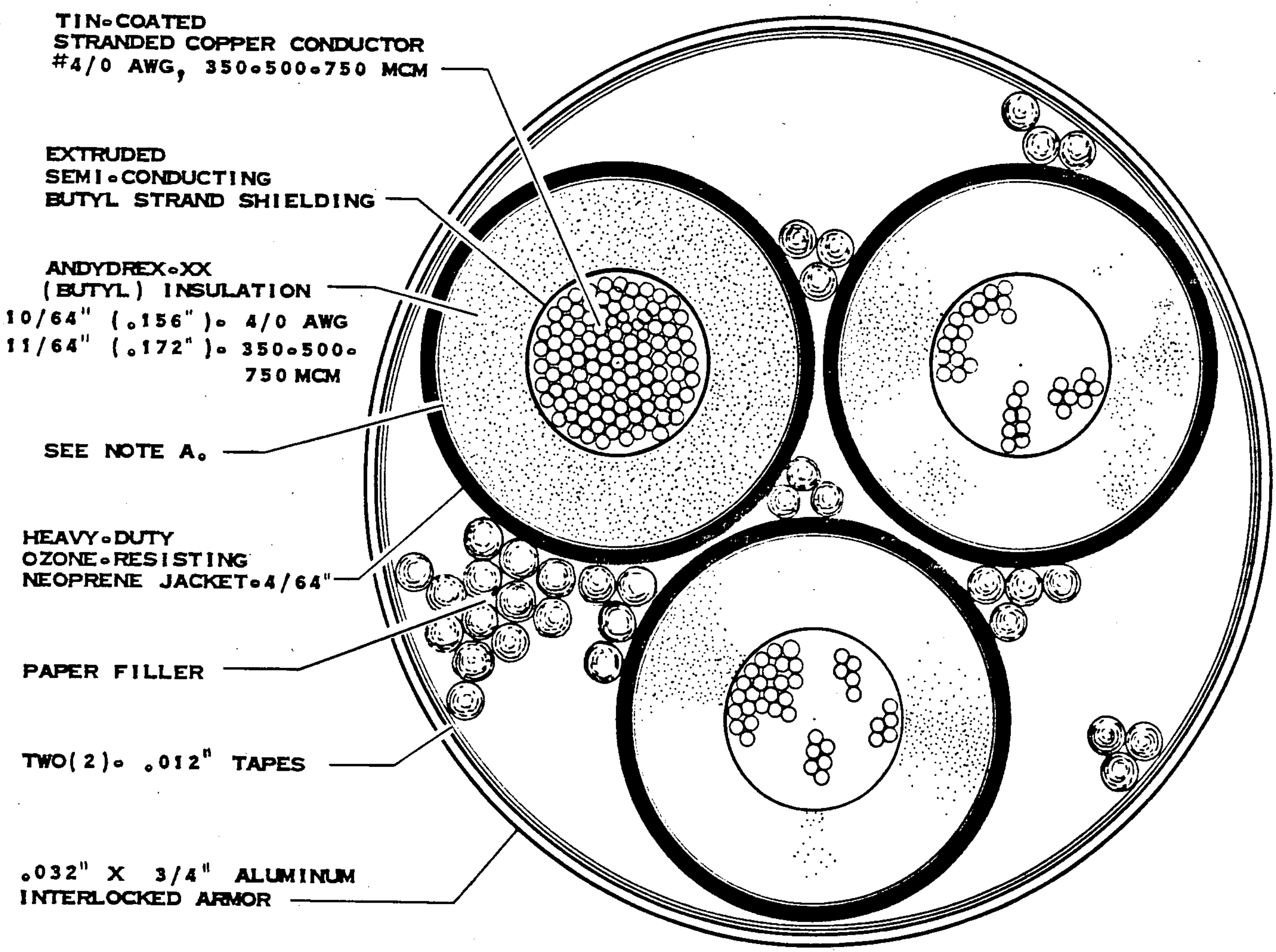
ATTACHMENT 1-2

SIMPLEX 5KV CABLE CONSTRUCTION (CUT-AWAY)



SIMPLEX 5KV 750Kcmil CONSTRUCTION DRAWING (CROSS-SECTION)

SIMPLEX 3/C-ANHYDREX-XX INSULATED ALUMINUM INTERLOCKED ARMORED CABLE. 5KV N.S. PER SOUTHERN CALIFORNIA EDISON CO. MS 228-64 & BECHTEL CORPORATION BSO-3008



NOTE A. ONLY THE 750 MCM CABLE UTILIZES THIS CLOTH TAPE BETWEEN THE NEOPRENE JACKET AND THE BUTYL INSULATION.

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

SIMPLEX WIRE & CABLE CO., FACTORY ORDER #16712 THRU 5

FACTORY ORDER - SIZE	APPROXIMATE O.D.	#/m' - NET
#16712 - #4/0	2.51"	4020#
#16713 - 350 MCM	2.92"	5930#
#16714 - 500 MCM	3.22"	7720#
#16715 - 750 MCM	3.64"	10660#

SECTION 2.0

OBJECTIVES

2.0 OBJECTIVES

The general objective of this task is to develop and implement an action plan to document the mechanism of the 4160V in-service failure and to assess the material condition of the 4160 Volt and lower voltage power control and instrumentation cable at Unit 1 to perform their intended functions in order to substantiate continued plant operation following the completion of the Unit 1 Cycle 9 Outage. Specific objectives are identified in the following sections. Cable is addressed in two categories, 600V (and lower voltage) and 4kV, to accomplish this task.

2.1 4kV CABLE EVALUATION

The specific objectives for evaluation of the 4kV cable are as follows:

- Determine the mechanism of in-service failure of the 4kV 'C' Transformer cable.
- Determine the mechanism of failure of those 4kV cables which failed DC overvoltage testing.
- Assess the implications of the 4kV cable failures on the balance 4kV circuits.
- Assess the material condition of 4kV cables remaining in place.
- Provide recommendations to minimize the possibility of further cable failures by modes identified in this investigation.
- Provide recommendations necessary to maintain the acceptable material condition of 4kV cables.

2.2 600V (AND LOWER VOLTAGE) CABLE EVALUATION

The specific objectives for 600V and lower voltage power, control and instrumentation cables are as follows:

- Assess the implications of the mechanism of failure of the in-service fault germane to the balance of 600V and lower voltage cable utilized at San Onofre, Unit 1.
- Assess the general material condition of 600V and lower voltage cables.
- Determine the cause of any cable degradation identified as a result of field inspections.
- Assess the implications of any identified cable degradation.
- Provide recommendations to minimize the possibility of cable failures in 600V cable resulting from the mechanism of the 4kV cable failures.
- Provide recommendations to maintain the acceptable material condition of 600 volt and lower voltage cable at San Onofre, Unit 1.

2.3 REFERENCES FOR SECTION 2.0

2.3.1 Letter, Harold B. Ray to Dr. L. T. Papay, dated March 6, 1986; Subject: Results of Testing 4kV Cable, SO1

2.3.2 Letter, Harold B. Ray to D. E. Nunn, dated March 10, 1986; Subject: Development of 4kV Electrical Cable Action Plan, SO1

2.3.3 Letter, Harold B. Ray to Dr. M. O. Medford, dated March 12, 1986; Subject: March 12 Meeting with NRC Region V, SO1

2.3.4 Letter, D. E. Nunn to D. A. Eastman, et al. dated March 14, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

2.3.5 Letter, C. K. Balog to M. Rodin, dated March 18, 1986; Subject: Support of 4kV Cable Evaluation Task Force, SO1

2.3.6 Letter, D. E. Nunn to R. S. Currie, dated March 19, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

2.3.7 Letter, D. E. Nunn to M. O. Medford, dated March 25, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

TABLES

There are no tables for Section 2.0.

ATTACHMENTS

There are no attachments for Section 2.0.

SECTION 3.0

THE 4kV CABLE EVALUATION TASK FORCE

3.0 THE 4kV CABLE EVALUATION TASK FORCE

In a continuing effort to develop a program to evaluate the 4kV and associated cable to support return to power from the current Unit 1 refueling outage, a special task force was organized to determine the mechanism of failure of the 'C' Transformer feeder cable, assume the responsibilities of the Material Condition Review Program (MCRP) with regard to cable (assess cable material condition), evaluate the corrective actions taken to date, investigate and correct the condition and failures of the Unit 1 4kV cable, determine the generic implications of those failures germane to the condition of the balance of power, control, and instrumentation cable, and identify and implement short and long-term recommendations necessary to return Unit 1 to service within the confines of the Unit 1 outage schedule (References 3.3.1 to 3.3.6).

The first task confronting the 4kVTF was to develop an action plan to implement the required evaluation program. (Reference 3.3.1). This plan evolved from its first development to the plan most recently updated by Reference 3.3.9 (Attachment 3-1).

3.1 COMPOSITION OF THE 4kV CABLE EVALUATION TASK FORCE

In order to assure that the 4kV Task Force had the necessary expertise to perform a detailed cable condition evaluation, the services of an independent consultant with extensive experience in cable engineering, manufacturing and testing (Reference 3.3.7) and engineering support from Bechtel Power Corporation (BPC) (Reference 3.3.8) were utilized in conjunction with the services of SCE personnel with extensive cable experience, and other senior SCE Engineering personnel (References 3.3.3 and 3.3.5). The 4kVTF members are identified in Attachment 3.2. In addition, four independent laboratories were selected by the 4kV Cable Evaluation Task Force for physical and electrical testing to establish cable material condition and identify potential cable failure mechanisms. The SCE Alhambra Shop and Test facilities were also utilized to conduct electrical testing on selected cable samples. These facilities are identified in Section 5.1.

3.2 INTERFACE WITH MCRP ACTIVITIES

The objective of the Material Condition Review Program (MCRP) is to identify, review and evaluate the material condition of the Unit 1 plant operating systems and components where material failures could lead to challenges to safety systems. The program also provides recommendations to restore and maintain the material condition of those systems to a degree of quality which minimizes unexpected failure. Material Condition Teams (MCTs) were formed for each of the various types of components to evaluate the material condition of the components and develop specific recommendations for restoring and maintaining systems or components.

The 4kV Cable Evaluation Task Force was established in March, 1986, very near the date that the Station cable MCT had planned to complete their evaluation. It was decided that the MCT Report would be completed and submitted to the 4kV Cable Evaluation Task Force in the latter part of March, 1986, as the mechanism for transfer of responsibility. The cable MCT report provided an opinion on the present condition on the 4160 volt cables based on DC Overvoltage tests and inspections of the majority of these cables. Additionally, the report documentd two activities in detail (i.e., inspections of 4kV components and D.C. overvoltage testing of two terminators and cables). It recommends a routine test program for 4160 volt cables, and various maintenance activities (delineated in Section 10.9). The establishment of a general, comprehensive testing, analysis and assessment program to specifically identify the mechanism of the in-service failure and to confirm the material condition of all power, control, and instrumentation cable at San Onofre Unit 1 was not accommodated. The 4kV Cable Evaluation Task Force established this required comprehensive program and was then responsible for reviewing the adequacy of the MCT actions, for identifying appropriate objectives (Section 2.0) and for developing, implementing, and documenting a program to meet those objectives (Attachment 3-2).

3.3 REFERENCES FOR SECTION 3.0

3.3.1 Letter, Harold B. Ray to D. E. Nunn, dated March 10, 1986; Subject: Development of 4kV Electrical Cable Action Plan, SO1

3.3.2 Letter, Harold B. Ray to Dr. M. O. Medford, dated March 12, 1982; Subject: March 12 Meeting with NRC Region V, SO1

3.3.3 Letter, D. E. Nunn to D. A. Eastman, et. al., dated March 14, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

3.3.4 Letter, C. K. Balog to M. Rodin, dated March 18, 1986; Subject: Support of 4kV Cable Evaluation Task Force, SO1

3.3.5 Letter, D. E. Nunn to R. S. Currie, dated March 19, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

3.3.6 Letter, D. E. Nunn to M. O. Medford, dated March 25, 1986; Subject: 4kV Cable Evaluation Task Force, SO1

3.3.7 P.O. Number S6D00129 to Mr. Andrew Hvizd, Cable Consultant

3.3.8 Letter, H. F. McCluskey (BPC) to M. P. Short (SCE), dated March 20, 1986 (BPC/SCE-86-3982); Subject: BPC Support of 5kV Cable Evaluation Task Force; CWA 795-OP, Work Authorization 3420.

3.3.9 Letter, C. K. Balog to D. E. Nunn, dated May 30, 1986; Subject: 4kV Cable Evaluation Task Force Activity Status

TABLES

SECTION 3.0

There are no tables for Section 3.0

ATTACHMENTS

SECTION 3.0

ATTACHMENT 3-1

05/30/86

4kV CABLE EVALUATION TASK FORCE

TASK OBJECTIVES/ACTION PLAN	RESPONSIBILITY	SUPPORT	STATUS
1. Establish task force and participants.	Balog	N/A	Complete
2. Identify task force objectives.	Balog	N/A	Complete
3. Develop and implement action plan.	Balog	4kVTF	Complete
4. Obtain services of EG&G, BPC and independent cable consultant.	BPC-Balog EG&G - Hover Cons. - Steinke	N/A	Complete
5. Establish contract with cable analysis labs. Specify data required from labs.	Steinke	Hvizd Engmann Wells	Complete
6. Submit faulted 4kV C-Transformer feeder cable for analysis and start failure analysis.	Hvizd	Wells	Complete
7. Assume responsibilities of MCRP, MCT with regard to cable.	Wells	Balog	Complete
8. Determine acceptability of replacement feeder cable.	Hover	Matthewson Engmann	Complete
9. Identify 4kV cable failing hi-pot testing and identify/locate failed section(s). Obtain samples of failed cable.	Wells	Jurszewicz	Complete
10. Submit failed and representative sample 4kV cable to test lab and start failure analysis.	Hvizd	Wells Jurszewicz	Complete
11. Identify cable runs, lengths, etc. and cable manufacturers.	Matthewson	Engmann	Complete
12. Establish priority for cable evaluation/replacement sequence (i.e., SR/NSR, etc.).	Hover	N/A	Complete
13. Estimate cost and schedule for replacing all 4kV cable.	Matthewson	N/A	Complete

ATTACHMENT 3-1 (Continued)

TASK OBJECTIVES/ACTION PLAN	RESPONSIBILITY	SUPPORT	STATUS
14. Review MCT documentation and evaluate 4kV cable data assimilated to date.	Engmann	Balog	Complete
15. Determine loading on existing cables.	Matthewson	Engmann	Complete
16. Develop schedule.	Balog	Frey	Complete
17. Identify cable failure modes.	Hvizd	Cohon Engmann Steinke	Complete
18. Assess the need to initiate Engineering and Procurement activities for specific 4kV circuits.	Balog	4kVTF	Complete
19. Review existing 4kV walkdown information and criteria and determine if additional walkdowns are required.	Engmann	Balog Matthewson	Complete
20. Determine adequacy of corrective actions to date by MCT and/or need for further action/testing.	Balog	4kVTF	Complete
21. Prepare necessary EG&G test procedures.	Frey	Hover	Complete
22. Identify available cable test windows for each circuit.	Frey	N/A	Complete
23. Assess capability of cable not being replaced to perform its required functions (both short and long term).	Balog	Hvizd Engmann	Complete
24. Determine generic implications of failure mechanism of faulted C-Transformer cable to other electrical cable.	Hvizd	Hvizd Matthewson	Complete
25. Obtain 4kV maintenance/testing records to determine extent of hi-pot testing to each cable.	Wells	N/A	Complete
26. Assess acceptability of 4kV hi-pot test procedure, voltages and test acceptance criteria.	Cohon	Engmann Steinke	Complete
27. Review and evaluate program test results for 4kV Simplex cable. Prepare recommendations.	Hvizd	4kVTF	Complete

ATTACHMENT 3-1 (Continued)

SUPPLEMENTAL ACTIONS	RESPONSIBILITY	SUPPORT	STATUS
28. Develop long term action plan.	Balog	4kVTF	Complete
29. Document test data, evaluations, conclusion, and recommendations in comprehensive report. Produce an auditable product.	4kVTF	N/A	Complete
30. Prepare correspondence to submit Report to NRC.	Bennet	4kVTF	F/C 06-04
31. Initiate activities to locate suitable SR 4kV cable for SR circuits.	Matthewson	N/A	Complete
32. Identify 480V cable/trays with cracked jacket.	Wells	Cohon Matthewson	Complete
33. Evaluate impact of cracked jackets on 480V circuits. Provide recommendation.	Engmann	Balog Wells	Complete
34. Obtain failure analysis results for all analyzed 4kV cable.	Hvizd	N/A	Complete
35. Perform vendor technical qualification for testing labs.	Steinke	Hvizd	Complete
36. Identify terminations/boots used on fossil plants. Compare to SO1.	Cohon	Jurszewicz	Complete
37. Prepare criteria to identify "hot" lines.	Matthewson	N/A	Complete
38. Investigate failure mechanism of OZ Cable Termination and provide recommendation.	Hvizd	Steinke	Complete
39. Document all EG&G Test Data.	Wells	Frey	Completed
40. Provide estimate to eliminate/relocate feedwater flanges.	Matthewson	N/A	Complete
41. Identify appropriate 480V cracked jacket circuits for sampling.	Matthewson	Wells Hvizd Engmann	Complete
42. Obtain 480V samples.	Wells	Hvizd	Complete

ATTACHMENT 3-1 (Continued)

SUPPLEMENTAL ACTIONS	RESPONSIBILITY	SUPPORT	STATUS
43. Forward 480V samples to lab for analysis.	Wells	Hvizd	Complete
44. Identify criteria for cable tray covers and provide recommendation.	Engmann	Matthewson	Complete
45. Locate original criteria for and data from construction Hi-Pot testing	Matthewson	Engmann	Complete
46. Assess material condition of 4kV RCP containment penetrations. Determine need for further testing.	Engmann	Wells Matthewson	Complete
47. Define and identify need for partial discharge testing on cable to supplement cable material condition basis.	Cohon	Hvizd	Complete
48. Prepare evaluation germane to material condition of power and control cable (Generic).	Engmann	Balog Hvizd	Complete
49. Investigate and evaluate construction damage (weld strike) to aluminum sheath of 4kV cable in 4kV switchgear room.	Cohon	Hvizd	Complete
50. Coordinate preparation of FCNs to replace 480V cabling used as samples. Issue FCNs.	Matthewson	Balog	Complete
51. Complete and evaluate "hot-pipe" walkdown data. Provide recommendations.	Matthewson	Hvizd Engmann	Complete
52. Provide list of lines requiring insulation to Construction.	Matthewson	Balog	Complete
53. Address generic implications of cable splices found in lube oil system 600V cable.	Balog	Matthewson	Complete
54. Receive, review and evaluate lab analysis and test results on 600V cable. Provide recommendation.	Hvizd	Matthewson Engmann	Complete
55. Contact various cable manufacturers to obtain information germane to temperature cables can be expected to withstand.	Engmann	Matthewson	Completed

ATTACHMENT 3-1 (Continued)

SUPPLEMENTAL ACTIONS	RESPONSIBILITY	SUPPORT	STATUS
56. Initiate Engineering to replace Simplex, Single Conductor No. 12 AWG 600V cables, with cracked jackets if necessary.	Matthewson	Balog	Complete
57. Identify all safety-related circuits utilizing Simplex, No. 12 AWG, 1/C, neoprene-jacketed cable (Code No. 122) for future inspections. Identify the total number of circuits utilizing Simplex butyl-rubber insulated, neoprene jacketed cables.	Matthewson	Cowles	Complete
58. Evaluate acceptability of Simplex, neoprene jacketed, 1/C, 4/0 AWG cable with cracked jacket (Circuit NO. 1GBS218P2 - 480V Switchgear No. 2 Feeder to MCC No. 2).	Hvizd	Matthewson	Complete
59. Assess the Environment Qualification implications germane to the 4kV cable in-service failures and to the qualification of 600V power and control cables	Hover	Wells	Complete
60. Prepare 'C' Transformer faulted cable temperature profile	Matthewson	Hvizd	Complete
61. Inspect all safety-related 600V Simplex, No. 12 AWG, 1/C, neoprene jacketed cables in trays (88 circuits)	Matthewson	Balog	Complete
62. Prepare list of cables utilized at San Onfore Unit 1	Matthewson	Cowles	Complete
63. Complete FCNs to relocate eight conduit away from localized heat source. Forward FCNs to Construction.	Balog	Matthewson	Complete
64. Perform calculations for selected localized heat source to cable raceway instances to determine acceptability of existing interfaces.	Matthewson	Cowles	Complete
65. Megger test all 600V Simplex No. 12 AWG circuits with cracked jackets.	Wells	Balog	Completed

ATTACHMENT 3-2

4kV CABLE EVALUATION TASK FORCE MEMBERS

	AFFILIATION	DEPARTMENT	POSITION
CHANE K. BALOG	SCE	E&C Nuclear Project Engineering	Principal Project Engineer
JACOB COHON	SCE	E&C	Senior Engineer
KEITH COWLES	Bechtel	Electrical Engineering	Engineer
GARY R. ENGMANN	SCE	E&C Electrical Engineering	Lead Electrical Engineer-SO1
DAN FREY	SCE	E&C Startup	Engineer 1
CRAIG R. HOVER	SCE	NES&L - Nuclear Systems Engineering	Engineer 1
ANDREW HVIZD	Independent	N/A	Cable Consultant
ARTHUR JURSZEWICZ	SCE	Power Supply	Senior Engineer
FRANK W. MATTHEWSON	Bechtel	Electrical Engineering	Electrical Engineering Group Supervisor
WOLFGANG W. STEINKE	SCE	E&C	Senior Engineer
KIRK WELLS	SCE	NES&L - Nuclear Systems Engineering	Engineer 2

SECTION 4.0

METHODOLOGY

4.0 METHODOLOGY

Aging of cable insulating materials implies a progressive change in the material from its original condition when manufactured to its end-of-life state. The basic change occurring during aging is chemical in nature. Changes in the molecular structure of the materials results in changes in the engineering properties of the material. In the case of insulation and jacket materials, particularly those used for low-voltage applications, the principal measure of life is the material's physical properties. For many materials, it has been shown that adequate electrical characteristics are maintained until the material becomes brittle and cracks.

The normal stresses that cause thermal degradation are created by a combination of ambient temperature and internal temperature rise due to cable loading (I^2R heating). The chemical reaction is oxidation, and the reaction rate depends on the temperature and available oxygen. Oxygen availability depends on the environment, the diffusion rate of oxygen into the material, and the cable geometry/construction. In the case of nuclear environments, it may be necessary, also, to consider radiation exposure.

Given these factors, the most valid basis for establishing remaining cable life is that of a semi-empirical approach comparing accelerated laboratory test results to the physical condition of naturally-aged cable.

The evaluation of the condition of the cable is based on two procedures. First, standard electrical tests consisting of 60 Hz, DC and impulse breakdown were conducted, with the results compared to expected "as manufactured" values for this type of cable. Secondly, the physical condition of the insulation and jacket materials was determined by conducting tensile and elongation tests on the returned samples. Estimates of the present thermal age and remaining life can be made by making a correlation between the present measured physical condition and the degradation rates for these materials as determined by previously conducted accelerated aging tests.

Tests applied to each cable were selected based on cable design guidelines of 1965 because most of the potentially aged (i.e., not recently replaced) cable in the plant was manufactured by Simplex in 1965. The scope of later cable manufacturing and associated testing is discussed in this report; however, the 1965 Simplex cables are by a large margin the oldest cables in the plant; hence, these cables were used as a benchmark. Attachment 7-6 of Section 7.0 is a listing of various types of cable installed in the plant and the year each type of cable was manufactured. The specific tests are different for 4kV and 600 Volt cable and are identified in Sections 4.1 and 4.2, respectively.

4.1 4kV CABLE EVALUATION

The electrical tests used to evaluate 4kV cable conditions were AC strength, DC strength, impulse strength, dielectric constant and dissipation factor, and breakdown in hostile environments (heat/water 90°C).

Some of the electrical tests not included were U-Bend Plate to test cable suitability for non-shielded applications (5kV service) and surface resistivity of jacket also related to suitability of jacket for non-shielded applications (5kV service). The measurements, if made, would be compared to cable design guidelines of today, not 1965. It is known that 1965 designs used mechanical type jacket formulations for neoprene (contain higher percentage of carbon in the mix) and not the "electrical" type which is defined by high surface resistivities and U-bend plate testing. The evidence of adequate performance is shown by the jacket condition within the cable construction after 18 years' service. There was evidence of electrical discharges between cable surfaces and to the outer aluminum armor (which is expected on non-shielded designs). Such electrical "sparking" of low energy is possible in any air space within an electrical field. For shielded cable designs, partial discharge measurements are made routinely at final testing by many cable manufacturers, but is not done on non-shielded designs.

Surface resistivity of the Simplex jacket would not be expected to meet current industry (ICEA) specifications. In fact, this was known by SCE engineers when preparing cable terminations, and was reported that the neoprene had to be removed at those locations. Refer to memorandum of A. Jurszewicz to A. A. Lingo of April 4, 1968 (Attachment 4-1), which measured this resistivity at 54 to 160 megohms per inch and called this material a semi-conductor.

The physical tests used were tensile strength and elongation, as discussed in Section 4.0.

4.2 600V (AND LOWER VOLTAGE) CABLE EVALUATION

The electrical tests used to evaluate 600V cable condition were insulation resistance, AC strength, DC strength, and breakdown in hostile environments (heat/water 90°C).

Some of the electrical tests not included were U-bend plate test, impulse strength, dielectric constant (specific inductive capacitance), and dissipation factor. Such measurements are not appropriate for 600V cable design. The operating properties for 600V cable are adequately monitored by the test data obtained and documented herein.

The physical tests used were tensile strength and elongation, as discussed in Section 4.0.

4.3 REFERENCES FOR SECTION 4.0

There are no references for this section.

TABLES

There are no tables in Section 4.0.

ATTACHMENTS

SECTION 4.0

ATTACHMENT 4-1

MEMORANDUM

April 4, 1968
(Reprint)

TO: Mr. A. A. Lingo

FROM: A. Jurszewicz (original signed)

SUBJECT: Inspection of Simplex 4kV Cable and Terminations at San Onofre Nucear Generating Station

PURPOSE:

To investigate reported Corona and electrical discharge noises emanating from 4kV cable terminals inside of switchgear compartments.

DISSCUSION:

The investigation centered on 4kV termination and cables in the switchgear and transformer compartments associated with the "A" auxiliary transformer.

During the investigation the following steps were taken:

1. Cables in the switchgear were cleaned with white gas while the transformer was de-endergized.

2. Transformer was energized, minor Corona and electrical discharge noises were observed.

3. The transformer was de-energized and terminations at the transformer compartment were unbolted and protected for high potential tests.

4. The cables were high protentially tested at 27.9kV DC for 15 minutes and statisfactorily passed the test.

5. Additional high potential testing was performed using Corona tape to search for insultation defects. The cable performed satisfacorily during this series of tests.

6. The cable jacket surface resistance was measured and was found to vary from 54 megohm to 160 megohm per inch. This shows that the jacket is semi-conductor.

7. The quality of taping at the terminations apppeared to be questionable; therefore, one termination was disassembled for inspection. The taping was found to be satisfactory except for the outer layer of tape.

ATTACHMENT 4-1 (Continued)

CONCLUSIONS AND RECOMMENDATIONS:

Jacket and insulation preparation prior to taping was as specified on Edison Drawing No. E19-568396-1. This type of termination is normally used on non-shielded cables with non-conducting jacket and is entirely unsatisfactory on cables with semi-conducting jacket. In order to provide a satisfactory installation it is recommended that the termination designed for a semi-conducting jacketed cable be used for this and all other cables at this station. The preferred corrective method to give a satisfactory termination will require:

1. Removal of all tapes on existing terminations.

2. Stripping of semi-conducting neoprene jacket an additional 6 inches away from the terminal.

3. The entire termination will then require retaping.

AJ/jmb

SECTION 5.0

SAMPLING PROGRAM

5.0 SAMPLING PROGRAM

A program was required to determine the type of samples necessary for the tests and evaluation to be performed by independent laboratories and the 4kVTF. Selection of laboratories was predicated on their expertise in performing the desired evaluations.

5.1 SAMPLE SELECTION

Samples of 4kV and 600V cables were selected to obtain cable representative of the various environments in the existing cable runs. In particular, this included samples in those areas having the most severe environmental and electrical loading conditions as it is these areas that dictate the operating life of the cable.

5.1.1 4kV System Cables

The 4kVTF reviewed the DC overvoltage test result summary list and attempted to obtain samples of both failed cable and various other 4kV cable samples for laboratory analysis.

Unfortunately, prior to the establishment of the 4kVTF, all but a few miscellaneous samples of the 'C' Transformer feeder cables, both 'X' and 'Y' Windings were removed and sent off site for salvage. The 4kVTF attempted to recover that cable but it had already been destroyed in salvage operations. The remaining small samples from the 'X' and 'Y' Windings were tagged and are identified in Tables 5-1 and 5-2 as Sample Nos. 1 through 9 and 36. Sample Nos. 10 through 14 are paper filler and binding tape from the 'C' Transformer cables. All of the samples ranged from one foot to four feet in length (suitable only for physical analysis and limited electrical testing). Sample Nos. 1 and 2 are approximately four foot sections of the 'C' Transformer feeder cable, Phase B and C conductors that failed in service in November, 1985. As such, samples of 'C' Transformer cables were limited.

Physical testing and visual inspection was conducted on the 'C' Transformer cables failing DC Overvoltage testing and/or failing in service. Limited electrical testing was done on the short non-failed phase conductors of the "C" Transformer cable failing in-service. (This testing revealed acceptable 4kV cable dielectric properties.)

With regard to the Turbine Plant Cooling Water Pump (TPCW) cable which failed DC Overvoltage testing, the failure was isolated to a section of cable associated with the terminator on the TPCW motor side of the circuit (Sample 23A as listed in Table 5-1). After removal of the terminator and suspect section of cable, the balance of the TPCW cable was again subjected to DC Overvoltage testing and passed this subsequent testing. The 4kVTF evaluated that failure and the implications germane to all terminators as discussed in Section 6.2.5 (Reference 5.3.1).

With regard to the 'B' Transformer cable failing DC Overvoltage testing, the failure was isolated to a section of line associated with the terminator. Again, the balance of the 'B' feeder cable (after removal of the terminator and suspect cable), passed a subsequent DC Overvoltage test.

The cable from the terminators associated with the TPCW and 'B' Transformer cables which failed DC Overvoltage testing and cable from from three 'A' Transformer terminators (passed DC Overvoltage testing) were also evaluated.

As noted above, samples of the 'C' Transformer 4kV cable were limited. Since these cables were replaced with a shielded cable construction of another manufacturer, it was then appropriate to select samples that would be typical of existing 4kV Simplex cables in other areas of San Onofre Unit 1. Cable samples from four areas of the 'B' Auxiliary Transformer circuits were selected as representative of the remaining Simplex non-shielded cable runs in San Onofre Unit 1.

Samples of the 'B' Transformer cable, considered representative of the service conditions of the balance of 4kV cable in San Onofre Unit 1 were sampled (Sample Nos. 16-22 and 24-35, 37 and 43 of Table 5-1) and forwarded to various laboratories for a variety of physical and electrical tests as identified in Table 5-2.

The samples were to be in fifteen foot lengths. Sixteen 3/C cable samples were cut from "B" Auxiliary Transformer cable tray runs to satisfy the electrical testing program. The cable tray location and sample identification number are in Table 5-1.

Four 15 foot samples of the Charging Pump cable which passed DC Overvoltage testing, various short pieces of "A" and "B" Transformer feeder, charging pump, and TPCW pump cable, and nine 15 foot samples of 'A' Transformer feeder cable (all of which passed DC Overvoltage testing) were also kept by the 4kV Task Force for archive purposes, but not forwarded to laboratories for testing. These samples will be sent to salvage after completion of laboratory testing. Some of the 15 foot sections of charging pump cable were electrically tested at the SCE Alhambra Shop and Test facility.

In addition to the electrical tests, tensile strength and elongation measurements were to be performed to assess any degradation or accelerated aging of physical properties. For this purpose, one foot samples would be adequate, also taken from various segments of the 'B' Auxiliary Transformer run. Twelve were cut for the physical tests.

The number of cable samples taken from the 'B' and 'C' Transformer and Charging Pump circuits, coupled with the number of physical analyses and electrical tests performed, provided a substantive base of data to assess the material condition of the 4kV Simplex cable remaining in service.

5.1.2 600V System Cables

The samples selected for analysis were taken from circuits exhibiting cracked jackets representing the worst case cable condition from the worst case environment. These were Simplex single conductor No. 12 AWG 600 volt cables with Anhydrex XX butyl insulation and neoprene jackets.

Circuits were megger tested and then removed. This provided 16 single conductor cables from which ten (10) were selected for analysis and testing (Table 5-3). These cable samples, comprised of cable having both cracked and intact jackets, were forwarded to an independent laboratory for testing.

5.2 LABORATORY FACILITIES UTILIZED

The evaluation of the cable samples required locating laboratories with expertise and facilities capable of performing high voltage testing and electrical parameter measuring and analysis, and/or the background and equipment in preparing and measuring physical properties taken from cable samples (Reference 5.3.2). The work was contracted to four independent laboratories (References 5.3.3 to 5.3.6), two that would perform the electrical tests and physical analysis, and two others performing only physical analysis as discussed in Section 5.1 (Reference 5.3.7 to 5.3.11).

5.2.1 Independent Laboratories

Four laboratories were identified as having the necessary expertise for the cable assessments. For measuring only the cable's physical properties, the Okonite Company and Springborn Laboratories were selected. The more extensive electrical and physical tests were submitted to the Kerite Company and Cable Technology Laboratories.

References 5.3.7 through 5.3.10 provide direction to the selected laboratories with regard to the specific testing each is required to perform on the cable samples forwarded to them.

Reference 5.3.11 specifically requests Cable Technology Laboratories to analyze the short, faulted 'C' Transformer cables to determine the cause of failure.

5.2.2 SCE Shop and Test Facilities

The electrical test facilities at the SCE Shop and Test at Alhambra were used for in-house evaluations of OZ terminations and to supplement the cable electrical strength tests performed by the independent laboratories.

5.2.3 4kV Cable Evaluation Task Force (Site)

The organization of which tests would be necessary, which samples were needed and which laboratories had the competence to provide the cable evaluations was done by the 4kVTF. In addition, specific calculations, circuit identifications, preparation of needed inspection procedures on existing circuit runs and detailed examinations of cable specimens were all within the 4kVTF's purview.

5.2.4 EG&G, Idaho Scope

SCE entered into an agreement with the U. S. Department of Energy (DOE) and Idaho National Engineering Laboratory (INEL) in order to implement a electrical circuit surveillance pilot program during the current Cycle 9 refueling outage to determine whether or not an ECCAD based circuit surveillance program for San Onofre Unit 1 would be beneficial. This circuit surveillance program utilizes equipment developed by EG&G Idaho, Inc. The system is designated the Electrical Circuit Characterization and Diagnostic (ECCAD) System. ECCAD utilizes time domain reflectometry (TDR) technology to assess overall circuit integrity in-situ. The equipment provides baseline data for each circuit which is compared against other known baseline data or, in later years, against the original data to notice any trends or departures from the expected norms. This technique was employed to establish base lines for certain 4kV and 600 volt circuits but played a minimal role in assessing the material condition of 4kV and 600V Simplex cable.

After establishment of the aforementioned agreement, it was determined that the ECCAD testing would be included as part of the overall Material Condition Review Program for San Onofre Unit 1. A sample set of representative circuits were selected. These included various instrumentation, control and power circuits. Subsequent to contract arrangements, the 4kVTF elected to expand the EG&G scope of testing to attempt to obtain further data on select 4kV and 600V circuits. The circuits to be tested and test status as of May 13, 1986 are identified in Table 5-4.

5.3 REFERENCES FOR SECTION 5.0

5.3.1 Appendix A - 4kVTF Task No. 38

5.3.2 Appendix A - 4kVTF Task No. 35

5.3.3 Purchase Order No. 8J036903 to Cable Technology Laboratories dated April 7, 1986

5.3.4 Purchase Order No. 8J036904 to the Kerite Company dated April 7, 1986

5.3.5 Purchase Order No. 8J036905 to The Okonite Company dated April 7, 1986

5.3.6 Purchase Order No. 8J036906 to Springborn Laboratories dated April 7, 1986

5.3.7 Letter, C. K. Balog to Cable Technologies Laboratory dated March 28, 1986; Subject: Cable Analysis

5.3.8 Letter, C. K. Balog to the Kerite Company dated March 28, 1986; Subject: Cable Analysis

5.3.9 Letter, C. K. Balog to the Okonite Company dated March 20, 1986; Subject: Cable Analysis

5.3.10 Letter, C. K. Balog to Springborn Laboratories dated March 28, 1986; Subject: Cable Analysis

5.3.11 Letter, C. K. Balog to Cable Technology Laboratories dated April 3, 1986; Subject: Analysis to Determine Failure Mode for Aux. Transformer "C" Cable

TABLES

SECTION 5.0

LIST OF TABLES

TABLE 5–1

4kV CABLE EVALUATION TASK FORCE
SAMPLE INDEX

Sample No.	Description
1.	C–XFMR X–Winding – Cable #4 Phase B – FAULTED
2.	C–XFMR X–Winding – Cable #4 Phase C – FAULTED
3.	C–XFMR X–Winding – Cable #4 Phase A – NON–FAULTED
4.	C–XFMR Y–Winding – 4kV Room
5.	C–XFMR Y–Winding – Near Lube Oil Reservoir
6.	C–XFMR Y–Winding – Near Lube Oil Reservoir
7.	C–XFMR X–Winding – Cable #3 – Fault Area
8.	C–XFMR X–Winding – Cable #2 – Fault Area (A, B and C phases)
9.	C–XFMR X–Winding – Cable #1 – Fault Area
10.	C–XFMR X–Winding – Cable #4 – Paper Filler – Fault Area
11.	C–XFMR X–Winding – Cable #2 – Paper Filler and Binding Tape – Fault Area
12.	C–XFMR Y–Winding – Paper Filler and Binding Tape – 4kV Room
13.	C–XFMR X–Winding – Cable #4 – Aluminum Armor – Fault Area
14.	C–XFMR Y–Winding – Binding Tape – Near Lube Oil Reservior
15.	B–XFMR – Cable #1 – Last 6 Ft. from 4kV Room – Conductor B–1 Failed Hi–Pot – Subsequently Passed When Cut Away from OZ Terminator
16.	B–XFMR – Cable #1 – Terminator from the XFMR side
17.	B–XFMR – Cable #1 – Compound from Terminator at Transformer
18.	B–XFMR – Cable #2 – 15 Feet & Terminator – 4kV Room
19.	B–XFMR – Cable #4 – Near Main Steam – (15 Foot sample)

TABLE 5-1 (Continued)

4kV CABLE EVALUATION TASK FORCE
SAMPLE INDEX

Sample No.	Description
20.	B-XFMR - Cable #3 - Near Main Steam - (15 Foot sample)
21.	B-XFMR - Cable #2 - Near Main Steam - (15 Foot sample)
22.	B-XFMR - Paper Filler Material from Cable #2 (Sample #21) - Near Main Steam (Cut inward from Sample #21 Cables)
23.	TPCW Cable w/Terminator (No Termination)
	23A FAILED Hi-Pot (A Phase)
	23B Passed Hi-Pot
	23C Passed Hi-Pot
	23 Cable From Terminator Back Passed Hi-Pot #23 is Cable above Terminator (about 3 Feet)
24.	B-XFMR - Cable #4 - from 4kV Room with Terminator 15 Feet
25.	B-XFMR - Cable #3 - from 4kV Room with Terminator 15 Feet
26.	B-XFMR - Cable #1 - Near Main Steam Line - 15 Feet
27.	B-XFMR - Cable #2 - South Straightaway - Near Exciter Housing - 15 Feet
28.	B-XFMR - Cable #1 - Middle Straightaway Near Weld Burn on Cable Tray - 15 Foot Sample
29.	B-XFMR - Cable #3 - South Straightaway Near Exciter Housing - 15 Feet
30.	B-XFMR - Cable #1 - South Straightaway Near Exciter Housing - 15 Feet
31.	B-XFMR - Cable #4 - South Straightaway Near Exciter Housing - 15 Feet
32.	B-XFMR - Cable #1 - with Boot - No Terminator from near the XFMR - 15 Feet

TABLE 5-1 (Continued)

4kV CABLE EVALUATION TASK FORCE
SAMPLE INDEX

Sample No.	Description
33.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet
34.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet
35.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet
36.	C-XFMR - Y-Winding - from 4kV Room about 3 Feet
37.	3 Pieces of B-XFMR Cable (9 conductors - about 3 ft. each)
38.	15 Foot Sample from Charging Pump G8A
39.	Charging Pump 'B' Booted Cable Near Pump
40.	Charging Pump 'B' - Mid-run - Indoors - Unbooted
41.	Charging Pump 'B' - 2nd Unbooted - Indoors
42.	Charging Pump 'B' - Booted Near Pump
43.	B - XFMR Cable #1 - 3 (1 foot pieces from sample #15)
44.	A-XFMR (3 O-Z Terminators from XFMR)
45.	Terminator 'C' Transf. 4kV Room (No Boot) A1C2-X04, 1A1C02, BWH
46.	Terminator, 'C' Transformer, With Boot, XFMR End
47.	Terminator, 'C' Transformer, With Boot, Transf. End

TABLE 5-2

March 28, 1986

SAMPLES FORWARDED TO PARTICIPATING LABORATORIES

SAMPLE REQUIRED	LABORATORY AND SAMPLE NUMBERS (#)				
	CTL	Okonite	Kerite	Springborn	SCE
Aux. B. Trans.					
1' Length of 1/c	—	#34c, 35	—	#34a, 34b	—
15' Length of 3/c	#32, 33	—	#34, 35	—	—
Aux. B - Straightaway					
15' Length of 3/c	#27, 28	—	#29, 30, 31	—	—
Aux. B - Steam					
1' Length of 1/c	—	#20c, 19c	—	#20a, 20b	—
15' Length of 3/c	#19, 20	—	#21, 26	—	—
Aux. B - Switchgear					
1' Length of 1/c	—	#43a, 43c	—	#43b, 18c	—
15' Length of 3/c	#18	—	#24, 25	—	—
Aux. C - Near Failure					
1' Length of 1/c	#7-2	#8-3	#8-1	#7-1	—
South Charging Pump G8B	—	—	—	—	41,42,43

TABLE 5-3

4kV TASK FORCE

600V Cable Sample Index

CABLE: Simplex 1/C, No. 12 AWG, 600 Volt, Butyl/Neoprene

Sample No.	Circuit Length (Feet)	(Internal Coding)
101	113	1NB0128C2-C1
102	223	1WB0115K3-K26
103	200	1WB0115P1-T1
104	200	1WB0115P1-T2
105	222	1WB0128K1-K15
106	193	1WY10901-U
107	217	1WB0128C1-X1
108	265	1WB0128P1-T1
109	265	1WB0128P1-T2
110	265	1WB0128P1-T3

All cable samples were sent to Cable Technology Laboratories

TABLE 5-4

May 13, 1986

TESTING STATUS

EG&G LIFE EXTENSION PROGRAM
ECCAD - CABLE CONDITION TESTING

		DEVICE	QUANTITY	W. A. NUMBER	STATUS
Complete	1.	RTDs	25	Pen. W.A.R.	25 Completed
Complete	2.	LVDTs	45	Pen. W.A.	45 Completed
	3.	Incore T/Cs	25	1-8601104 FC 5-6-86	Sta. Mtnce. Restrt. RV. Head Restoration
Complete	4.	FT-400 Flow Trans	1	1-8601158	W.A. Submitted 04/21 Test 5-9A
Complete	5.	Nuclear Instruments	5	1-8601164	W.A. Submitted 04/21 Test FC 5-9A
	6.	480V Cables	21		Completed 7. Need EG&G and Megger Testing on balance.
Complete	7.	Cont. Fans	2	1-8601163	Fan A1 Tested 4-28A, Fan A3 Test 4-20A
Complete	8.	PZR. Heaters	3	1-8601165	Test 4-30A
Complete	9.	RCP Motors	3	1-8601160	3 Completed 4-26A
	10.	H_2 Recombiners	2	1-8601187	Test FC 5-13
Complete	11.	Power Cables Cond. Pump Motor (4kV)	1	1-8601186	Test 4-30A

TABLE 5-4 (Continued)

May 13, 1986

TESTING STATUS

		DEVICE	QUANTITY	W. A. NUMBER	STATUS
Complete	12.	N. Circ Pump	1	1-8601274	Test 5-1-86A
	13.	480V Cables with outer jacket cracked	25		CWOs generated for 20 Cables. Need balance generated.

ATTACHMENTS

SECTION 5.0

There are no Attachments to Section 5.0

SECTION 6.0

TESTING, ANALYSIS, INSPECTION, AND EVALUATION PROGRAM

6.0 TESTING, ANALYSIS AND INSPECTION PROGRAM

In order to conduct an in-depth and comprehensive evaluation program to meet the objectives outlined in Section 2.0, an extensive testing, analysis, and inspection program was required to provide meaningful data on general cable condition, electrical and physical properties, and environments.

The assessment of cable integrity requires an evaluation of both electrical and physical characteristics. Either could be a factor in cable life; however, it is usually the physical aging that governs. The test program implemented encompassed both categories. Additionally, for existing 4kV circuits, in-place DC overvoltage testing was done to detect any abnormalities.

Separate analyses on the 4kV cable were initiated to determine the root cause of the in-service failure, and to assess the material condition of 4kV cable to determine the reason for the OZ terminations not meeting the DC overvoltage test requirements.

For the 600 Volt circuits, visual inspection of cables in trays was performed. Megger tests and ECCAD (EG&G, Idaho) were also used to assess the condition of these in-service cables.

This program is discussed in detail in the following sections.

6.1 TESTING OVERVIEW

The selected 4kV cable samples were sent to the independent laboratories; Okonite and Springborn each received six of the short one-foot 1/C samples, Kerite receiving nine 15-foot, 3/C lengths, and Cable Technology Laboratories received seven. All four laboratories also received a one-foot 1/C sample taken from cables near the 'C' Auxiliary Transformer in-service failure. All other samples were from the 'B' Auxiliary Transformer circuit.

SCE Shop and Test were sent four 15-foot lengths of the 4/0 conductor size from Charging Pump G-8B to broaden the sample spectrum.

A listing of samples sent to participating laboratories is shown in Table 6-20 and 6-21.

The 600 volt cables removed for further testing were placed into coils. Ten coils were sent to Cable Technology Laboratories and one length to SCE Shop and Test. The remaining coils were to be visually examined by the 4kV Task Force on site. The test results are in Section 6.3.

The electrical and physical tests performance will provide the basis for evaluating the present condition of the cables and for projecting future life. Although there are other measurements that can be performed, the results are either obvious from observation of the actual cable or encompassed within the test data obtained. Further, the electrical tests and physical analysis performed will provide sufficient data to assess the material condition of the subject cables as discussed in the following paragraphs.

6.1.1 Test Parameters for Electrical Tests

The cable insulation system is normally exposed to AC and DC voltages. These parameters are tested using a step procedure; that is raising the voltage in 5kV increments and holding at each level for 5 minutes (unless otherwise indicated) until breakdown. Surge tests were also performed as another measure of the dielectric strength. An inherent property of the insulation is its specific inductive capacitance and dissipation factor. These were also measured and compared to industry requirements.

6.1.2 Test Parameters For Physical Analysis

Cable electrical integrity depends on maintaining intact cable physical dimensions, particularly that of the insulation. Measurements of tensile strength and elongation were therefore, tested on both the insulation and jacket. The cable industry utilizes measurements of these parameters as a standard for determining cable condition.

6.1.3 The Use of Microscopic and Visual Inspection to Supplement Electrical Tests and Physical Analysis

The evaluation of the mechanism of the 4kV cable failure required visual examination of 4kV cable from the failure area and samples taken from adjacent cables at the failure area. A microscope was made available to the 4kVTF for close examination and evaluation of the 'C' Transformer 4kV cable failure and some short, (one-foot), 4kV cable single conductor sections from adjacent 'X' winding cables, and 600 volt cable cracked jacket specimens. The DC overvoltage breakdowns in 4kV cable at OZ Terminations were dissected and similarly examined. Use of the microscope allows detailed examination to discern between mechanical and electrical anomalies in or on cable insulation, conductors, etc.

6.1.4 DC Overvoltage Testing

The first priority following the 4kV 'C' Transformer cable failure was to schedule DC overvoltage tests on all 4kV circuits to detect any other potential cable insulation weaknesses or anomalies that could cause the cable to fail in the normal service environment and under normal electrical load. Additionally, a DC overvoltage test is a reasonable test to perform to aid in an assessment of cable material condition. The applicability of DC overvoltage testing is discussed in Section 7.5.3.

6.1.5 Megger Testing

Megger testing is a test routinely used at power plants to test the integrity of 600 volt and lower voltage circuits. The No. 12 AWG 600 volt Simplex cables with cracked jackets were all scheduled for megger testing. The scope and results of megger testing are discussed in Section 6.3.1.

6.1.6 EG&G, Idaho ECCAD Testing

A method of in-place testing developed by EG&G Idaho, ECCAD, which sends an electrical pulse through the cable circuits and records reflections as well as measuring certain electrical parameters was used to aid in this evaluation. This system was utilized by EG&G, Idaho to evaluate circuitry at Three Mile Island. SCE is cooperating with EG&G in a joint effort to prepare baseline data for select circuits at San Onofre Unit 1 and to further develop the ECCAD system. The pending results of this program are addressed in Section 6.3.3.

6.2 TEST, ANALYSIS AND EVALUATION RESULTS OF 4kV CABLES

The results from the four independent laboratories, SCE Shop & Test, and the 4kV Task Force were summarized to provide the basis for an overall assessment of the present condition of the existing cables and for their remaining life.

6.2.1 DC Overvoltage Test Results for 4kV Cables

The schedule of 4kV circuits that were tested and the results of that testing are identified in Table 6-18 and 6-19. The 4kV Task Force reviewed the initial DC overvoltage test results summary list (Table 6-18) and attempted to obtain samples of both failed cable and various other 4kV cable samples for laboratory analysis.

The 4kV cable that failed DC Overvoltage testing was identified as follows:

1. Feeder Cable #4 from the 'C' Transformer, X-Winding to Bus 1C (faulted in-service).

2. Feeder Cable #3 from the 'C' Transformer, X-Winding to Bus 1C.

3. Feeder Cable #2 from the 'C' Transformer, X-Winding to Bus 1C.

4. Feeder Cable from the 'B' Transformer to Bus 1B.

5. Cable from Bus 1C to the Turbine Plant Cooling Water Pump G6S.

6. Cable from Bus 2C to the Turbine Plant Cooling Water Pump G6N.

With regard to the South TPCW Pump (G6S) cables failing DC Overvoltage testing, the failure was isolated to a section of cable associated with the outdoor terminator on the TPCW motor side of the circuit (Sample 23A as listed in Table 6-20.) After removal of the terminator and suspect section of cable, the balance of the TPCW cable was again subjected to DC Overvoltage testing and passed the subsequent testing. The 4kVTF evaluated that failure and its implications germane to all terminators as discussed in Section 6.2.5 and 7.1.1.

With regard to the North TPCW Pump (G6N) which failed DC Overvoltage testing, the failure was again isolated to a section of cable associated with the outdoor terminator on the TPCW motor side. This cable was DC Overvoltage tested in late May, 1986 as it had been in continuous service since the beginning of the Cycle 9 outage. However, rather than replace the entire cable at this time, a repair of the cable was effected. This repair consisted of extending the motor terminal housing, cutting back the aluminum armor of the cable, replacing the OZ terminator and repairing the insulation with insulating tape and heat shrink jacketing. The terminator/cable interface was then covered with the same type of heat shrink tubing utilized on the replaced 4kV cable terminators. The repaired assembly was then DC Overvoltage tested at 28kV and passed. This is an interim repair until new cable is installed (no later than return to power from the Cycle 10 refueling outage). This repair is acceptable to the 4kVTF because of the quality of the repair and since the TPCW Pumps are non-safety related.

With regard to the 'B' Transformer cable failing the DC Overvoltage testing, the failure was isolated to a section of line associated with the terminator. Again, the balance of the 'B' feeder cable (after removal of the terminator and suspect cable), passed a subsequent DC Overvoltage test. As stated above, terminators were evaluated in Sections 6.2.5 and 7.1.1.

A comprehensive listing of all the DC Overvoltage test results on the existing as well as replacement 4160V cable can be found on Table 6-19.

6.2.2 Laboratory Physical Analysis and Electrical Test Results for 4kV Cables

The Laboratory results are presented in Tables 6-2 through 6-17. These results are taken from the final laboratory reports (References 6.6.15 through 6.6.21). An explanation of the results in each table is as follows:

Tables 6-2, 6-3, and 6-4

These Voltage Withstand Tests were performed to compare the present cable condition to the industry and manufacturer's requirements when the cable was originally manufactured. It should be recognized that the industry/ manufacturer's test levels for new cable are well above the 2.4kV that the insulation system will be subjected to in-service.

The results indicate the cable to be electrically in "as new" condition, that is, the AC, DC, and impulse test results are at the levels normally found in new cables.

Tables 6-5, 6-6, 6-7 and 6-8

These tests are a measure of the specific inductive capacitance and dissipation factor properties of the insulation and insulation system. This data is normally used to determine "self heating" of the insulation system from the alternating 60Hz voltage impressed across the system, in this case, 2.4kV. Self heating, or dielectric losses, are not a concern until operating voltages exceed 15kV across the insulation system (25kV circuit voltage). However, if these values have changed for the worse, then it is an indication of potential problems in the environment in which the cable has been operating. The results of tests show no evidence that these properties have been compromised.

Tables 6-9, 6-10, 6-11, 6-12 and 6-13

A measure of the aging of materials is to compare tensile strength and elongation values against original data. Original data may include Arrhenius curves, or just air-oven tests to meet industry or manufacturer's requirements.

Industry requirements for "new" material is shown in the tables as a basis for comparison, but the actual values, normally exceed these. For Simplex butyl, the reported original values were about 525 to 575 for per cent elongation and 795 to 1005 psi for tensile strength (Attachment 6-4). For the neoprene, original values were 387 to 475 percent elongation, and 2250 to 2650 psi tensile. These test results show the degree of aging (loss of physical properties) that has occurred over the 18 year operating period. This is developed in Tables 6-16 and 6-17. For conservatism, the 4kVTF draws its conclusion based on the lower curve.

Original data on Arrhenius aging for either the insulation or the jacket material could not be located; however, there exists a 168 hour, 100°C air-oven test on the butyl insulation which prompted the tests reported in Tables 6-10 and 6-13. Unfortunately, a similar air oven test on the neoprene jacket does not exist. It is expected that the availability of this data would have supported the conclusions regarding continued serviceability of the 4kV cable.

The results of these test series are used to envelope a projected future aging rate. This is shown in Tables 6-16 and 6-17 and is the basis for stating that the materials are adequate for the remaining design life of Unit 1.

A particular comment about Table 6-11 as it relates to the 'C' Transformer cable in-service failure is required. Note that both the tensile strength and elongation of the insulation are reduced at the elevated temperatures, making the butyl more susceptible to the mechanical splitting that actually occurred.

Tables 6-14, and 6-15

The initial reports of the in-service cable failures (C Transformer) cited that the cable appeared overheated and the fillers were wet. To assess the susceptibility of the cable to heat and moisture, the hostile environment tests of excessive heat and immersion in 90°C water were initiated.

Table 6-14 shows the electrical stability. The dielectric losses appeared to double with each 25°C increase above 100°C, but instability was not triggered even at 200°C. These temperatures are much higher than the 100-125°C temperatures calculated for the cable at the failure location. Thus, although the faulted 4kV cables were substantially overheated, this condition alone would not have accounted for the in-service failure.

Table 15 shows the effect of hot (90°C) water after a period of 21 days immersion. Again, the cable was stable for this period and there was no evident vulnerability to problems from moisture.

These hostile environments of excessive heat and hot water did not affect the electrical properties of physically intact insulation. Therefore, for the cable to fail, the insulation had to be compromised in some other manner. The mechanism of failure was a result of the localized heating expanding the cable components within the confinement of the aluminum interlock armor leading to the cracking of the neoprene jacket and tearing into the insulation at the pressure points between phase conductors.

Tables 6-16, and 6-17

The test results from Table 6-9 through 6-13 and the available 1965 physical data on Simplex butyl and neoprene (Attachment 6-4) have been used to develop the aging curves for these materials.

Tables 6-16 and 6-17 represent the aging rate experienced by the cable over its 18 years in service. Butyl, shown in Table 6-16, has significant resilience remaining. The two outer lines on the charts envelope the laboratory data. The lower line represents the worst case. From this analysis, the projection was given that this insulation will be satisfactory for the remaining design life of Unit 1.

Table 6-17 shows that the neoprene jacket, under the same conditions of operation, will also be satisfactory for the remaining design life of Unit 1.

6.2.3 SCE Shop and Test Electrical Test Results for 4kV Cables

The electrical breakdown tests summarized in Tables 6-3, and 6-4 were performed on the Auxiliary Transformer "B" cable samples. These were 500 kcmil conductor size. The tests reported from SCE Alhambra Shop and Test (Reference 6.6.7 and 6.6.23) are on 4/0 AWG size. The test results corroborate each other. In addition, OZ terminations were tested to breakdown (Reference 6.6.6 and 6.6.7).

The electrical tests performed at SCE Alhambra Shop and Test support the conclusion that the dielectric strength properties of the 4kV cable are essentially in "as new" condition. The cables tested were 4/0 AWG conductor size from the South Charging Pump G8B. Test results were:

kV WITHSTAND LEVEL
(5kV - 5 Minute Step Test)

AC	DC
60 + (Terminal Failure)	230
60 + (Terminal Failure)	230 + (Test discontinued)
60 + (Terminal Failure)	230 + (Test discontinued)
	190 + (Terminal Failure)
	190 + (Test discontinued)
	190 + (Test discontinued)
	210
	210 + (Test discontinued)
	210 + (Test discontinued)

This series of tests at Alhambra also corroborated that the OZ terminations (Reference 6.6.6, 6.6.7 and 6.6.8) had dielectric strength levels well above the 28kV DC Overvoltage test value providing that the cables are not compromised by the moisture penetration observed in the OZ terminations failing the 28kV DC test. The SCE Alhambra Shop and Test test levels for three OZ terminations were above 120kV DC (one termination could not be tested above 60kV due to inadequate cable lengths beyond OZ housing).

6.2.4 Results of Laboratory Tests on Sections of 4kV Cable Involved in the November 1985 In-Service Failure

The mechanism involved in the actual in-service failure was analyzed to assess if this was an isolated incident due to unusually severe local circumstances or whether there was a general problem associated with this cable design or its application.

The failure location was near and under an uninsulated ten-inch diameter 407°F feedwater pipe and a flange that periodically was reported as leaking. The ambient temperatures were in excess of the normal 40-50°C operating levels, and the conductor temperature was calculated to be in excess of 100°C (Reference 6.6.9). These cables are rated for 90°C conductor temperatures in the normal environment. This localized condition was beyond the design basis and established "Hot-Pipe Criteria" (Reference 6.6.10) for this cable circuit.

Analysis of the actual in-service failure section and adjacent cable samples reveal that the basic mechanism involved in the insulation breakdown was the splitting of the insulation surface from the excessive temperatures and confined pressures under the interlock armor. The neoprene jacket over the individual conductors was hardened and cracked at the interface contact between phases. In this same area the fabric tape between the jacket and insulation was split apart. It was only in the phase contact areas that this jacket hardening and cracking, the torn tape, and the splits in the insulation were evident. This held true on the samples sent to Cable Technology Laboratories, to Kerite, and two one-foot samples examined on site. The splits penetrated one-third through the insulation thickness on these samples (the non-faulted conductors) and undoubtedly were deeper in the failed locations (Reference 6.6.11).

Attachment 6-1 is the documentation of the physical examination of samples of cable adjacent to the 4kV cable that failed in-service. The examination identifies the same mechanism underway in samples that did not fail in-service. This mechanism of degradation could only occur in an environment well beyond the design basis for the cable. Reports from the MCRP Team indicated that portions of these same cables away from the hostile area were pliable without jacket cracking, which further supports the localized severity conclusion. It is also unlikely that the remaining 4kV Simplex cable is vulnerable to the same failure mechanism as the construction is different; i.e., the other conductor sizes do not have a fabric tape between the jacket and the insulation, which appeared to be a contributing factor in the insulation splitting.

6.2.5 Evaluation of OZ Terminators

OZ Terminators are designed for both jacketed and non-jacketed metal clad cables for wet locations. The Simplex 4kV cable is not jacketed over the interlock armor and the procedure of using a separate outer sleeve has not been effective. Moisture has penetrated above and within the OZ fitting between the neoprene and butyl on the individual phase conductors. This has resulted in electrical stress distortions both externally and within the cable insulation system as evidenced by the low DC Overvoltage Test breakdowns of the two outdoor OZ Terminators in References 6.6.7, 6.6.8 and 6.6.23.

The experience of SCE with these same Cable/OZ Terminations throughout its system indicates no service failures even though the outer aluminum armor has been severely corroded under the sleeves at some locations. This experience demonstrates no immediate or rapid degradation in electrical integrity for those circuits where the 28kV Hi-Pot tests were satisfactorily passed. SCE Shop and Test has taken three OZ Terminators passing the 28kV DC Overvoltage Test and tested them to breakdown at 80 to 120kV. This demonstrates ample margin above operating and test requirements. It does not, however, remove the compromising effects of moisture ingress, both existing and potentially occurring on these terminations.

6.3 TEST, ANALYSIS, AND EVALUATION RESULTS FOR 600 VOLT CABLES

As described in Section 6.4.1, only one type of cable exhibited cracked jackets; Simplex single conductor, No. 12 AWG, with approximately 50 mils of Anhydrex XX Butyl insulation and approximately 20 mils of neoprene jacket. There was no in-service problem other than observing the accelerated aging of the jacket. The assessment program to establish cable integrity follows.

6.3.1 Megger Test Results for 600 Volt Cables

The 600V Simplex cables with cracked jackets that have been removed for further testing satisfactorily passed megger tests prior to removal. All other cables with cracked jackets have been or will be megger tested. Approximately 95% (47 of 51) of these circuits have been tested to date with satisfactory results. The balance are energized and will be tested when removed from service.

6.3.2 Laboratory Physical Analysis and Electrical Test Results for 600 Volt Cables

The cracked neoprene jackets on these No. 12 AWG single conductor sizes are evidence of thermal aging and because of their normally light current loading, are indicative of higher area ambient temperatures. The trays containing cables with cracked jackets contained mostly control circuits so that adjacent circuits in the tray were not contributing to the heat source and are therefore not considered to be a factor in the identified jacket degradation.

The higher area ambient temperature obviously envelopes all other materials in the trays and a question of the effect on their thermal life is appropriate unless neoprene ages more rapidly than the other materials. In fact, the neoprene material does age more rapidly than the butyl insulation used on the conductors. This can also be stated when neoprene is compared with other commercially used materials.

Tables 16 and 17 show air-oven aging of both butyl and neoprene respectively. Table 6-23 is an early (circa 1965) Arrhenius Plot showing the rate of oxidation and useful life for butyl-rubber and neoprene. Although these particular compounds are from another cable manufacturer, they represent the thermal aging properties of these higher quality neoprene formulations and are applicable to this assessment. Materials are tested on small samples at constant temperatures in circulating hot air ovens to establish the Arrhenius curves. The relationship to actual service, however, has been semi-empirical, relating known materials having 40 years service to newer materials. However, the "known" materials have been operating under typical environmental conditions, typical load cycles, and with cable coverings that limit oxidation (aging) of the components. When this relationship is no longer valid, then aging will more closely follow the Arrhenius Plot.

Therefore, under normal circumstances, neoprene jackets would give a 30-40 year life, but when the area ambient temperature increases, the material is placed into a continuous elevated temperature environment, resulting in an "accelerated" rate of aging. From the plot, it is evident that butyl has at least a 50°C margin above neoprene; i.e., if neoprene aged to brittleness in 10 years at 50°C, butyl would still be pliable at approximately 95°C or alternatively, if exposed to the same ambient temperatures, the butyl would still be pliable years later. This is also evident from the 4kV cable evaluation (Reference 6.6.12), where neoprene jackets in the "hot-spot" location have cracked, but the butyl is still pliable and would project life in excess of the remaining design life of Unit 1 under historical operating conditions. Physical analysis on the insulation (References 6.6.13 and 6.6.22) confirm these assessments.

This same butyl insulation is on the small 600V cable and its thermal history cannot be more severe than the insulation on the 4kV cable at the hot-spot location which was in a higher ambient area. This higher ambient is due to air stratification as well as the proximity of large steam and feedwater pipes. Therefore, the thermal condition of the exposed butyl insulation under the cracked neoprene jacket of the 600 volt cables is more than adequate to operate for many more years, i.e., for the design life of Unit 1.

Results of the 4kV cable evaluation demonstrated the electrical stability of butyl even under adverse temperature conditions (Reference 6.6.12). The maximum operating voltage on these circuits is 480 volts phase-to-phase. The test results (References 6.6.13 and 6.6.22) of the cracked jacketed cable samples show they held the acceptance level of 4.5kV AC and 13.5kV DC for new cable and broke down above 10kV AC and 25kV DC. These levels are significantly above operating requirements.

6.3.3 EG&G, Idaho ECCAD Test Information

The review of data from EG&G, Idaho ECCAD testing has identified no significant anomalies in any of the circuits tested to date. The scope of that testing is delineated in Section 5.1.4.

The main purpose of this testing is to establish a data base for future testing and as a result, many of the circuits tested had cable that was installed as part of the Cycle 9 outage EQ activities. The material condition of a circuit is expected to be assessed by comparison with subsequent testing. However, the test results can be compared to data from other circuits at other plants for a preliminary assessment of circuit condition. The testing would also, at this time, identify any circuit anomalies of significance.

The type of information to be obtained with initial tests is discussed as part of the RCP 4kV Penetration Assessment in Section 7.1.4.

6.4 FIELD INSPECTIONS

Field inspections of the plant were conducted to evaluate the material condition of power, control and instrumentation cable. These inspections included:

a. A review of all power and control cable in San Onofre Unit 1 to determine the material condition of these cables.

b. Walkdowns of all "hot-pipes" in the plant to identify potential interfaces between these lines and cable raceways that could be detrimental to maintaining acceptable cable material condition.

c. Walkdowns of all cable trays containing safety-related circuits utilizing Simplex, single conductor, 12 AWG cable to identify if jacket cracking is present.

6.4.1 Tray/Cable Inspections

The Material Condition Review Program (MCRP) Team for power and control cable conditions in San Onofre Unit 1 performed extensive plant walkdowns. These walkdowns were to identify, review and visually evaluate the material condition of all power and control cable and to provide recommendations that will maintain this material condition to a degree of reliability which would avoid in-service failures.

The cables inspected were selected by Operations and Station Technical Advisors based on their knowledge of the plant devices, the failure of which could challenge the Safety Systems.

The raceways inspected under the MCRP program and their conditions are as follows:

a. Single and Multiconductor Cables in Trays 52K1, 52K2, 52V1 and 52V2. Cables in this area were inspected and found to be in good condition.

b. Tray 46C7 East Condenser Area. Cables in this area were inspected and found to be in good condition.

c. Vertical Tray 46AA3 near East Recirculation Pump. Cables in this tray were inspected and found to be in good condition.

d. Trays 46S3, 46S4, 46S2 and JB446 West of East Feedwater Pump. Cables in these trays and junction box were inspected and found to be in good condition.

e. Tray 46C1: Cables in this tray were inspected and found to be in good condition.

f. Trays 46C2, 46C4, 46C3 located outdoors south of 4kV Switchgear Room: Cables in these trays were inspected and found to be in good condition.

g. Tray 49J2 located above west feedwater pump: Cables in this tray were inspected and found to be in good condition.

h. Trays 49V2, 49V4 located inside of the Turbine Building at the west wall: Cables in these trays were inspected and found to be in good condition.

i. Terminal boxes at Tsunami gate operator motor for SW inlet in the intake structure: Control and power cables were inspected and found to be in good condition.

j. Breaker 52-1102, Station Service Transformer #1 in 4kV Switchgear Room: Cable and terminations were found to be in good condition.

k. Breaker 52-1117, Condenser Vacuum Pump X-7A in 4kV Switchgear Room: Power cables were found to be in good condition.

l. Breaker 52-1315, Turbine Auxiliary Lube Oil Pump G-29 in 480 Volt Room: Cable and terminations were found to be in good condition.

m. Breaker 52-1207, Recirculation Pump G-45B in 480 Volt Room: Cable was found to be in good condition.

n. Auxiliary Lube Oil Pump motor G-29 terminations at Turbine Building Mezzanine area: Terminations were found to be in good condition.

o. Auxiliary Feedwater Pump Motor: Motor connections and cable inside P.B. 833 F were inspected and found to be in good condition.

p. West Vacuum Pump: Terminal box, cables and terminations were found to be in good condition.

q. Terminal area behind Control Room control and relay panels: Cables were found to be in good condition. At terminal lugs, the neoprene jackets have not been cut back. Quantities of abandoned cable behind panels were identified.

r. Some Simplex cable was found with the neoprene jacket hardened and cracked in the following trays:

1. E&W Vapor Extractor Motor Power Cables near Turbine Lube Oil Reservoir: Single conductor cable neoprene jackets were found cracked.

2. Tray 36P1 at bend turning from West to South: Single conductor cable neoprene jackets were found cracked.

3. Tray 49S1: Several single conductor cables with neoprene jackets were found cracked.

4. Tray 36Q1 at T junction: Several single conductor cables with neoprene jackets were found cracked.

5. Tray 39W1 in 480V Room: Nine single conductor, 4/0 AWG Simplex cables with neoprene jackets were found cracked.

6. Tray 39V7 in 480V Room: Single conductor, 4/0 AWG cables were found in good condition.

Due to the findings in Item r. above, the 4kVTF conducted additional inspections, concentrating in the plant areas containing the cable raceways identified above.

A detailed review of the Turbine Building, primarily in the upper elevations above the Lube Oil Area and Reheater Area, identified a total of 65 circuits (140 cables) utilizing Simplex, single conductor, 12 AWG, butyl-rubber insulated and neoprene jacketed cable exhibiting cracked jackets.

In addition, the top wireway of Motor Control Center (MCC) No. 1 located in the 4kV Switchgear Room contained Simplex, single conductor, 12 AWG cables with cracked jackets. A total of 157 circuits (312 cables) utilizing this cable type enter this MCC.

Only one other 600V circuit was found in the plant exhibiting jacket cracking. This was the feeder circuit to MCC No. 2 from 480V Switchgear No. 2 located in the 480V Switchgear Room. This circuit consists of nine single conductor, 4/0 AWG, Simplex cables, some of which exhibit minor jacket cracking.

A detailed tabulation of the walkdowns and circuit listing is contained in Attachment 6-3.

6.4.2 <u>Localized Heat Source Walkdowns</u>

To determine if any areas in SONGS 1 have hot pipes in close proximity to cable raceways, separation criteria and walkdown packages were prepared. An Engineering Checklist (Attachment 6-5) was used to identify piping meeting the temperature criteria specified in the following sections. A Walkdown Verification Sheet (Attachment 6-6) was used to document suspect raceway to pipe interfaces and insulation requirements. The criteria used to determine the walkdown selection criteria is as follows:

a. Hot Pipe to Conduit - The previously established SONGS 1 criteria with one inch added to all dimensions to account for thermal growth in the lines.

The existing SONGS 1 Conduit Clearance from Heat Sources Criteria is as follows:

1. Power, control and instrumentation conduits shall be separated from uninsulated hot pipes with operating temperatures of less than 141°F and from hot pipe insulation surfaces with temperatures of less than 141°F by a minimum distance of one (1) inch.

2. Power, control and instrumentation conduits shall be separated from uninsulated hot pipes with operating temperatures greater than 141°F and from hot pipe insulation surfaces with temperatures greater than 141°F by the following minimum distances:

INSULATION SURFACE OR HOT PIPE TEMPERATURES (°F)						
TEMPERATURE RANGE (°F)	141-300	301-350	351-400	401-450	451-500	501-550
HOT PIPE OD OR INSULATION OD (INCHES)	SEPARATION DISTANCE (INCHES)					
1 to 3	1	1 1/2	2	3	4	5
4 to 8	1	3 1/2	5 1/2	8	11	12
10 to 14	1	6	9	12	*	*
16 to 20	1	8	12	*	*	*
24 to 30	1	12	*	*	*	*
36 to 43	1	*	*	*	*	*

* Asterisk denotes a minimum distance of 12 inches for conduit crossing pipe perpendicular and 18 inches for conduit running parallel to pipe.

b. Hot Pipe to Cable Tray - As no specific project criteria existed, twice the conduit criteria dimensions were used. This is a conservative criteria to be used only for the walkdowns.

c. All lines with surface temperatures 140°F ±10% (60°C) or less were eliminated as not requiring verification. The 140°F cut-off temperature used is essentially ambient temperature and would have minimal or no effect on cables in close proximity.

Engineering packages by plant area were prepared consisting of an Engineering Checklist Form listing all selected lines and marked-up piping area drawings. The Engineering Checklist contains data such as line number, pipe size, pipe insulation, surface temperature and conduit and tray separation criteria. (Attachment 6-5)

A Hot Pipe to Conduit/Tray Walkdown Verification Sheet was prepared for every line identified on the Engineering Checklist as requiring verification. If no raceways were found for a particular line not meeting the criteria, a Walkdown Verification Sheet (Attachment 6-6) was completed for documentation purposes.

Walkdowns of all "Hot-Pipes" identified on the Engineering Checklist Form were performed to identify potential interfaces between these "Hot-Pipes" and cable raceways that could be detrimental to maintaining acceptable cable material condition.

Evaluation of the data from these walkdowns identified several instances where piping must be insulated and/or conduits moved to provide proper thermal separation.

The data was evaluated and reduced into seven categories of action codes as follows:

HOT PIPE TO RACEWAY EVALUATION ACTION CODES

ACTION CODE	EVALUATION	ACTION REQUIRED
1)	a) Not touching b) Design condition below 200°F	1) None
2)	a) Touching b) Design condition below 200°F	1) Review pipe operating temperature
3)	a) Not touching b) Line insulated c) Meets separation criteria for 140°F, that is 1" for conduit, 2" for tray.	1) None
4)	a) Not touching/touching b) Line insulated c) Does not meet separation criteria of 140°F (same as Action Code 3)	1) Review pipe operating temperature 2) Evaluate circuit necessity
5)	a) Not touching b) Line uninsulated c) Line should be insulated per design	1) Review operating temperature 2) Evaluate temperature gradient 3) Evaluate circuit necessity 4) Provide pipe insulation if required. 5) Provide pipe and raceway separation
6)	a) Not touching b) Line uninsulated	1) Same as Action Code 5
7)	a) Touching b) Line uninsulated	1) Same as Action Code 5

Further data reduction (as listed in the "Action Required" Column) was performed using the following bases:

a. Under the Action Required column any one of the actions listed may be used to evaluate the condition.

b. Circuits contained in affected conduit/tray were identified as to function (instrumentation, control, power) and safety train.

c. Instrumentation, control and lightly loaded power cables were considered acceptable where the design line temperature was below 200°F since cables are not subject to self heating.

d. Circuit function was reviewed, with circuits such as telephones, lighting and some alarms being eliminated from consideration.

e. Specific case calculations were performed to determine cable core temperature where criteria was not met. (Reference 6.6.14)

f. The additional one inch separation allowance in the walkdown criteria was deleted where there was no pipe thermal growth in the cable raceway direction.

g. Additional walkdowns were performed to further evaluate the acceptability of specific cases.

h. Piping function was reviewed with infrequently used piping such as drain lines being eliminated from consideration.

Of the nineteen areas in the plant walked down, ten did not contain any separation concerns. In the remaining nine areas, 142 findings were noted. These are listed below:

BREAKDOWN SUMMARY OF ACTION CODE BY AREA

AREA	ACTION CODE							COMMENTS
	1	2	3	4	5	6	7	
1	5	2	0	5	15	1	2	30 Finds
2	6	1	0	2	11	0	0	20 Finds
3	0	0	0	0	12	0	1	13 Finds
4	0	0	0	0	0	0	0	OK
5	1	1	1	9	1	0	0	13 Finds
6	1	1	7	11	12	0	1	33 Finds
7	0	0	0	0	0	0	0	OK
8	13	2	0	0	0	0	0	15 Finds
9	0	0	0	0	0	0	0	OK
10	6	1	0	0	0	0	0	7 Finds
11	0	0	0	0	0	0	0	OK
12	0	0	0	0	0	0	0	OK
13	0	0	0	0	0	0	0	OK
14	5	0	0	0	0	0	0	5 Finds
15	0	0	0	0	0	0	0	OK
16	0	0	0	0	0	0	0	OK
17	6	0	0	0	0	0	0	6 Finds
18	0	0	0	0	0	0	0	OK
19	0	0	0	0	0	0	0	OK
Total	43	8	8	27	51	1	4	142

Of the 142 findings, 88 were accepted based on the criteria listed above and 54 required physical work in the plant. These rework items are listed below:

AREA	INSULATE PIPE	MOVE CONDUIT
1	13	3
2	11	—
3	11	1
5	1	1
6	1	3
8	3	—
17	6	—
TOTALS	46	8

The 46 lines requiring insulation were identified to SCE Construction as requiring insulation prior to return to power (Reference 6.6.4) and are identified as follows:

AREA	NODE POINT	LINE NUMBER	AREA DRAWING	INSULATE WHOLE PIPE	INSULATE ONLY CONDUIT AND PIPE JUNCTION	CONDUIT NUMBER	LEVEL OF INSULATION STANDARD	STD W/MW-K AT COND.	MIN-K
1	201	391-10"	568567	YES	NO	10104N		X	
1	202	392-10"	568567	YES	NO		X		
	203						X		
1	1	1208-3/4"	568568	NO	YES	7930N			X
1	2,3	1201-3/4"	568568	NO	YES	7817F			X
						7818F			X
						7819F			X
						7909G			X
1	5	1203-3/4"	568568	NO	YES	31H2	X		
						31H3	X		
						31H4	X		
						31H5	X		
1	6	1203-3/4"	568568	NO	YES	7870F			X
2	1	1-24"	568586	YES	NO		X		
	2						X		
	3						X		
2	5	329-10"	568586	YES	NO		X		
	8						X		
2	6	326-10"	568586	YES	NO		X		
	9						X		
2	7	325-10"	568586	YES	NO		X		
	10						X		
2	8	329-4"	568586	YES	NO		X		
2	9	326-4"	568586	YES	NO		X		
3	1	381A-3"	568596	NO	YES	6074N			X
3	2	381C-3"	568596	NO	YES	4448N			X
3	3	381B-3"	568596	NO	YES	73138N			X
	4					7417N			X
3	6	182-12"	568596	NO	YES	4448N			X
3	7	160-8"	568596	NO	YES	74577N	X		
	8					74576N	X		
3	9	7068-6"	568596	NO	YES	72003F	X		

AREA	NODE POINT	LINE NUMBER	AREA DRAWING	INSULATE WHOLE PIPE	INSULATE ONLY CONDUIT AND PIPE JUNCTION	CONDUIT NUMBER	LEVEL OF INSULATION STANDARD	STD W/MW-K AT COND.	MIN-K
3	11 12 13	347-4"	568596	NO	YES	7548F 7694F 7691F			X X X
5	5	155-8"	568619	NO	YES	(UNSCHED) (2")	X		
6	26A	208-1 1/2"	568629	YES	NO		X		
8	1	737-8"	568644	NO	YES	(TWO UNSCHED EMT)	X		
8	2	3037-14"	568644	NO	YES	(ONE UNSCHED 2" EMT)	X		
8	3	734-6"	568644	NO	YES	(TWO UNSCHED EMT)	X		
17	1 2 3	1651-3"	713939	YES	NO		X X X		
17	4 5 6	1683-1 1/2"	713939	YES	NO		X X X		

Insulation will be applied to these lines prior to the plant returning to service.

Field Change Notices (FCNs) were issued to rework the eight conduits identified as being too close to a hot-pipe. These FCNs (F-1778E, F-1779E, F-1785E, F-1786E and F-1789E) will be implemented prior to the plant returning to service. (Reference 6.6.5)

6.4.3 Safety-related Simplex Cable Walkdowns

This section identifies all safety-related, Simplex, 600V, Anhydrex XX, butyl-rubber insulated, neoprene jacketed, single conductor, 12 AWG cable in SONGS 1 and documents the results of the field inspections of these cables in trays.

In order to identify these circuits, a special EE553 Circuit and Raceway Schedule sort by cable code and cable scheme number was requested. This report lists all the Simplex cable codes in scheme number sequence. Using the report, a listing of all Simplex, single conductor, 12 AWG, cables (Cable Code 122) utilized in safety-related circuits was prepared. Safety-related circuits are identified with a "F", "G" or "H" as the second character of the cable scheme number. 88 circuits (185 cables) were identified as being safety-related and are listed in Table 6-1.

From this review, no Simplex cables of any size or type are found to be located inside the Unit 1 Containment Building.

Plant walkdowns of the cable trays containing these 88 circuits were conducted to confirm that none of the suspect Simplex cable utilized in safety-related circuits exhibited jacket cracks.

These cables are routed to seven areas of the plant in 282 tray sections.

In order to inspect the cable trays containing these circuits the conduit and tray area drawings were marked to indicate the locations of all these trays. A cable tray walkdown checklist was prepared to identify information such as tray number, drawing number, cable scheme number of safety-related Code 122 cables, and observations. (Attachment 6-7)

All 282 tray sections containing Simplex, single conductor, 12 AWG, safety-related cables were walked down. No evidence of jacket cracking was observed in any of these cable trays.

Following is a summary of the walkdowns by Drawing Number:

Drawing Number	No. of Trays With Subject Cables	No. of Trays Without Subject Cables	No. of Trays Unaccessible	Cracked Jackets Found	
				YES	NO
568422-26	11	0	0		X
568434-20	1	0	0		X
568436-25	22	0	0		X
568439-32	21	3	0		X
568441-10	5	0	0		X
568449-27	6	0	0		X
568452-25	3	0	0		X
568456-32	10	0	0		X
568457-22	1	0	0		X
568460-33	140	1	0		X
568461-26	0	0	3		X
568462-18	1	0	0		X
568464-18	6	1	0		X
568468-11	38	9	0		X
TOTALS	265	14	3		

It should be noted that the cables in 17 of the 282 cable tray sections could not be inspected for cracked jackets for the following reasons:

a) In 14 of the tray sections no Cable Code 122 cables were found. These cables appear to have been removed and replaced with multiconductor cables or penetration pigtails in Cycle 9 outage design change packages.

b) Three cable tray sections were unaccessible, being located above a false ceiling in an environmentally controlled area. No cable code 122 cracked jacketed cables are expected in this area since none were found in walkdown areas of a similar environment.

6.5 SUMMARY OF TEST, ANALYSIS AND EVALUATION RESULTS

The basis for conclusions are the collective inputs of all the independent laboratory reports (References 6.6.15 through 6.6.24), SCE Shop and Test results, and the investigations performed separately by the 4kV Task Force. The conclusions are summarized separately for 4kV and 600V cable in Sections 6.5.1 and 6.5.2.

6.5.1 4kV Cable

The 4kV cable evaluation program utilized four independent laboratories as well as on site resources to assess the present and continued serviceability of the 4kV Simplex cable remaining in service at San Onofre Unit 1. The electrical and physical properties were scheduled for a series of tests as detailed in the preceding sections. The results demonstrate that electrical properties continue to be intact and while the physical tests show effects of aging over this 18-year operating period, the conclusion is that the cables should operate reliably for the remaining design life of San Onofre Unit 1 under the same operating conditions as previously experienced by the representative cable samples analyzed. (Reference 6.6.12)

The basic mechanism involved in the insulation breakdown was the splitting of the insulation surface from the excessive temperatures and confined pressures under the interlocked armor. It is further concluded that the failure is an isolated incident whose mechanism was associated with unusually severe local circumstances and that there exists no general concern associated with the cable design or its application.

Is also unlikely that the remaining 4kV Simplex cable is vulnerable to the same failure mechanism since its cable construction is different from that of the 4kV cable that failed in-service; i.e., the cable construction does not utilize a fabric tape between the jacket and the insulation.

Walkdowns were conducted to identify localized heat sources similar to that prompting the in-service cable failure. Those identified will be eliminated by a combination of installing piping insulation or relocating conduit prior to return to power from the Cycle 9 refueling outage.

6.5.2 600 Volt Cable

The electrical and physical tests were performed by Cable Technology Laboratories with SCE Shop and Test supplementing the electrical assessment. The electrical data is summarized in Table 6-22. The butyl insulation under the cracked neoprene jacket continues to be resilient and shows little effects of aging. (Reference 6.6.13).

The balance of 600V and lower voltage power, control and instrumentation cable is in good material and electrical condition and is acceptable for continued plant operation for the remaining design life of San Onofre Unit 1.

6.6 REFERENCE FOR SECTION 6.0

6.6.1 4kV Cable Hi-Pot Test Result Summary

6.6.2 4kV Task Force Sample Index

6.6.3 Laboratory and Sample Number Coordination Schedule

6.6.4 Letter, C. K. Balog to N. R. Dickenson, dated May 2, 1986; Subject Piping Insulation.

6.6.5 Letter, N. R. Dickenson (SCE) to T. Valenzano, dated May 13, 1986 regarding relocation of eight (8) S01 conduit.

6.6.6 Memorandum, R. Peck to W. Steinke dated April 15, 1986; Subject: Dielectric Test of 5kV Cable and Coupling (Terminators) from SONGS Unit 1

6.6.7 Report, W. W. Steinke to C. K. Balog dated April 30, 1986; Subject: SCE Tests at Alhambra on 5kV Cable and Trifurcators (Terminators)

6.6.8 Appendix A – 4kVTF Task No. 38

6.6.9 Appendix A – 4kVTF Task No. 60

6.6.10 Appendix A – 4kVTF Task No. 37

6.6.11 Appendix A – 4kVTF Task No. 17

6.6.12 Appendix A – 4kVTF Task No. 27

6.6.13 Appendix A - 4kVTF Task No. 54

6.6.14 Calculation MC-795-001, dated May 13, 1986; Subject: Heat Transfer from Process Piping to Electrical Conduit

6.6.15 Letter, J. S. Laskey to C. K. Balog dated April 8, 1986; Subject: Okonite Engineering Report No. 418, Physical Analysis Results of 4kV Cable Samples

6.6.16 Letter R. F. Smith, Jr. (Kerite Company) to C. K. Balog, April 9, 1986; Subject: Status of Cable Testing (4kV Cable Sample)

6.6.17 Test Report 11404.1 from Springborn Laboratories dated April 10, 1986; Subject: Results of Physical Analysis of 4kV Cable Analysis

6.6.18 Letter, Carlos Katz (Cable Technology Laboratories) to C. K. Balog dated April 19, 1986; Subject: Results of Tests Performed on 5kV Cable

6.6.19 Letter R. F. Smith, Jr. (Kerite Company) to C. K. Balog dated May 1, 1986; Subject: Final Report, SCE 4kV Cable Evaluation, San Onofre Unit 1

6.6.20 Letter, Carlos Katz (Cable Technology Laboratories) to C. K. Balog dated May 9, 1986; Subject: Test Report No. 86-026 dated May 9, 1986, "Investigation to Assess Condition of 5kV Butyl-Rubber Insulated Cable Installed at San Onofre

6.6.21 Letter, Carlos Katz to C. K. Balog dated May 10, 1986; Subject: Test Report No. 86-023 dated May 5, 1986 - "Analysis of 5kV Cable to Determine Failure Mode"

6.6.22 Letter, Carlos Katz (Cable Technology Laboratories) to C. K. Balog dated May 9, 1986; Subject: Test Report No. 86-027 dated May 9, 1986, "Investigation to Assess Condition of 600V Cable Installed at San Onofre Unit 1

6.6.23 Report, L. C. Calloway to W. Steinke dated May 8, 1986; Subject: Hi-POT of Cable for SONGS 1 (5kV Charging Pump Cable)

TABLES

SECTION 6.0

LIST OF TABLES
SECTION 6.0

Table 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
FA1C 4	NC09	1FA1C04C4	9	122	130	Feedwater Pump B (West) Control
FA1C 7	NC22	1FA1C07C6	2	122	93	Charging Pump B (South) Control
FA33	FB01 40	1FB0140C1	7	122	160	Control Room Supply Fan A33 Control
FB01 40	NC13	1FB0140C2	2	122	105	Control Room Supply Fan A33 Control
FB01 40	NC20	1FB0140C3	2	122	48	Control Room Supply Fan A33 Control
FB01 40	FMA33	1FB0140P1	3	122	147	Control Room Supply Fan A33 Power
FB01 41	NC03	1FB0141C1	5	122	122	Boric Acid Transfer Pump (North) G9A Control
FB01 47	NC22	1FB0147C8	1	122	136	MOV LCV1100B - Recirc. to Charging Pump Control
F1108S	FNX50B	1FB0163C2	2	122	45	Boric Acid Tank Heater Control
FNX50B	F1108S	1FB0163C3	2	122	17	Boric Acid Tank Heater Control
FB01 69	FC22	1FB0169C2	2	122	83	MOV-813 RHR Loop C Hot Leg Control
FB02 79	FB04	1FBS107C7	2	122	351	Sphere Sump Pump G21B Control
FB04 7	FEPC2	1FBS107CA	2	122	168	Recirculation Pump A (East) Control

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
FB04 9	NC03	1FBS109C7	1	122	96	Pressurizer Heater (Backup) Group C Control
FB04 14	GB05 14	1FBS114C1	2	122	273	Salt Water Cooling Pump A (North) Control
FB04 15	NC22	1FBS115C5	1	122	113	Pressurizer Heater Control Group A Control
NC03	NC22	1FBS115C6	1	122	80	LC-430B-X - Pressurizer Ch. 1 Level Loop Control
FB04 21	GB05 21	1FBS121C3	1	122	293	Component Cooling Pump A (North) Control
FB04 21	HB06 5	1FBS121C4	1	122	283	Component Cooling Pump A (North) Control
GB05 21	NC09	1FBS121C7	1	122	236	Component Cooling Pump B (Center) Control
HB06 5	NC09	1FBS121C8	1	122	226	Component Cooling Pump B (Center) Control
NC09	NC22	1FBS121C9	2	122	80	PC-605X - Component Cooling Pp. Discharger Hdr. Pressure Control
FEPC6	JB640F	1FD0120D3	1	122	30	RCP Thermal Barrier Cooling Pump M01 Shunt-Field
NC10	FEPC2	1FQ102060	2	122	146	Incore Thermal Element TE-1202
NC10	FEPC2	1FQ102061	2	122	146	Incore Thermal Element TE-1205
NC10	FEPC2	1FQ102062	2	122	146	Incore Thermal Element TE-1206
NC09	FA1112	1FQ107037	2	122	425	RCP Loop B Limit Switches Control

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location		Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
From	To					
NC09	FCV410	1FQ107061	5	122	17	RCP Loop B Limit Switches for Solenoid SV410 Control
NC09	GCV411	1FG107062	5	122	17	RCP Loop B Limit Switches for Solenoid SV411 Control
HC09	FCV456	1FW102C05	2	122	168	Main F. W. Flow Solenoid FCV-456 Control
NC14	NC16	1FY1107	2	122	88	120 VAC Vital Bus 1 to Regulated Bus 1 Power
F1108S	NC23	1FY110901	2	122	687	Boric Acid Tank Temperature Control TIC-1108S Power
FFT912	NJB428	1FY11R504	2	122	23	SI Flow Loop A FT-912 Power
NC24 10	GWPC4	1FYR1007	2	122	178	Steam Gen. A Level LT-450 Control
NC24 10	GWPC4	1FYR10	2	122	178	Steam Flow Transmitter YE-460 Power
GA2C 7	NC22	1GA2C07C5	2	122	100	Charging Pump A (North) Control
FB01 80	GWPC3	1GB0180C8	2	122	550	MOV-850B - S.I. to Loop B Control
FB01 80	GWPC3	1GB0180CA	2	122	550	MOV-850B - S.I. to Loop B Control
FB01 80	GWPC3	1GB0180CB	2	122	550	MOV-850B - S.I. to Loop B Control
NC23	GWPC3	1GB0180CC	2	122	475	MOV-850B - S.I. to Loop B Control

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
GB02 72	NC22	1GB0272C2	2	122	224	MOV-1702 - Ball Collector Screen Control
PB921G	GWPC4	1GB0274C1	2	122	83	Safety Injection to Loops A & B MOV-850A Control
PB921G	GWPC4	1GB0274C3	2	122	83	Safety Injection to Loops A & B MOV-850A Control
PB921G	GWPC4	1GB0274C4	2	122	83	Safety Injection to Loops A & B MOV-850A Control
PB921G	GWPC4	1GE0274C7	2	122	83	Safety Injection to Loops A & B MOV-850A Control
NB2A 4	NC03	1GB2A04C1	5	122	511	Boric Acid Transfer Pump MG9A (South) Control
NB2A 4	GMG9B	1GB2A04C2	2	122	101	Boric Acid Transfer Pump MG9 (South) Control
GNX50A	G1108	1GB2A05C2	2	122	49	Boric Acid Tank Temperature TIC-1108 Control
NC09	GTC1108	1GB2A05C3	2	122	518	Boric Acid Tank Alarm TC-1108
NB2A 76	NC22	1GB2A76C3	2	122	462	Boric Acid Tank Low Level Alarm LC-1100BX
NC09	NC22	1GB2A76C5	2	122	80	Volume Control Tank MOV LCV-1100C Control
GB02 79	GB05 7	1GBS207C1	2	122	95	Recirculation Pump B (West) Control
GB05 7	GWPC4	1GBS207C6	2	122	244	Recirculation Pump B (West) Control

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
GB05 9	NC03	1GBS205C6	1	122	291	Pressurizer Heater (Backup) Group D Control
FB04 14	GB05 14	1GBS214C2	2	122	357	Salt Water Cooling Pump B/S.W.C. Pp. A Control
GMG13E	GSV82	1GBS214C7	2	122	34	Salt Water Cooling Pump G-13B Control
GB05 15	NC22	1GBS215C4	3	122	17	Salt Water Cooling Pump G-13B Control
GB05 15	NC22	1GBS215C5	1	122	228	Salt Water Cooling Pump G-13B Control
NC03	NC22	1GBS215C7	1	122	101	Salt Water Cooling Pump G-13B Control
FB04 21	GB05 21	1GBS221C2	1	122	278	Inst. Air Compressor B (Center) CCW Pp A Control
GB05 21	PB06 5	1GES221C4	1	122	49	Inst. Air Compressor B (Center) CCW Pp A Control
HB06 5	NC09	1GBS221C7	1	122	239	Component Cooling Water Pump C (South) Control
HMG10S	HSV135	1GBS306C3	2	122	42	AFW Pump G-10S Bearing Cooling Control
NC10	GEPC2	1GQ102063	2	122	146	Incore Thermal Element TE-1207
NC10	FEPC2	1GQ102064	2	122	146	Incore Thermal Element TE-1208
NC10	FEPC3	1GQ102067	2	122	141	Incore Thermal Element TE-1201

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
GFT913	NJB428	1GY11R505	2	122	19	SI Flow Loop B FT-913 Power
NC14	NC16	1GY1207	2	122	88	120VAC Vital Bus 2 to Regulated Bus 2 Power
NC25	G1108	1GY141602	2	122	463	Boric Acid Tank Temperature Control TIC-1108
NC24 10	FEPC3	1GYR1002	2	122	131	Steam Generator A Level LT-451 Control
NC24 10	GWPC4	1GYR10	2	122	178	Steam Flow Transmitter YE-461 Power
HB06	NC09	1HB0305C1	1	122	17	Component Cooling Water Pump G-15C Control
FB04 21	NC09	1HB0305C3	1	122	96	Component Cooling Water Pump G-15C Control
NC09	NC22	1HB0305C8	2	122	79	Component Cooling Water Pump G-15C Control
HB03 23	HMG12	1HB0323C2	2	122	667	Boric Acid Injection Pump MG12 Control
NC03	NC22	1HB0323C3	2	122	84	Boric Acid Injection Pump MG12 Control
PB922H	HEPC2	1HB0391C3	2	122	76	Safety Injection to Loop C MOV-850C Control
PB922H	HEPC2	1HB0391C4	2	122	76	Safety Injection to Loop C MOV-850C Control
PB922H	HEPC2	1HB0391C5	2	122	76	Safety Injection to Loop C MOV-850C Control

TABLE 6-1

SAFETY RELATED SINGLE CONDUCTOR 12AWG SIMPLEX CABLE

Location From	Location To	Cable Scheme No.	No. of Cable	Cable Codes	Circuit Length (Feet)	Equipment Operated
PB922H	HEPC2	1HB0391C6	2	122	76	Safety Injection to Loop C MOV-850C Control
NB2A 10	NC09	1HB2A10C1	5	122	458	Test Pump G-42 Control Circuit
GB05 21	HB06 5	1HBS305C2	1	122	105	Component Cooling Wtr Pp B (Center)/CCW Pp C (South)
FB04 21	HB06 5	1HBS305C4	1	122	386	Component Cooling Wtr Pp A (North)/CCW Pp C (South)
GB05 21	NC09	1HBS305C5	1	122	354	Component Cooling Water Pump B (Center) Control
HFT914	NJB428	1HY11R506	2	122	23	SI Flow Loop C FT-914 Power
NC14	NC16	1HY1307	2	122	88	120VAC Vital Bus 3 to Regulated Bus 3 Power
NC24 10	FEPC3	1HYR1003	2	122	131	Steam Generator A Level LT-452 Control
NC24 10	FEPC3	1HYR10	2	122	241	Steam Flow Transmitter YE-462 Power

TABLE 6-2
ELECTRICAL TEST RESULTS SUMMARY

AC AND DC STEP TESTS
4kV Cable Samples Removed From SONGS, Unit 1

JACKETED SAMPLES

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
AC TEST – kV WITHSTOOD 5 MINUTE STEP DURATION	Industry (ICEA) and MFG (Simplex) original (new) specification requirements are 13 and 20.6, respectively.			
LABORATORY				
B	OVER 85	60	OVER 75	60, OVER 45
D	OVER 70	85	85	OVER 65
DC TEST – kV WITHSTOOD 5 MINUTE STEP DURATION	Industry (ICEA) and MFG(Simplex) original (new) specification requirements are 35 and 68.8, respectively.			
LABORATORY				
B	230	235	240	OVER 200
D	OVER 144	OVER 144	OVER 144	OVER 144

NOTES: LAB B – KERITE; LAB D – CABLE TECHNOLOGY

- ICEA – S-19-81, NEMA WC-3 paragraphs 7.11.6.1.1 and 7.11.6.1.3.
- Simplex Specification – paragraph 28.2.1.
- Step tests started at 10kV, and increased in 5kV steps for 5 minutes at each step.
- 'OVER' indicates termination limitation of test set-up, cable values are higher than shown.

TABLE 6-3
ELECTRICAL TEST RESULTS SUMMARY

AC AND DC STEP TESTS
4kV Cable Samples Removed From SONGS, Unit 1

SAMPLES WITH JACKET REMOVED

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
AC TEST - kV WITHSTOOD 5 MINUTE STEP DURATION	Industry (ICEA) and MFG (Simplex) original (new) specification requirements are 13 and 20.6, respectively.			
LABORATORY				
B	OVER 55	30, 40	60	N/R
D	OVER 60	65	45	N/R
DC TEST - kV WITHSTOOD 5 MINUTE STEP DURATION	Industry (ICEA) and MFG (Simplex) original (new) specification requirements are 35 and 68.8, respectively.			
LABORATORY				
B	225	245	235	245
D	OVER 144	OVER 144	OVER 144	N/R

NOTES: LAB B - KERITE; LAB D - CABLE TECHNOLOGY

- ICEA - S-19-81, NEMA WC-3 paragraphs 7.11.6.1.1 and 7.11.6.1.3.
- Simplex Specification - paragraph 28.2.1.
- Step tests started at 10kV, and increased in 5kV steps for 5 minutes at each step.
- 'OVER' indicates termination limitation of test set-up, cable values are higher than shown.
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-4
ELECTRICAL TEST RESULTS SUMMARY

IMPULSE STRENGTH

4kV Cable Samples Removed From SONGS, Unit 1

JACKETED SAMPLES

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
BREAKDOWN kV IMPULSE STRENGTH	Industry Requirement 60, SONGS 1 Station Level is 75.			
LABORATORY				
B	N/R	N/R	OVER 165	OVER 165
D	OVER 183	N/R	207	213
BREAKDOWN kV IMPULSE STRENGTH	SAMPLES WITH JACKET REMOVED			
LABORATORY				
B	OVER 120	OVER 120	N/R	N/R
D	111	105	99	N/R

NOTES: LAB B - KERITE; LAB D - CABLE TECHNOLOGY

- 'OVER' indicates termination limitation of test set-up, cable values are higher than shown.
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-5
ELECTRICAL TEST RESULTS SUMMARY

CAPACITANCE AND DISSIPATION FACTOR

4kV Cable Samples Removed From SONGS, Unit 1

SAMPLES WITH JACKET REMOVED

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
SPECIFIC INDUCTIVE CAPACITANCE	Industry Requirement – 4.5 maximum			
LABORATORY				
B	4.0	3.9	4.0	N/R
D	3.8	3.7	3:6	N/R
DISSIPATION FACTOR PER CENT	Industry Requirement – 3.5 maximum			
LABORATORY				
B	0.5	0.5	0.5	N/R
D	0.8	0.7	0.67	N/R

NOTES: LAB B – KERITE; LAB D – CABLE TECHNOLOGY

- 1CEA-S-19-81, NEMA WC-3, paragraph 3.15.3.1
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-6

ELECTRICAL TEST RESULTS SUMMARY

CAPACITANCE AND DISSIPATION FACTOR

4kV Cable Samples Removed From SONGS, Unit 1

JACKETED SAMPLES

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
SPECIFIC INDUCTIVE CAPACITANCE	Industry Requirement covers only unjacketed design.			
LABORATORY				
B	5.3	5.3	5.3	4.8, 5.1
D	4.9	5.1	5.2	5.2
DISSIPATION FACTOR PER CENT	Industry Requirement covers only unjacketed design.			
LABORATORY				
B	2.9	3.1	3.3	5.0, 3.1
D	2.4	4.0	2.5	5.0

NOTES: LAB B - KERITE; LAB D - CABLE TECHNOLOGY

TABLE 6-7
ELECTRICAL TEST RESULTS SUMMARY

Capacitance & Dissipation Factor at R.T. 90°C, 125°C
4kV Cable Samples Removed From SONGS, Unit 1

JACKETED SAMPLES

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
CAPACITANCE pf (SIC)	Industry requirement covers only unjacketed design.			
LABORATORY B				
Tested at R.T.	1790 (5.3)	1782 (5.3)	1808 (5.3)	1637 (4.8) 1727 (5.1)
Tested at 90°C	1663 (4.9)	1621 (4.8)	1625 (4.8)	1532 (4.5) 1583 (4.7)
Tested at 125°C	1631 (4.8)	1567 (4.6)	1555 (4.6)	1487 (4.4) 1531 (4.5)
DISSIPATION FACTOR - PERCENT	Industry (ICEA) and MFG (Simplex) original (new) specification requirement at R.T. is 3.5 maximum for non-jacketed insulations. Does not apply here.			
LABORATORY B				
Tested at R.T.	2.91	3.12	3.32	3.07 4.97
Tested at 90°C	1.87	1.76	2.06	1.77 1.79
Tested at 125°C	3.84	3.14	3.54	3.11 3.17

LABORATORY B - KERITE

NOTE: Capacitance in picofarads is shown to indicate stability with temperature. Figures in brackets are the specific inductive capacitance (SIC).

TABLE 6-8
ELECTRICAL TEST RESULTS SUMMARY

Capacitance & Dissipation Factor at R.T. 90°C, 125°C
4kV Cable Samples Removed From SONGS, Unit 1

SAMPLES WITH JACKET REMOVED

	AUXILIARY TRANSFORMER "B"		
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM
CAPACITANCE pf (SIC)	Industry requirement is 4.5 maximum (SIC)		
LABORATORY B			
Tested at R.T.	1768 (4.0)	1728 (3.9)	1768 (4.0)
Tested at 90°C	1679 (3.8)	1658 (3.8)	1676 (3.8)
Tested at 125°C	1664 (3.8)	1633 (3.7)	1660 (3.8)
DISSIPATION FACTOR - PERCENT	Industry (ICEA) and MFG (Simplex) original (new) specification requirement at R.T. is 3.5 maximum.		
LABORATORY B			
Tested at R.T.	0.5	0.5	0.5
Tested at 90°C	0.63	0.52	0.59
Tested at 125°C	2.13	1.73	1.70

LABORATORY B - KERITE

NOTE: Capacitance in picofarads is shown to indicate stability with temperature. Figures in brackets are the specific inductive capacitance (SIC).

TABLE 6-9
TENSILE AND ELONGATION TEST RESULTS SUMMARY

AS RECEIVED
4kV Cable Samples Removed From SONGS, Unit 1

BUTYL - ANHYDREX XX

	AUXILIARY TRANSFORMER "B"				AUXILIARY TRANSFORMER "C"
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR	IN-SERVICE FAILURE AREA
% ELONGATION MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 350.				
LABORATORY					
A	430, 440	N/R	410, 400	370, 370	290
B	380	350	350	340	N/R
C	400	N/R	370	410	340
D	460	460	450, 490	460	N/R
TENSILE P.S.I. MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 600.				
LABORATORY					
A	788, 800	N/R	762, 800	758, 727	673
B	521	511	537	504	N/R
C	730	N/R	750	780	750
D	630	630	660, 650	640	N/R

LAB A - OKONITE; LAB B - KERITE; LAB C - SPRINGBORN; LAB D - CABLE TECHNOLOGY

- ICEA - 5-19-81, NEMA WC-3, paragraph 3.15.1
- LAB D utilized new measurement technique
- LAB B attempted to select oldest appearing areas for sample selection
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-10

TENSILE AND ELONGATION TEST RESULTS SUMMARY

BEFORE AND (AFTER) AGING

4kV Cable Samples Removed From SONGS, Unit 1

BUTYL - ANHYDREX XX

	AUXILIARY TRANSFORMER "B"				AUXILIARY TRANSFORMER "C"
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR	IN-SERVICE FAILURE AREA
% ELONGATION MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 350.				
LABORATORY					
B	380 (280)	350 (300)	350 (320)	340 (360)	N/R
C	400 (330)	N/R	370 (310)	410 (330)	340 (310)
D	SEE NOTE	N/R	N/R	N/R	N/R
TENSILE P.S.I. MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 600.				
LABORATORY					
B	521 (461)	511 (582)	537 (493)	504 (557)	N/R
C	730 (790)	N/R	750 (780)	780 (800)	750 (800)
D	SEE NOTE	N/R	N/R	N/R	N/R

LAB B - KERITE; LAB C - SPRINGBORN; LAB D - CABLE TECHNOLOGY

AGING - 168 HOURS IN CIRCULATING HOT AIR OVEN AT 100°C

- LAB D data gave much better results than others, and is in question, thus not used as the approach being taken is conservative.
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-11

TENSILE AND ELONGATION TEST RESULTS SUMMARY

AT R.T., 90°C, 125°C

4kV Cable Samples Removed From SONGS, Unit 1

BUTYL - ANHYDREX XX

	AUXILIARY TRANSFORMER "B"			
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR
% ELONGATION MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement at R.T. is 350.			
LABORATORY B				
Tested at R.T.	380	350	350	340
Tested at 90°C	250	240	260	250
Tested at 125°C	230	200	210	210
TENSILE P.S.I. MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement at R.T. is 600.			
LABORATORY B				
Tested at R.T.	521	511	537	504
Tested at 90°C	295	324	286	293
Tested at 125°C	206	224	236	223

LABORATORY B - KERITE

TABLE 6-12
TENSILE AND ELONGATION TEST RESULTS SUMMARY

AS RECEIVED
4kV Cable Samples Removed From SONGS, Unit 1
NEOPRENE JACKET

	AUXILIARY TRANSFORMER "B"				AUXILIARY TRANSFORMER "C"
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR	IN-SERVICE FAILURE AREA
% ELONGATION MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 300.				
LABORATORY					
A	280, 290	N/R	240, 220	220, 230	BRITTLE
B	170	110	110	120	N/R
C	280	N/R	200	210	25 (AWAY FROM BRITTLE AREA)
D	400	430	300	370	N/R
TENSILE P.S.I. MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 1800.				
LABORATORY					
A	2576, 2498	N/R	2418, 2367	2425, 2436	BRITTLE
B	1538	1417	1422	1494	N/R
C	2590	N/R	2590	2520	1700
D	2360	2040	2370	2120	N/R

LAB A - OKONITE; LAB B - KERITE; LAB C - SPRINGBORN; LAB D - CABLE TECHNOLOGY
ICEA - 5-19-81, NEMA WC-3, paragraph 4.13.3
Simplex Specification, paragraph 27.3.4

NOTE:
- Laboratory B made a special effort to select the poorest portion of the cable jacket for the physical tests. Other labs made random samplings which accounts for the spread between results.
- Laboratory D used "New" measurement technique (data not used in analysis).
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-13
TENSILE AND ELONGATION TEST RESULTS SUMMARY

BEFORE AND (AFTER) AGING

4kV Cable Samples Removed From SONGS, Unit 1

NEOPRENE JACKET

	AUXILIARY TRANSFORMER "B"				AUXILIARY TRANSFORMER "C"
	NEAR TRANS	IN STRAIGHT AWAY	NEAR STEAM	NEAR SWITCHGEAR	IN-SERVICE FAILURE AREA
% ELONGATION MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 300.				
LABORATORY					
B	(160)	(155)	(150)	(140)	N/R
C	280 (200)	N/R	200 (120)	210 (90)	25 (5)
D	N/R	N/R	N/R	N/R	N/R
TENSILE P.S.I. MINIMUM	Industry (ICEA) and MFG (Simplex) original (new) specification requirement is 1800.				
LABORATORY					
B	(1820)	(2007)	(1858)	(1956)	N/R
C	2590 (2410)	N/R	2590 (2120)	2520 (1850)	1700 (1030)
D	N/R	N/R	N/R	N/R	N/R

LAB B - KERITE; LAB C - SPRINGBORN; LAB D - CABLE TECHNOLOGY

AGING - 168 Hours in a Circulating Hot Air Oven at 100°C

- All aged samples randomly selected.
- Where N/R is indicated, the measurements were not taken, as adequate information was available for assessing those particular properties.

TABLE 6-14

HOSTILE ENVIRONMENT TESTS

CABLE IN EXCESSIVE HEAT

A 15-foot sample from the transformer location was placed into an oven, energized at 2500 volts, phase-to-ground, and the oven temperature gradually increased in 25°C steps from a 100°C starting level. Dissipation factor measurements were taken to monitor stability.

Oven Temperature - °C	Capacitance - pf	Dissipation Factor - %
20	1716	2.5
100	1623	2.3
125	1602	4.4
150	1570	9.8
175	1446	15.6
200	1759	36.2

The dissipation factor stabilized at each level before the oven temperature was increased.

TABLE 6-15

HOSTILE ENVIRONMENT TESTS

CABLE IMMERSED IN 90°C WATER

Two fifteen-foot, single-conductor samples from the straight-away section were immersed in 90°C water. One length was jacketed and the other had the jacket removed. The cables were subjected to daily AC withstand tests at 5kV for 5 minutes.

Immersion Time - Days	Jacketed Dissipation Factor	Jacketed Capacitance pf	Unjacketed Dissipation Factor	Unjacketed Capacitance pf
4	.0223	1597	.0114	1698
7	.0237	1593	.0123	1713
8	*.0089	*1546	.0101	1714
10	.0262	1564	.0105	1738
11	.0234	1556	.0084	1733
14	.0284	1610	.0064	1800
16	.0242	1629	.0082	1750
18	.0262	1627	.0136	1732
21	.0258	1621	.0118	1721

*Readings affected by change in water level

The cables withstood the daily voltage tests.

TABLE 6-16

ANHYDREX XX - BUTYL - 5kV CABLE

AGING CHARACTERISTIC FOR CABLES INSTALLED AT UNIT 1 SAN ONOFRE NUCLEAR GENERATING STATION

AT OPERATING CONDITIONS EXPERIENCED OVER PAST 18 YEARS AND PROJECTED TO CONTINUE

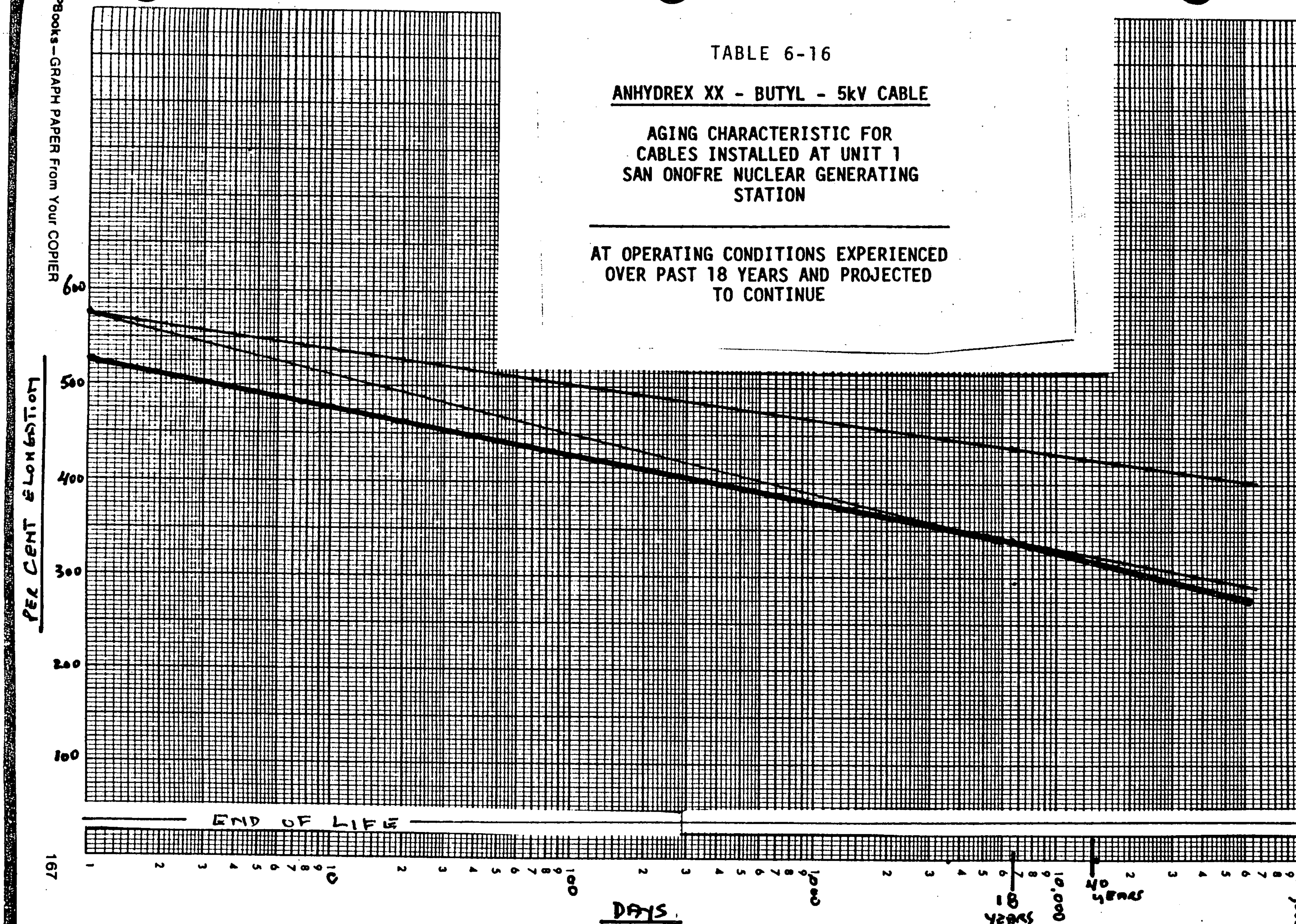


TABLE 6-17

NEOPRENE JACKET - SIMPLEX 5kV CABLE

AGING CHARACTERISTIC FOR
CABLES INSTALLED AT UNIT 1
SAN ONOFRE NUCLEAR GENERATING
STATION

AT OPERATING CONDITIONS EXPERIENCED
OVER PAST 18 YEARS AND
PROJECTED TO CONTINUE

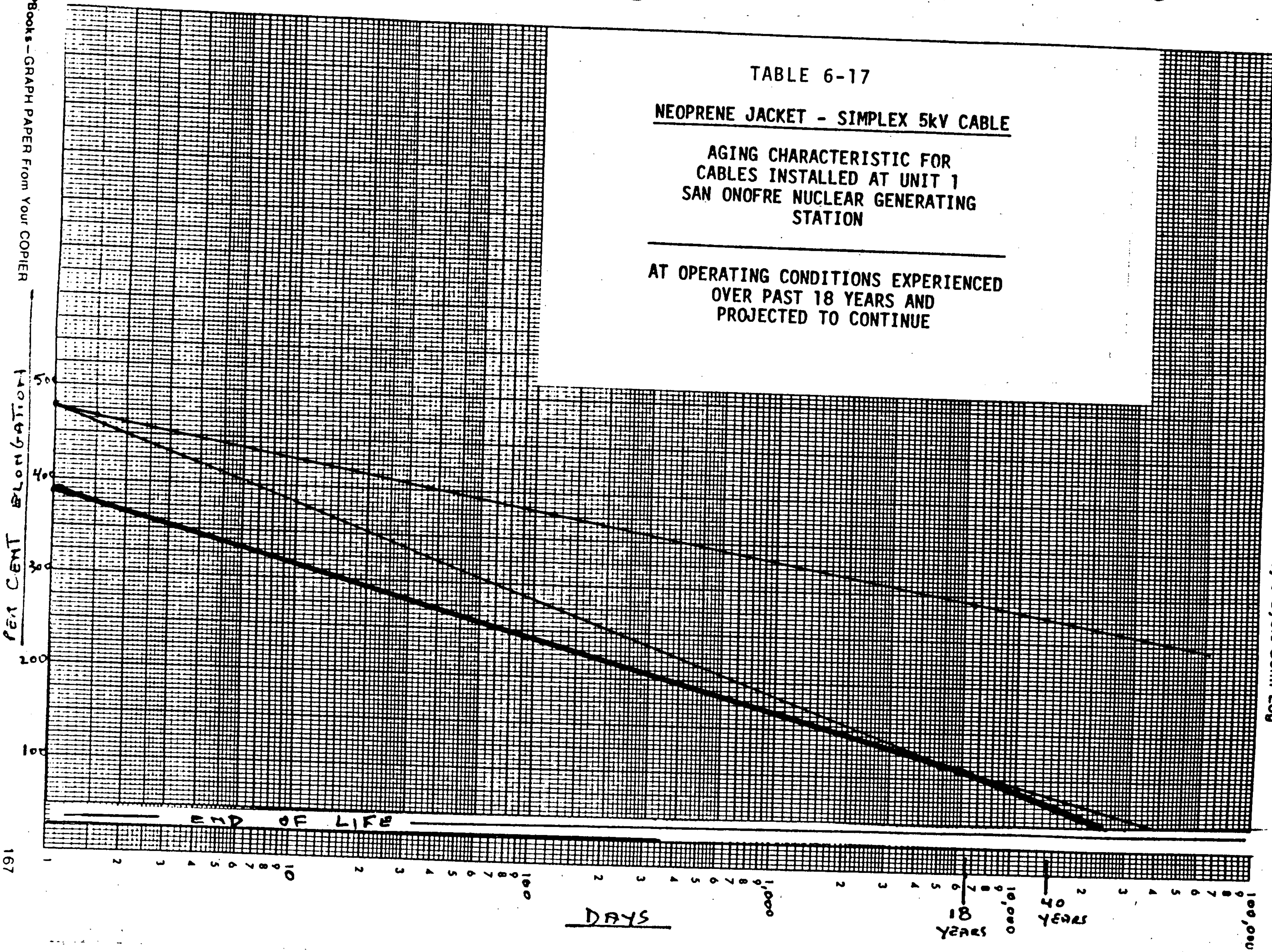


TABLE 6-18

4kV CABLE
DC OVERVOLTAGE
TEST RESULTS

SONGS 1

NO.	LOAD DESCRIPTION	CIRCUIT #	HI-POT STATUS	CABLE TYPE	YEAR INSTALLATION
1	FEEDER CABLE FROM 'C' TRANSFORMER TO BUS	1WA1C02P1 1WA1C02P2 1WA1C02P3 1WA1C02P4	PASSED FAILED FAILED FAILED	750 KC MIL ALAR	1965
2	CIRCULATING WATER PUMP G-4B (N)	1WA1C03P1 1WA1C03P2	PASSED PASSED	350 KC MIL ALAR	1965
3	FEEDWATER PUMP G-3B (W)	1FA1C04P1 1FA1C04P2	PASSED PASSED	350 KC MIL ALAR	1965
4	SI PUMP G-50B (W)	1FA1C05P1	PASSED	4/0 ALAR	1965
5	CONDENSATE PUMP G-1D (SW)	1WA1C06P1	PASSED	4/0 ALAR	1965
6	CHARGING PUMP G-8B (S)	1FA1C07P1	PASSED	4/0 ALAR	1965
7	CONDENSATE PUMP G-1C (NW)	1WA1C08P1	PASSED	4/0 ALAR	1965
8	HEATER DRAIN PUMP G-36B (W)	1WA1C09P1	PASSED	4/0 ALAR	1965
9	STATION SERVICE TRANSFORMER 1	1FA1C10P1	PASSED	750 KC MIL	1976
10	STATION SERVICE TRANSFORMER 3	1WA1C11P1	PASSED	4/0 ALAR	1965
11	TPCW PUMP G-6S (S)	1WA1C12P1	FAILED	4/0 ALAR	1965
12	LIGHTING TRANSFORMER	1WAC13P1	PASSED	4/0	1965
13	FEEDER FROM DG 1 TO BUS 1C	1FA1C14P5 1FA1C14P6 1FA1C14P7 1FA1C14P8	PASSED PASSED PASSED PASSED	750 KC MIL ALAR SHIELDED	1976
13a	DG #1 TO EXCITER	1FA1C14P1 1FA1C14P2 1FA1C14P3	PASSED PASSED PASSED	750 KC MIL ALAR SHIELDED	1976

TABLE 6-18

4kV CABLE
DC OVERVOLTAGE
TEST RESULTS
(Continued)

SONGS 1

NO.	LOAD DESCRIPTION	CIRCUIT #	HI-POT STATUS	CABLE TYPE	YEAR INSTALLATION
14	FEEDER FROM C TRANSFORMER TO 2C BUS	1XA2C02P1 1XA2C02P2 1XA2C02P3 1XA2C02P4	PASSED PASSED PASSED PASSED	750 KC MIL ALAR	1965
15	CIRC WATER PUMP G-4A	1XA2C03P1 1XA2C03P2	PASSED PASSED	350 KC MIL ALAR	1965
16	FEEDWATER PUMP G-3A	1GA2C04P1 1GA2C04P2	PASSED PASSED	350 KC MIL ALAR	1965
17	SI PUMP G50-A (E)	1GA2C05P1	PASSED	4/0 ALAR	1965
18	CONDENSATE PUMP G-1B (SE)	1XA2C06P1	PASSED	4/0 ALAR	1965
19	CHARGING PUMP G-8B (N)	1GA2C07P1	PASSED	4/0 ALAR	1965
20	CONDENSATE PUMP G-1A	1XA2C08P1	PASSED	4/0 ALAR	1965
21	HEATER DRAIN PUMP G-36A (E)	1XA2C09P1	PASSED	4/0 ALAR	1965
22	STATION SERVICE TRANSFORMER 2	1GA2C10P1	PASSED	4/0 ALAR	1965
23	STATION SERVICE TRANSFORMER 3	1XA2C11P1	PASSED	4/0 ALAR	1965
24	TPCW PUMP G 6 N (N)	1XA2C12P1	FAILED	4/0 ALAR	1965
25	LIGHTING TRANSFORMER (STAND BY)	1XA2C13P1	PASSED	4/0 ALAR	1965
26	WAREHOUSE AND SWITCHYARD READER	1XA2C14P1	PASSED	4/0 ALAR	1965

TABLE 6-18

4kV CABLE
DC OVERVOLTAGE
TEST RESULTS
(Continued)

SONGS 1

NO.	LOAD DESCRIPTION	CIRCUIT #	HI-POT STATUS	CABLE TYPE	YEAR INSTALLATION
27	FEEDER FROM DG2 TO BUS 2C	1GA2C15P5 1GA2C15P6 1GA2C15P7 1GA2C15P8	PASSED PASSED PASSED PASSED	750 KC MIL ALAR, SHIELDED	1976
27a	DG #2 EXCITER	1GA2C15P1 1GA2C15P2 1GA2C15P3	PASSED PASSED PASSED	750 KC MIL ALAR, SHIELDED	1976
28	RCP G-2C	1WA1A01P1 1WA1A01P2	PASSED PASSED	500 KC MIL ALAR	1965
29	RCP G-2A	1WA1A03P1 1WA1A03P2	PASSED PASSED	500 KC MIL ALAR	1965
30	FEEDER FROM AUX 'A' TRANSFORMER TO BUS 1A	1NA1A04P1 1NA1A04P2 1NA1A04P3 1NA1A04P4	PASSED	500 KC MIL ALAR	1965
31	SPARE EXCITER	1WA1B01P1 P2	PASSED	500 KC MIL ALAR	1965
32	EXCITER	1WA1B02P1	PASSED	500 KC MIL ALAR	1965
33	RCP 2B	1WA1B03P1 1WA1B03P2	PASSED PASSED	500 KC MIL ALAR	1965
34	FEEDER FROM AUX B TRANSFORMER TO BUS 1B	1WA1B04P1 1WA1B04P2 1WA1B04P3 1WA1B04P4	PASSED PASSED PASSED FAILED	500 KC MIL	1965

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER		REMARKS
A. Bus 1C												
#11C02	Transformer C "X" Winding to Bus 1C	19kV (P)	NSR	1WA1C02P1	3/C 750 MCM —	391	391	—	—	Simplex		Simplex cable replaced with Kerite cable, March, 1986
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P1	3/C 750 MCM R					Kerite		
		13kV (F)	NSR	1WA1C02P2	3/C 750 MCM —	391				Simplex		Simplex cable P4 failed in service phase-to-phase ground, November, 1985. Hi-Pot test data in MO #85121064000
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P2	3/C 750 MCM R					Kerite		
		19kV (F)	NSR	1WA1C02P3	3/C 750 MCM —	391				Simplex		
	(Replacement Cable)	36kV (9)	NSR	1WA1C02P3	3/C 750 MCM R					Kerite		
		3kV (F)	NSR	1WA1C02P4	3/C 750 MCM —	391				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P4	3/C 750 MCM R					Kerite		
#11C03	Circulating Water Pump G-4B	28kV (P)	NSR	1WA1C03P1	3/C 350 MCM NR	255	255	—	—	Simplex	Indoor	B/M BSO-3008 12-10-64
		28kV (P)	NSR	1NA1C03P2	1/C 350 MCM NR (3)	279	—	93	—	Anaconda	Outdoor	B/M BSO-3006 12-01-64
*11C04	Feedwater Pump G-3B	28kV (P)	SR	1FA1C04P1	3/C 350 MCM NR	200	200	—	—	Simplex		B/M BSO-3008 12-10-64
		28kV (P)	SR	1FA1C04P2	3/C 350 MCM NR	200				Simplex		

* DCP 3420.00BE (To replace 4kV Simplex cable for SR circuits, if required)
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
*/#11C05	Safety Injection Pump G-50B	28kV (P)	SR	1FA1C05P1	3/C 4/0 AWG NR	347	347	—	—	Simplex	B/M BSO-3008 12-10-64
11C06	Condensate Pump G-1D	28kV (P)	NSR	1WA1C06P1	3/C 4/0 AWG NR	282	282	—	—	Simplex	B/M BSO-3008 12-10-64
11C07	Charging Pump G-8B	28kV (P)	SR	1FA1C07P1	3/C 4/0 AWG —	337	337	—	—	Simplex	Simplex cable replaced with Anaconda cable by DCP 3341.02
	(Replacement Cable)	36kV (P)	SR	1FA1C07P1	3/C 250 MCM R	—	—	—	—	Anaconda	
11C08	Condensate Pump G-1C	28kV (P)	NSR	1WA1C08P1	3/C 4/0 AWG NR	252	252	—	—	Simplex	B/M BSO-3008 12-10-64
11C09	Heater Drain Pump G-36B	28kV (P)	NSR	1WA1C09P1	3/C 4/0 AWG NR	211	211	—	—	Simplex	B/M BSO-3008 12-10-64
#11C10	Station Service Transformer No. 1 Feeder	28kV (P)	SR	1FA1C10P1	1/C 750 MCM R (3)	360	110	10	—	Anaconda	Procured under specification S023-304-8
*/#11C11	Station Service Transformer No. 3 Feeder	28kV (P)	SR	1WA1C11P1	3/C 4/0 AWG NR	276	276	—	—	Simplex	B/M BSO-3008 12-10-64

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
#11C12	Turbine Plant Cooling	0kV (F)	NSR	1WA1C12P1	3/C 4/0 AWG —	402	402	—	—	Simplex	Simplex Cable replaced with Kerite cable, March 1986. Cable in O-Z termination failed initial Hi-Pot at starting voltage MO #86032395000
	Water Pump G-6S	28kV (P)									
	(Replacement Cable)	36kV (P)	NSR	1WA1C12P1	3/C 4/0 AWG R					Kerite	
11C13	Lighting Transformer Normal	28kV (P)	NSR	1WA1C13P1	3/C 4/0 AWG NR	309	309	—	—	Simplex	B/M BSO-3008 12-10-64
11C14	Diesel Generator No. 1 Exciter	28kV (P)	SR	1FA1C14P1	1/C 750 MCM R	243	81	—	—	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1FA1C14P2	1/C 750 MCM R	243				Anaconda	
		28kV (P)	SR	1FA1C14P3	1/C 750 MCM R	243				Anaconda	
11C14	Diesel Generator No. 1	28kV (P)	SR	1FA1C14P5	1/C 750 MCM R	1812	—	—	604	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1FA1C14P6	1/C 750 MCM R	1812			604	Anaconda	
		28kV (P)	SR	1FA1C14P7	1/C 750 MCM R	1812			604	Anaconda	
		28kV (P)	SR	1FA1C14P8	1/C 750 MCM R	1812			604	Anaconda	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER		REMARKS
B. Bus 2C												
#12C02	Transformer C "Y" Winding to Bus 2C	19kV (P)	NSR	1XA2C02P1	3/C 750 MCM —	374	374	—	—	Simplex		Simplex cable replaced with Kerite cable, March, 1986
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P1	3/C 750 MCM R					Kerite		
		19kV (P)	NSR	1XA2C02P2	3/C 750 MCM —	374				Simplex		Simplex cable Hi-Pot test data in MO #85121064000
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P2	3/C 750 MCM R					Kerite		
		19kV (P)	NSR	1XA2C02P3	3/C 750 MCM —	374				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P3	3/C 750 MCM R					Kerite		
		19kV (P)	NSR	1XA2C02P4	3/C 750 MCM —	374				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P4	3/C 750 MCM R					Kerite		
#12C03	Circulating Water Pump G-4A	28kV (P)	NSR	1XA2C03P1	3/C 350 MCM NR	248	248	—	—	Simplex	Indoor	B/M BSO-3008 12-10-64
		28kV (P)	NSR	1XA2C03P2	1/C 350 MCM NR (3)	279	—	93	—	Anaconda	Outdoor	B/M BSO-3006 12-01-64
*12C04	Feedwater Pump G-3A	28kV (P)	SR	1GA2C04P1	3/C 350 MCM NR	89	89	—	—	Simplex		B/M BSO-3008 12-10-64
		28kV (P)	SR	1GA2C04P2	3/C 350 MCM NR	89				Simplex		

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
12C07	Charging Pump G-8A	28kV (P)	SR	1GA2C07P1	3/C 4/0 AWG —	387	387	—	—	Simplex	Simplex cable replaced with Anaconda cable by DCP 3009.05
	(Replacement Cable)	36kV (P)	SR	1GA2C07P1	3/C 250 MCM R	—	—	—	—	Anaconda	
12C08	Condensate Pump G-1A	28kV (P)	NSR	1XA2C08P1	3/C 4/0 AWG NR	169	169	—	—	Simplex	B/M BSO-3008 12-10-64
12C09	Heater Drain Pump G-36A	28kV (P)	NSR	1XA2C09P1	3/C 4/0 AWG NR	99	99	—	—	Simplex	B/M BSO-3008 12-10-64
*/#12C10	Station Service Transformer No. 2 Feeder	28kV (P)	SR	1GA2C10P1	3/C 4/0 AWG NR	249	249	—	—	Simplex	B/M BSO-3008 12-10-64
*12C11	Station Service Transformer No. 3 Feeder	28kV (P)	SR	1XA2C11P1	3/C 4/0 AWG NR	59	59	—	—	Simplex	B/M BSO-3008 12-10-64
#12C12	Turbine Plant Cooling Water Pump G-6N	25kV (F) 28kV (P)	NSR	1XA2C12P1	3/C 4/0 AWG NR	326	326	—	—	Simplex	B/M BSO-3008 12-10-64 Failed Hi-Pot in May 1986. Insulation underneath termination repaired. Replacement cable ordered from Kerite.
12C13	Lighting Transformer Standby	28kV (P)	NSR	1XA2C13P1	3/C 4/0 AWG NR	181	181	—	—	Simplex	B/M BSO-3008 12-10-64

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
#12C14	Switchyard Supply Transformer	28kV (P)	NSR	1XA2C14P1	3/C 4/0 AWG NR	675	—	—	675	Simplex	Abandoned - breaker to be used for 3rd AFW Pump
12C15	Diesel Generator No. 2 Exciter	28kV (P)	SR	1GA2C15P1	1/C 750 MCM R	243	81	—	—	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1GA2C15P2	1/C 750 MCM R	243	81	—	—	Anaconda	
		28kV (P)	SR	1GA2C15P3	1/C 750 MCM R	243	81	—	—	Anaconda	
*/#12C05	Safety Injection Pump G-50A	28kV (P)	SR	1GA2C05P1	3/C 4/0 AWG NR	268	268	—	—	Simplex	B/M BSO-3008 12-10-64
12C06	Condensate Pump G-1B	28kV (P)	NSR	1XA2C06P1	3/C 4/0 AWG NR	204	204	—	—	Simplex	B/M BSO-3008 12-10-64
12C15	Diesel Generator No. 2	28kV (P)	SR	1GA2C15P5	1/C 750 MCM R	705	—	—	705	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1GA2C15P6	1/C 750 MCM R	705	—	—	705	Anaconda	
		28kV (P)	SR	1GA2C15P7	1/C 750 MCM R	710	—	—	710	Anaconda	
		28kV (P)	SR	1GA2C15P8	1/C 750 MCM R	710	—	—	710	Anaconda	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
C. Bus 1A											
11A01	Reactor Coolant Pump G-2C		NSR	1WA1A01P1	3/C 500 MCM NR	102	107	—	—	Simplex	B/M BSO-3008 12-10-64
			NSR	1WA1A01P2	3/C 500 MCM NR	107	161			Simplex	
			NSR	1NA1A01P3	3/C 500 MCM NR	107	107	—	—	Simplex	B/M BSO-3008 12-10-64
			NSR	1NA1A01P4	3/C 500 MCM NR	107				Simplex	
11A03	Reactor Coolant Pump G-2A		NSR	1XA1A03P1	3/C 500 MCM NR	248	248	—	—	Simplex	B/M BSO-3008 12-10-64
			NSR	1XA1A03P2	3/C 500 MCM NR	248	161			Simplex	
			NSR	1NA1A03P3	3/C 500 MCM NR	76	76	—	—	Simplex	
			NSR	1NA1A03P4	3/C 500 MCM NR	76				Simplex	
#11A04	Transformer A Feeder to Bus 1A	28kV (P)	NSR	1NA1A04P1	3/C 500 MCM —	284	284	—	—	Simplex	Simplex cable replaced with Kerite cable, March, 1986
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P1	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P2	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P2	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P3	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P3	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P4	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P4	3/C 500 MCM R					Kerite	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-19

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
D. Bus 1B											
#11B01	Spare Exciter	28kV (P)	NSR	1WA1B01P1	3/C 500 MCM NR	172	172	—	—	Simplex	B/M BSO-3008 12-10-64
11B02	Exciter	28kV (P)	NSR	1WA1B02P1	3/C 500 MCM NR	237	237	—	—	Simplex	B/M BSO-3008 12-10-64
11B03	Reactor Coolant Pump G-2B		NSR	1WA1B03P1	3/C 500 MCM NR	108	113	—	—	Simplex	B/M BSO-3008 12-10-64
			NSR	1WA1B03P2	3/C 500 MCM NR	113	161			Simplex	
			NSR	1NA1B03P3	3/C 500 MCM NR	106	106	—	—	Simplex	
			NSR	1NA1B03P4	3/C 500 MCM NR	106				Simplex	
#11B04	Transformer B Feeder to Bus 1B	5kV (F) 28kV (P)	NSR	1NA1B04P1	3/C 500 MCM —	274	274	—	—	Simplex	Simplex cable replaced with Kerite cable, March, 1986 Hi-Pot test data in MO #86020663000 cable P1 failed at 5kV, then passed after O-Z termination at XFMR was removed
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P1	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P2	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P2	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P3	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P3	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P4	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P4	3/C 500 MCM R					Kerite	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 6-20
4kV CABLE EVALUATION TASK FORCE
SAMPLE INDEX

Sample No.	Description
1.	C-XFMR X-Winding - Cable #4 Phase B - FAULTED
2.	C-XFMR X-Winding - Cable #4 Phase C - FAULTED
3.	C-XFMR X-Winding - Cable #4 Phase A - NON-FAULTED
4.	C-XFMR Y-Winding - 4kV Room
5.	C-XFMR Y-Winding - Near Lube Oil Reservoir
6.	C-XFMR Y-Winding - Near Lube Oil Reservoir
7.	C-XFMR X-Winding - Cable #3 - Fault Area
8.	C-XFMR X-Winding - Cable #2 - Fault Area (A, B and C phases)
9.	C-XFMR X-Winding - Cable #1 - Fault Area
10.	C-XFMR X-Winding - Cable #4 - Paper Filler - Fault Area
11.	C-XFMR X-Winding - Cable #2 - Paper Filler and Binding Tape - Fault Area
12.	C-XFMR Y-Winding - Paper Filler and Binding Tape - 4kV Room
13.	C-XFMR X-Winding - Cable #4 - Aluminum Armor - Fault Area
14.	C-XFMR Y-Winding - Binding Tape - Near Lube Oil Reservior
15.	B-XFMR - Cable #1 - Last 6 Ft. from 4kV Room - Conductor B-1 Failed HyPot - Subsequently Passed When Cut Away from OZ Terminator
16.	B-XFMR - Cable #1 - Terminator from the XFMR side
17.	B-XFMR - Cable #1 - Compound from Terminator at Transformer
18.	B-XFMR - Cable #2 - 15 Feet & Terminator - 4kV Room
19.	B-XFMR - Cable #4 - Near Main Steam - (15 Foot sample)
20.	B-XFMR - Cable #3 - Near Main Steam - (15 Foot sample)
21.	B-XFMR - Cable #2 - Near Main Steam - (15 Foot sample)

TABLE 6-20 (Continued)

Sample No.	Description
22.	B-XFMR - Paper Filler Material from Cable #2 (Sample #21) - Near Main Steam (Cut inward from Sample #21 Cables)
23.	TPCW Cable w/Terminator (No Termination)
	23A FAILED Hi-Pot (A Phase)
	23B Passed Hi-Pot
	23C Passed Hi-Pot
	23 Cable From Terminator Back Passed Hi-Pot #23 is Cable above Terminator (about 3 Feet)
24.	B-XFMR - Cable #4 - from 4kV Room with Terminator 15 Feet
25.	B-XFMR - Cable #3 - from 4kV Room with Terminator 15 Feet
26.	B-XFMR - Cable #1 - Near Main Steam Line - 15 Feet
27.	B-XFMR - Cable #2 - South Straightaway - Near Exciter Housing - 15 Feet
28.	B-XFMR - Cable #1 - Middle Straightaway Near Weld Burn on Cable Tray - 15 Foot Sample
29.	B-XFMR - Cable #3 - South Straightaway Near Exciter Housing - 15 Feet
30.	B-XFMR - Cable #1 - South Straightaway Near Exciter Housing - 15 Feet
31.	B-XFMR - Cable #4 - South Straightaway Near Exciter Housing - 15 Feet
32.	B-XFMR - Cable #1 - with Boot - No Terminator from near the XFMR - 15 Feet
33.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet
34.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet

TABLE 6-20 (Continued)

Sample No.	Description
35.	B-XFMR - Cable with Boot - No Terminator - From near the XFMR - 15 Feet
36.	C-XFMR - Y-Winding - from 4kV Room about 3 Feet
37.	3 Pieces of B-XFMR Cable (9 conductors - about 3 ft. each)
38.	15 Foot Sample from Charging Pump G8A
39.	Charging Pump 'B' Booted Cable Near Pump
40.	Charging Pump 'B' - Mid-run - Indoors - Unbooted
41.	Charging Pump 'B' - 2nd Unbooted - Indoors
42.	Charging Pump 'B' - Booted Near Pump
43.	B - XFMR Cable #1 - 3 (1 foot pieces from sample #15)
44.	A-XFMR (3 O-Z Terminators from XFMR)
45.	Terminator 'C' Transf. 4kV Room (No Boot) A1C2-X04, 1A1CO2, BWH
46.	Terminator, 'C' Transformer, With Boot, XFMR End
47.	Terminator, 'C' Transformer, With Boot, Transf. End

TABLE 6-21

LISTING OF CABLE SAMPLES SENT TO PARTICIPATING LABORATORIES

	LABORATORY AND SAMPLE NUMBERS (#)				
	CTL	Okonite	Kerite	SCE	Springborn
Aux. B. Trans.					
1' Length of 1/C	—	#34c, 35	—	—	#34a, 34b
15' Length of 3/C	#32, 33	—	#34C, 35	—	#34a, 34b
Aux. B - Straightaway					
15' Length of 3/C	#27, 28	—	#29, 30, 31	—	—
Aux. B - Steam					
1' Length of 1/C	—	#20c, 19c	—	—	
15' Length of 3/C	#19, 20	—	#21, 26	—	#20a, 20b
Aux. B - Switchgear					
1' Length of 1/C	—	#43a, 43c	—	—	#43b
15' Length of 3/C	#18	—	#24, 25	—	#18c
Aux. C - Near Failure					
1' Length of 1/C	#7-2	#8-3	#8-1	—	#7-1
Aux. C Failure	#1,2	—	—	—	
South Charging Pump G8B					
4-15' Lengths of 3/C (4/0)	—	—	—	41,42,43	—

TABLE 6-22

SUMMARY OF ELECTRICAL TESTS

Simplex, 1/C No. 12 AWG, 50 mil Anhydrex XX Butyl insulation, 20 mil neoprene jacket (circuits identified in Reference 6.6.13)

	kV (withstand time)					
	Cable with Intact Jacket		Cable With Cracked Jacket		Cable with Both Jacket Conditions	
	AC	DC	AC	DC	AC	DC
Cable Technology Laboratory (Ref. B)					10 (2 min) 15 (5 sec) 15 (10 sec) 20 (10 sec) 10 (4.5min)	25 (5 min)
SCE – Alhambra (Ref. E)	17 (30 sec)	57 (70 sec)	12 (35 sec)	57 (30 sec)		

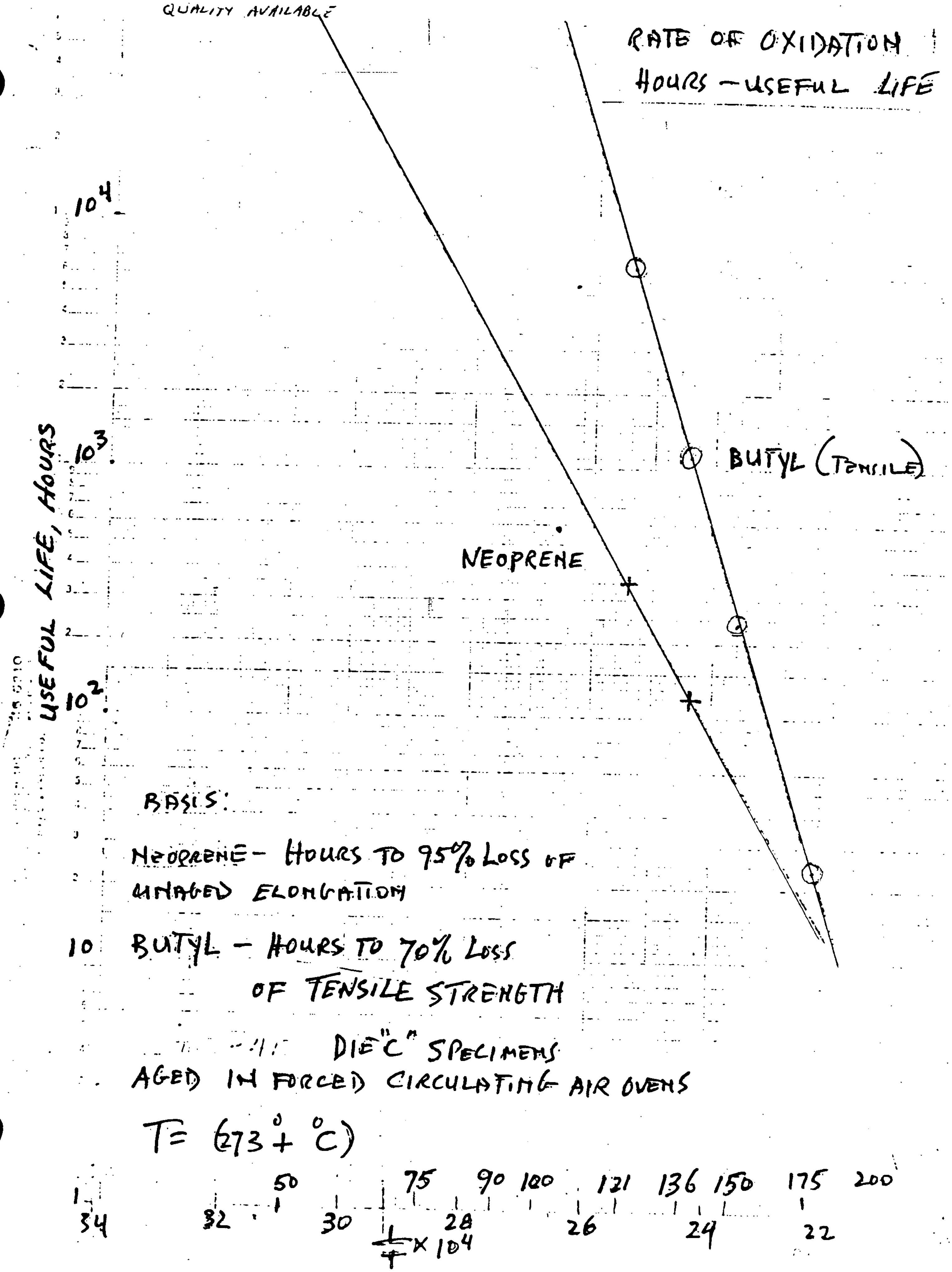
NOTES:

1) AC and DC step tests were 5kV steps for 5 minutes. Reference E started tests at 2kV for AC and DC Reference B started test at 10kV AC, 15kV DC

2) Reference B – eight coils, in their condition as removed from service, were tested at normal factory acceptance levels for new cable; 4.5kV AC for 5 minutes, and 13.5kV DC for 5 minutes. Five of the eight passed this test indicating that any abuses from handling were not excessive. The other three were compromised by the removal problems; in fact, two had test failures at the good portions (jacket intact) due to physical damage.

NOTE: COPY OF ORIGINAL DOCUMENT DATED 23 April, 1968 - BEST QUALITY AVAILABLE

TABLE 6-23



ATTACHMENTS

SECTION 6.0

LIST OF ATTACHMENTS

ATTACHMENT 6-1

MEMORANDUM FOR FILE

May 5, 1986

SUBJECT: Examination of Sample No. 9 (1) and No. 8 (2)
4kV Cable Evaluation Task Force
San Onofre Nuclear Generating Station, Unit 1

REFERENCES: A) Task No. 17, Identify Cable Failure Modes
B) Report Kerite to C. K. Balog, dated May 1, 1986
Subject: 4kV Cable Evaluation

OBSERVATIONS

These short 10" and 15" cable samples are from cables 1 and 2, adjacent to the failure section on cable 4. Both samples had the neoprene jacket severely cracked along the phase-to-phase interface with portions of the jacket missing.

The fabric core tape over the cabled conductors stuck to the jacket at the armor tape location. The neoprene jacket has a longitudinal crack along the legend imprint lines. A line of small cracks borders the phase-to-phase conductors' contact area. The neoprene away from the conductor to conductor interface is more pliable than in the interface location. Under this phase-to-phase "pressure" area, the fabric tape between the insulation and jacket is torn and there are splits in the insulation. This is true for both Sample No. 9 (1) and 8 (2). The depth of the splits varies with 1/3 or more of the insulation thickness penetrated in the samples examined. This condition completely compromises the electrical integrity of the insulation and failure is imminent as the splitting will progress as evidenced by the in-service failures. The location of the in-service failures, from the photographs taken in November 1985, coincides with the location of the splitting on the samples; i.e., in the interface area.

CONCLUSION

'Hostile' environment tests at the Kerite Laboratory with extreme temperatures up to 200°C and hot water at 90°C did not show any tendency toward instability of the insulation system (Reference B). The excessive temperatures that were present at the 'C' transformer cable failure location, however, did cause a physical weakening and resultant tearing/splitting of the cable components. A significant factor in the

ATTACHMENT 6-1
(Continued)

mechanism of breakdown was the fabric tape between the insulation and jacket that tended to lock the two surfaces and subject them to physical forces exerted by the thermal expansion within the confines of the overall aluminum interlock armor. Without the localized high temperatures, these internal pressures would not have developed.

(Original signed)
A. HVIZD
Cable Consultant

ATTACHMENT NO. 6-2

Shop Services and Instrumentation Division
Application Test Report

Documented By: Wolfgang Steinke
Engineering Division

SUBJECT: DC Dielectric Test of 5kV Cable Terminations from San Onofre Nuclear Generating Station, Unit 1

Purpose of Test:

Subject three samples to an increasing DC voltage until insulation breakdown occurs,

Test Equipment:

110 VDC Biddle Hipot Test Set,
Biddle Handcrank Megger

ATTACHMENT NO. 6-2

(Continued)

Test Procedure:

After all short ends of cable samples were stripped of their outer insulating jackets, each sample was suspended from a crane by non-conductive dacron string. All three spades on each sample bonded together with copper wire. Applied Station ground was to metal coupling.

Using a portable DC hi-potential test set all three samples were stressed as follows:

1. Raised voltage to 50kV DC and held for five minutes.

2. From 50kV DC increased voltage in 10kV steps holding each step for five minutes until failure occurred.

After each sample failed, cable failed with a megger insulation tester.

Test Results:

1. All samples withstood the routine dielectric test voltage of 29kV DC to ground.

2. Insulation breakdown occurred between 80 and 120kV DC.

NOTE: See attached sheets for test measurements and diagrams.

ATTACHMENT NO. 6-2

(Continued)

All questions regarding this report should be directed to Mr. Robert Peck at PAX 46131.

(original signed)

ROBERT PECK
Apparatus Test Supervisor

Tested By: Gilbert Lemos
Harold Yoshimura

Witnessed By: Wolfgang W. Steinke
Engineering Division
G.O. 3

ATTACHMENT NO. 6-2

(Continued)

TEST MEASUREMENTS

Sample #1

Hi-POT Test:

kV DC	uA@5 min.	
50	6.5	
60	9.5	
70	13.5	
80	18	* Failure occurred at three minutes into test @ 80 kV DC

Megger Results: (each phase to ground)

AØ = 20 Megohm (failed)
BØ =
CØ =

ATTACHMENT NO. 6-2

(Continued)

TEST MEASUREMENTS

Sample #3

Hi-POT Test:

kV DC	uA@5 min.
50	250
60	275
70	300
80	315
90	375 *Failure occurred at one minute into test @ 90kV DC

Megger Results:

AØ = 6 Megohm (failed)

BØ =

CØ =

ATTACHMENT NO. 6-2
(Continued)

TEST MEASUREMENTS

Sample #4

Hi-POT Test:

kV DC	uA@5 min.
50	.9
60	2.25
70	9
80	14
90	19
100	26
110	34
120	41.5 *Failure occurred at one minute into test @ 120kV DC

Megger Results:

AØ = .8Megohm (failed)
BØ =
CØ =

ATTACHMENT 6-3

IDENTIFICATION OF CIRCUITS WITH CRACKED JACKETS

ATTACHMENT 6-3

Sheet No. 1

600V CABLE WITH CRACKED/DEGRADED JACKETS

Single conductor 12 AWG Simplex Cable (Cable Code 122) in certain areas of the plant have exhibited cracked or degraded jackets.

The following pages list those circuits that have been identified by visual inspection as being in this condition.

These circuits are located in the upper elevations of the Turbine Building, primarily in the lube oil area and in the top wireway of MCC No. 1 located in the 4kV Switchgear Room.

In addition to the 1/C 12 AWG cables, 9 single conductor 4/0 Simplex cables 4 (Cable Code 128) in the 480V Switchgear Room also exhibited jacket cracking.

6-91

CALCULATION SHEET

BECHTEL

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V CABLE IDENTIFICATION SHEET NO. 2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

REV. INDICATOR

SUMMARY:

RACEWAY NO.	CODE	NO. CIRCUITS	NO. CABLES	
36P1	122	6	13	
36Q1	"	19	38	
36R1	"	0	0	(CABLES LISTED IN ABOVE RCY.)
46AD1	"	0	0	" " " " "
46AE1	"	12	33	
46AF1	"	0	0	" " " " "
49F1	"	5	11	
49F2	"	18	35	" " " " "
49M1	"	5	10	
49S1	"	0	0	" " " " "
		65	140	
39W1	128	1	9	
MCC #1 (GB01)	122	157	312	
TOTAL		223	461	

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CALCULATION SHEET

PROJECT: SONGS 1　　JOB NO. 15691-795　　CALC. NO.

SUBJECT: 600V CABLE IDENTIFICATION　　SHEET NO. 3

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'s	DWG #	EQUIPMENT
36P1	122	1NB0128C2	NL$49	NNG40	113'	2	C1, C11	455495	L.O. FILTER DP G40
"	"	1WB0115K3	NK01	NT$8	223'	2	K26, TP2	455496	
"	"	1WB0115P1	FB0115	NNK9	200'	3	T1, T2, T3	455496	L.O. VAPOR EXTRACTOR
"	"	1WB0128K1	NK01	NL$49	222'	2	K15, TP1	455495	
"	"	1WB$315K1	NK01	NTOR	217'	2	TP2, K25	568268 (W), 5150332 568333 (W)	
"	"	1WY10901	FB01	NM01	193'	2	U, C1	455496	L.O. COND. VAPOR EXTRACTOR

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SHT. 4

36N6 W	8436	24X3	TRAY	30	E	36V1	SWGR RM	1W80111K4	2	122	.10	.10	0	
36P1 W	8436	12X3	TRAY	30	C	BLIND END	36Q1 36R1	1W80128C2	2	122	.10			✓
								1N80164WP	1	136	.33			
								1N80139C3	2	129	2.16			
								1N80139C4	1	124	.10			
								1W8011SK3	2	122	.10			✓
								1W8011SP1	3	122	.15			✓
								1W80128K1	2	122	.10			✓
								1WBS31SK1	2	122	.10			✓
								1W0108117	1	236	.10			
								1W0108118	1	236	.10			
								1WY10981	2	122	.10			✓
								1V80302P1	3	134	.64			
								1VBS31SP2	3	154	2.50	6.60	18	

13   6

Total	Cables	Ckts
	~~64~~	~~32~~
←	140	65

REFERENCE B

CALCULATION SHEET

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'S	DWG #	EQUIPMENT
36Q1	122	1WB0115K3	SEE TRAY 36P1						
"	"	1WB0115P1	SEE TRAY 36P1						
"	"	1WB0119C1	FB01	NX51	187'	2	M1, M2	5149952	CENTRIFUGE FDR. X51
"	"	1WB0128C1	FB0128	NMG40	217'	2	X1, C1	455495	
"	"	1WB0128K1	SEE TRAY 36P1						
"	"	1WB0128P1	FB0128	NMG40	265'	3	T1, T2, T3	455495	
"	"	1WB0131K1	NJ358	NK01	205'	2	AP2, K32	5150352	
"	"	1WB0317C5	NTOA	NTOG	288'	2	X1, C7	568266 (W), 568268 (W), N1541-14	
"	"	1WB0317C6	NTOB	NTOG	303'	2	U1, C27	568266 (W), 568268 (W), N1541-14	
"	"	1WB$315K1	SEE TRAY 36P1						
"	"	1WD0139C5	NTOI	NTOH	306'	2	C11, C1	568234 (W), 568268 (W), N1541-17	
"	"	1WT10203	NC06	NTOA	187'	1	13N3	568266 (W), 568348 (W), N1541-2	
"	"	1WT110A12	NJ333	NSV1	173'	2	11N5, C1	N1541-8	

CALCULATION SHEET

BECHTEL

PROJECT Sonc: 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V CABLE IDENTIFICATION SHEET NO. 6

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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REV. INDI-

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG #	EQUIPMENT
36Q1	122	1WT110A13	NJ333	N$V3	173'	2	11NS, C11	N1541-8	
"	"	1WT110B12	NJ323	N$V2	401'	2	11NS, C1	N1541-8	
"	"	1WT110B13	NJ323	N$V4	396'	2	11NS, C11	N1541-8	
"	"	1WT11102	NC04	NJ350	147'	2	DV6, DV7	5110881 (W), N1541-10	
"	"	1WT11215	NTOA	NTOC	148'	2	$4L, $VY	568266 (W) 568267 (W)	
"	"	1WT11216	NTOB	NTOT	366'	2	$4RX, $VY	568266 (W) 568267 (W)	
"	"	1WY10802	FB01	NTOB	170'	2	1X8, U	568266 (W) 568236 (W)	
"	"	1WY10901	SEE TRAY 36P1						
"	"	1YB$315C3	HB06	NTOB	278'	2	C11, C1	568234 (W), 5150332 568266 (W)	
"	"	1YT10802	HB0317	NSV74	323'	2	C1, 11N3	568206 (W) 568245 (W)	
"	"	1YT10803	HB0317	NT08	358'	2	C1, 11P3	568266 (W) 568245 (W)	

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S+T 7

KE553-RD8/ 84) 08 APR 86

11793- 1- 0

** TRAYS WITH INCLUDED CABLES **

SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

3601 W

32 51 84

3601 W 8436 24X3 TRAY 25 E 36P1 46AB4

1NW0184AP	1	136	.33	
1ND0139C3	2	129	2.16	
1WD0139C4	1	124	.10	
1WB0115K3	2	122	.10	36P1
1WB0115P1	3	122	.15	36P1
1WB0119C1	2	122	.10	✓
1WB0119P1	3	126	.42	
1WB0128C1	2	122	.10	✓
1WB0128K1	2	122	.10	36P1
1WB0128P1	3	122	.15	✓
1WB0131C1	1	136	.33	
1WB0131C2	1	136	.33	
1WB0131K1	2	122	.10	✓
1WB0317C5	2	122	.10	✓
1WB0317C6	2	122	.10	✓
1WBS315K1	2	122	.10	36P1
1WD0139C1	1	270	.44	
1WD0139C5	2	122	.10	✓
1WD0139K1	1	136	.33	
1WQ108117	1	236	.10	
1WQ108118	1	236	.10	
1WT10108	1	136	.33	
1WT10109	1	136	.33	
1WT10282	1	136	.33	
1WT10283	1	122	.05	✓
1WT10304	1	138	.53	
1WT10305	1	136	.33	
1WT10306	1	137	.37	
1WT10605	1	138	.53	
1WT10606	1	136	.33	
1WT10703	1	136	.33	
1WT10706	1	138	.53	
1WT10707	1	136	.33	
1WT110A12	2	122	.10	✓
1WT110A13	2	122	.10	✓
1WT110B12	2	122	.10	✓
1WT110B13	2	122	.10	✓
1WT11102	2	122	.10	✓
1WT11103	1	138	.53	
1WT11215	2	122	.10	✓
1WT11216	2	122	.10	✓
1WT11402	1	236	.10	
1WT11403	1	236	.10	
1WT11428	1	238	.13	
1WT11429	1	237	.11	
1WT11431	1	236	.10	
1WT11432	1	237	.11	
1WT11434	1	236	.10	
1WV10802	2	122	.10	✓
1WV10901	2	122	.10	36P1
1WB0210C1	1	136	.33	

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			32	51	85	
1X80210P2	1	136	.33			
1X80219C2	1	136	.33			
1X80219P1	1	136	.33			
1XQ108097	1	138	.53			
1XT11301	1	136	.33			
1XT11302	1	136	.33			
1KT11033	1	236	.10			
1VB0302P1	3	134	.64			
1VBS315C3	2	122	.10			✓
1VBS315P2	3	154	2.50			
1V0013901	2	129	2.16			
1VF10802	2	122	.10			✓
1VF10803	2	122	.10	20.59	28	✓

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BECHTEL

CALCULATION SHEET

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600V CABLE IDENTIFICATION SHEET NO. 9

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDI-
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TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES WIRE #'S	DWG #	EQUIPMENT
36R1	122	1NB0128C2	SEE TRAY 36P1					
"	"	1WB0119C1	SEE TRAY 36Q1					
"	"	1WB0122C1	SEE TRAY 36Q1					
"	"	1WB0131K1	SEE TRAY 36Q1					
"	"	1WB0317C5	SEE TRAY 36Q1					
"	"	1WB0317C6	SEE TRAY 36Q1					
"	"	1WT10203	SEE TRAY 36Q1					
"	"	1WT110A12	SEE TRAY 36Q1					
"	"	1WT110A13	SEE TRAY 36Q1					
"	"	1WT110B12	SEE TRAY 36Q1					
"	"	1WT110B13	SEE TRAY 36Q1					
"	"	1WT11102	SEE TRAY 36R1					
"	"	1WT11215	SEE TRAY 36Q1					

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CALCULATION SHEET

PROJECT: SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT: 600 V CABLE IDENTIFICATION SHEET NO. 10

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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REV. INDI-

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	AWG #	EQUIPMENT
36R1	122	1WT11216	SEE TRAY 26Q1						
"	"	1WY10802	SEE TRAY 36Q1						
"	"	1YES315C3	SEE TRAY 36Q1						
"	"	1YT10802	SEE TRAY 36Q1						
"	"	1YT10803	SEE TRAY 36Q1						

SHT. 11

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36R1 W

(E553-R1A/ 86) ** TRAYS WITH INCLUDED CABLES **
08 APR 86 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB 32 51 86

36R1 W 0436	12X3 TRAY	5	C	36P1	46A01	1WB0120C2	2	122	.10		36P1
						1WB0119C1	2	122	.10		36Q1
						1WB0119P1	3	126	.42		
						1WB0120C1	2	122	.10		36Q1
						1WB0131C1	1	136	.33		
						1WB0131C2	1	136	.33		
						1WB0131K1	2	122	.10		36Q1
						1WB0131P1	1	136	.33		
						1WB0317C5	2	122	.10		36Q1
						1WB0317C6	2	122	.10		36Q1
						1WQ108117	1	236	.10		
						1WQ108118	1	236	.10		
						1WT10108	1	136	.33		
						1WT10109	1	136	.33		
						1WT10202	1	136	.33		
						1WT10203	1	122	.05		36Q1
						1WT10304	1	138	.53		
						1WT10305	1	136	.33		
						1WT10306	1	137	.37		
						1WT10605	1	138	.53		
						1WT10606	1	136	.33		
						1WT10703	1	136	.33		
						1WT10706	1	138	.53		
						1WT10707	1	136	.33		
						1WT110A12	2	122	.10		36Q1
						1WT110A13	2	122	.10		36Q1
						1WT110B12	2	122	.10		36Q1
						1WT110B13	2	122	.10		36Q1
						1WT11102	2	122	.10		36Q1
						1WT11103	1	138	.53		
						1WT11215	2	122	.10		36Q1
						1WT11216	2	122	.10		36Q1
						1WT11402	1	236	.10		
						1WT11403	1	236	.10		
						1WT11428	1	238	.13		
						1WT11429	1	237	.11		
						1WT11431	1	236	.10		
						1WT11432	1	237	.11		
						1WT11434	1	236	.10		
						1WY10802	2	122	.10		36Q1
						1XB0210C1	1	136	.33		
						1XB0210P2	1	136	.33		
						1XB0219C2	1	136	.33		
						1XB0219P1	1	136	.33		
						1XQ108097	1	138	.53		
						1XT11301	1	136	.33		
						1XT11302	1	136	.33		
						1XT11433	1	236	.10		
						1YBS316C3	2	122	.10		36Q1
						1YT10802	2	122	.10		36Q1
						[illegible]	2	122	.10	11.55 32	36Q1

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CALCULATION SHEET

PROJECT Songs 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V Cable Identification SHEET NO. 12

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDI-
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TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG #	EQUIPMENT
46AD1	122	1NB0128C2	SEE	TRAY 36Q1					
"	"	1WB0119C1		"					
"	"	1WB0128C1		"					
"	"	1WB0128P1		"					
"	"	1WB0131K1		"					
"	"	1WB0317C5		"					
"	"	1WB0317C6		"					
"	"	1WT10203		"					
"	"	1WT110A12		"					
"	"	1WT110A13		"					
"	"	1WT110B12		"					
"	"	1WT110B13		"					
"	"	1WT11102		"					

CALCULATION SHEET

PROJECT: SONGS 1 | JOB NO.: 15691-795 | CALC. NO.:

SUBJECT: 600V CABLE IDENTIFICATION | SHEET NO.: 13

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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△					△				

TRAY #	CODE SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'S	DWG #	EQUIPMENT
46A01	1.22	1WT11215	SEE TRAY 3601					
"	"	1WT11216	"					
"	"	1WY10802	"					
"	"	1YB$315C3	"					
"	"	1YT10802	"					
"	"	1YT10803	"					

46ADIW 8446	12X3 TRAY	4	C	36R1	46AE1 46AF1	1WB0128C2	2	122	.10	36P1
						1WB0119C1	2	122	.10	36Q1
						1WB0119P1	3	126	.42	
						1WB0128C1	2	122	.10	36Q1
						1WB0128P1	3	122	.15	36Q1
						1WB0131C1	1	136	.33	
						1WB0131C2	1	136	.33	
						1WB0131K1	2	122	.10	36Q1
						1WB0131P1	1	136	.33	
						1WB0317C5	2	122	.10	36Q1
						1WB0317C6	2	122	.10	36Q1
						1WQ108117	1	236	.10	
						1WQ108118	1	236	.10	
						1WT10103	1	136	.33	
						1WT10109	1	136	.33	
						1WT10202	1	136	.33	
						1WT10203	1	122	.05	36Q1
						1WT10304	1	138	.53	
						1WT10305	1	136	.33	
						1WT10306	1	137	.37	
						1WT10605	1	138	.53	
						1WT10606	1	136	.33	
						1WT10703	1	136	.33	
						1WT10706	1	138	.53	
						1WT10707	1	136	.33	
						1WT110A12	2	122	.10	36Q1
						1WT110A13	2	122	.10	36Q1
						1WT110B12	2	122	.10	36Q1
						1WT110B13	2	122	.10	36Q1
						1WT11102	2	122	.10	36Q1
						1WT11103	1	138	.53	
						1WT11215	2	122	.10	36Q1
						1WT11216	2	122	.10	36Q1
						1WT11402	1	236	.10	
						1WT11403	1	236	.10	
						1WT11428	1	238	.13	
						1WT11429	1	237	.11	
						1WT11431	1	236	.10	
						1WT11432	1	237	.11	
						1WT11434	1	236	.10	
						1WT10802	2	122	.10	36Q1
						1XB0210C1	1	136	.33	
						1XB0210P2	1	136	.33	
						1XB0219C2	1	136	.33	
						1XB0219P1	1	136	.33	
						1XQ108097	1	138	.53	
						1XT11301	1	136	.33	
						1XT11302	1	136	.33	
						1XT11433	1	236	.10	
						1YBS315C3	2	122	.10	36Q1
						1YT10802	2	122	.10	36Q1

0 0

CALCULATION SHEET

BECHTEL

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600V CABLE IDENTIFICATION SHEET NO. 15

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG. #	EQUIPMENT
46AE1	122	1NB0317C4	NTOA	NTOB	57'	2	X1, C27	N1541-14	
"	"	1NT10309	NTOA	NTOB	57'	1	TT1	N1541-3	
"	"	1NT11109	NJ350	NSV48	55'	2	DV1, DVY	N1541-10	
"	"	1NT11110	NJ350	NSV49	55'	2	DV2, DVY	N1541-10	
"	"	1NT11111	NJ350	NSV50	57'	2	DV3, DVY	N1541-10	
"	"	1NT11112	NJ350	NSV51	57'	2	DV4, DVY	N1541-10	
"	"	1NT11113	NJ350	NSV52	55'	2	DV5, DVY	N1541-10	
"	"	1WB0131K1	SEE	TRAY	36Q1				
"	"	1WB0317C5		"					
"	"	1WT10203		"					
"	"	1WT110A12		"					
"	"	1WT110A13		"					
"	"	1WT110B12		"					

CALCULATION SHEET

PROJECT: SONGS 1 JOB NO.: 15691-795 CALC. NO.:

SUBJECT: 600V CABLE IDENTIFICATION SHEET NO.: 16

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'s	DWG #	EQUIPMENT
46AE1	122	1WT110B13	SEE	TRAY	3GQ1				
"	"	1WT11102		"					
"	"	INT11104	NCU83	NJ350	55	4	DV61, DV8 DV71, DV9		
"	"	INT11105	NCU84	NJ350	55	4	DV6, DV61 DV7, DV71		
"	"	INT11106	NCU85	NJ350	57	4	DV10, DV12 DV11, DV13		
"	"	INT11107	NCU86	NJ350	57	4	DV8, DV10 DV9, DV11		
"	"	INT11108	NCU87	NJ350	55	4	DV12, U1 DV13, U1		

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SHT. 17

06AE1W,8446 12X3 TRAY 3 C 46AD1 06AF1 BLEND END

1WT10003	2	122	.10	11.71	32	36Q1
1WB031FC	2	122	.10	✓		
1WT10509	1	122	.05	✓		
1WT11104	~~1~~ 4	~~137~~ 122	.37	✓		
1WT11105	~~1~~ 4	~~137~~ 122	.37	✓		
1WT11106	~~1~~ 4	~~137~~ 122	.37	✓		
1WT11107	~~1~~ 4	~~137~~ 122	.37	✓		
1WT11108	~~1~~ 4	~~137~~ 122	.37	✓		
1WT11109	2	122	.10	✓		
1WT11110	2	122	.10	✓		
1WT11111	2	122	.10	✓		
1WT11112	2	122	.10	✓		
1WT11113	2	122	.10	✓		
1WB0131C1	1	136	.33			
1WB0131C2	1	136	.33			
1WB0131K1	2	122	.10	36Q1		
1WB0131P1	1	136	.33			
1WB031VCB	2	122	.10	36Q1		
1WT10108	1	136	.33			
1WT10202	1	136	.33			
1WT10203	1	122	.05	36Q1		
1WT10304	1	138	.53			
1WT10306	1	137	.37			
1WT110A12	2	122	.10	36Q1		
1WT110A13	2	122	.10	36Q1		
1WT110B12	2	122	.10	36Q1		
1WT110B13	2	122	.10	36Q1		
1WT11102	2	122	.10	36Q1		
1WT11103	1	138	.53			
1X80219C2	1	136	.33			
1X80219P1	1	136	.33	7.01	19	

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BECHTEL

CALCULATION SHEET

PROJECT: SONGS I   JOB NO.: 15691-795   CALC. NO.:

SUBJECT: 600 V CABLE IDENTIFICATION   SHEET NO.: 18

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
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△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG #	EQUIPMENT
46AF1	122	1NB0128C2	SEE TRAY 3GP1						
"	"	1NB0317C4	SEE TRAY 46AE1						
"	"	1NT10309	"						
"	"	1NT11109	"						
"	"	1NT11111	"						
"	"	1NT11112	"						
"	"	1NT11113	"						
"	"	1WB0119C1	SEE TRAY 3GQ1						
"	"	1WB0128C1	"						
"	"	1WB0128P1	"						
"	"	1WB0317C6	"						
"	"	1WT110A12	"						
"	"	1WT110A13	"						

CALCULATION SHEET

PROJECT: SONGS 1 JOB NO.: 15691-795 CALC. NO.:

SUBJECT: 600V CABLE IDENTIFICATION SHEET NO.: 19

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #s	DWG. #	EQUIPMENT
4GAF1	122	1WT110B12	SEE TRAY 3GQ1						
"	"	1WT110B13	"						
"	"	1WT11215	"						
"	"	1WT11216	"						
"	"	1WY10802	"						
"	"	1YB5315C3	"						
"	"	1YT10802	"						
"	"	1YT10803	"						

SHT 20

6-109

KE553-R0A/ 1949 — 08 APR 86

** TRAYS WITH INCLUDED CABLES **

11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

46AF1W

32 51 184

46AF1W 6446 12X3 TRAY 8 C 46AD1 46AE1 BLIND END

1WB0128C2	2	122	.10		3671
1WB0317C4	2	122	.10		46AE1
1WT10309	1	122	.05		46 AE1
1WT11104	4	~~1~~ ~~137~~ 122	.37		46 AE1
1WT11105	4	~~1~~ ~~137~~ 122	.37		46 AE1
1WT11106	4	~~1~~ ~~137~~ 122	.37		46 AE1
1WT11107	4	~~1~~ ~~137~~ 122	.37		46AE1
1WT11108	4	~~1~~ ~~137~~ 122	.37		46AE1
1WT11109	2	122	.10		46AE1
1WT11111	2	122	.10		46AE1
1WT11112	2	122	.10		46AE1
1WT11113	2	122	.10		46AE1
1WB0119C1	2	122	.10		36Q1
1WB0119P1	3	126	.42		
1WB0128C1	2	122	.10		36Q1
1WB0128P1	3	122	.15		36Q1
1WB0317C6	2	122	.10		36Q1
1WT10189	1	136	.33		
1WT10305	1	136	.33		
1WT10605	1	138	.53		
1WT10606	1	136	.33		
1WT10703	1	136	.33		
1WT10706	1	138	.53		
1WT10707	1	136	.33		
1WT110A12	2	122	.10		36Q1
1WT110A13	2	122	.10		36Q1
1WT110B12	2	122	.10		36Q1
* 1WT110B12	2	122	.10		36Q1
1WT110B13	2	122	.10		36Q1
* 1WT110B13	2	122	.10		36Q1
1WT11218	2	122	.10		36Q1
1WT11218	2	122	.10		36Q1
1WT11402	1	236	.10		
1WT11403	1	236	.10		
1WT11428	1	238	.13		
1WT11429	1	237	.11		
1WT11431	1	236	.10		
1WT11432	1	237	.11		
1WT11434	1	236	.10		
1WV10802	2	122	.10		36Q1
1XB0210C1	1	136	.33		
1XB0210P2	1	136	.33		
1XQ10803J7	1	138	.53		
1XT11301	1	136	.33		
1XT11302	1	136	.33		
1XT11433	1	236	.10		
1VBS315C1	2	122	.10		36Q1
1YT10802	2	122	.10		36Q1
[illegible]	2	122	.10	10.04 27	36Q1

BECHTEL

CALCULATION SHEET

PROJECT Svacc 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600V CABLE IDENTIFICATION SHEET NO. 21

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE

REV. INDICATOR

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG. #	EQUIPMENT
49F1	122	1ABDN0243	FB0124	NMG3A	194	3	T1, T2, T3		
"	"	1ABDND258	FA1C4	FP$21	281	2	P1, C27		
"	"	1ABDND259	FA1C4	FP$22	281	2	P1, C37		
"	"	1WA1C04K3	NK01	NP$10	267	2	AP1, K19		
"	"	1WA1C12K3	NK01	NT$25	400	2	AP4, K70		

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S1+T-5

									1XQ1120C4	1	654	.10			
									1XQ1120C5	1	654	.10			
									1XQ1120C6	1	654	.10			
									1XY2A29P1	1	624	.19			
									1YB0383P2	3	125	.36			
									1YB0388K1	1	153	.90	17.41	24	
49D4	W	8449	6X3	TRAY	75	A	49C4	5KV SPLICE BOX	1WA1C08P1	1	168	6.38	6.38	35	*
49E4	W	8449	6X3	TRAY	35	A	4984	HTR DRN PP 636B	1WA1C89P1	1	159	5.31	5.31	29	
49F1	F	8449	12X3	TRAY	35	C	4981	BLIND END	1ABDN0243	3	122	.15 ✓			
									1ABDN0258	2	122	.10 ✓			
									1ABDND259	2	122	.10 ✓			
									1FA1C0838	1	401	.18			
									1WA1C04K3	2	122	.10 ✓			
									1WA1C12K3	2	122	.10 ✓			
									1WT11213	1	136	.33			
									1WW10518	1	236	.10	1.17	3	

11 5

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CALCULATION SHEET

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V CABLE IDENTIFICATION SHEET NO. 23

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDICATOR
△					△					
△					△					

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'s	DWG #	EQUIPMENT
49F2	122	1ABDND102	GB02	NB10	443	1	C1		
"	"	1NB0184LP	NB13	NMK1A	322	2	T1,T3		
"	"	1WB0107C2	FB017	NT$4	387	2	1X7, C41		
"	"	1WB0111K5	NK01	NP$15	422	2	K51, AP3		
"	"	1WB0111K6	NK01	NP$16	382	2	K52, AP3		
"	"	1WB$111C3	FB0411	NP$56	437	2	C11, C1		
"	"	1WB$111C4	FB0411	N$V62	418	2	N1, C7		
"	"	1WB$111C5	FB0411	NT$15	418	2	P1, C32		
"	"	1WT110B12	SEE	TRAY	36Q1				
"	"	1WT 110B13	"	"	"				
"	"	1WY31002	NX47	NK01	422	2	AP3, K48		
"	"	1XA2C08C7	GA2C8	N$V130	287	2	N21, C41		
"	"	1XB0229C1	GB0229	NJ201	294	2	C11, X1		

SHT. 25

49F2 G 8449 24X3 TRAY #5 E 4982 49J2

1ABDNB182	1	122	.05	✓
1ABDNB194	1	136	.33	
1FA1C04C8	1	401	.18	
1GY2A30C2	1	624	.19	
1WB0180LP	2	122	.10	✓
1WA1C02A4	1	147	.82	
1WA1C09C4	1	136	.33	
1WB0107C2	2	122	.10	✓
1WB0111K5	2	122	.10	✓
1WB0111K6	2	122	.10	✓
1WB0229K1	1	136	.33	
1WBS111C3	2	122	.10	✓
1WBS111C4	2	122	.10	✓
1WBS111C5	2	122	.10	✓
1WBS111P2	3	133	1.00	
1WNR127	1	020	.16	
1WNT109	1	021	.13	
1WT110802	1	137	.37	
1WT110812	2	122	.10	SEE 36 QI
1WT110813	2	122	.10	SEE 36 QI
1WT11213	1	136	.33	
1WW101801	1	136	.33	
1WY31082	2	122	.10	✓
1XA2C08C7	2	122	.10	✓
1XB0229C1	2	122	.10	✓
1XB0229C3	4	300	.12	
1XB0229K2	2	300	.06	
1XB0230C2	2	122	.10	✓
1XB0230P1	1	145	.71	
1XB0231C2	2	122	.10	
1XB0231P1	1	145	.71	
1XBS211C3	2	122	.10	✓
1XBS211C4	2	122	.10	✓
1XBS211C5	2	122	.10	✓
1XNR130	1	020	.16	
1XNR176	1	020	.16	
1XNT110	1	020	.16	
1XNT111	1	021	.13	
1XNT145	1	021	.13	
1XT110801	2	122	.10	✓
1XT110814	2	122	.10	✓
1XW101804	2	300	.06	
1XW101805	2	300	.06	
1XW101806	2	300	.06	
1XW101807	2	300	.06	
1YB038VC3	1	400	.17	
1YBS318C4	2	122	.10	✓ 9.38 13

35 18

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CALCULATION SHEET

PROJECT: SONGS I JOB NO.: 15691-755 CALC. NO.:

SUBJECT: 600V CABLE IDENTIFICATION SHEET NO.: 24

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'S	DWG. #	EQUIPMENT
4GF2	122	1XB0230C2	GB0230	NNG37B	299	2	C11, X1		
"	"	1XB0231C2	GB0231	NC21	313	2	C11, X1		
"	"	1XB$211C3	GB0511	NP$57	491	2	C11, C1		
"	"	1XB$211C4	GB0511	N$V63	472	2	N1, C7		
"	"	1XB$211C5	GB0511	NT$16	472	2	P1, C32		
"	"	1XT110B01	NC19	NJ323	318	2	11P5, 11N5		
"	"	1XT110B14	NJ323	N$V6	131	2	11N5, C21		
"	"	1YB$315C4	HB0615	NT0H	465	2	C21, C11		

CALCULATION SHEET

PROJECT Song: 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V CABLE IDENTIFICATION SHEET NO. 26

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

REV. INDICATOR

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #S	DWG.#	EQUIPMENT
49M1	122	1WG104C4	NTOC	NTOD	322	2	G32, G32A		
"	"	1WT11211	NC19	NTOD	263	2	S4R, S4RX		
"	"	1WT11216	NTOB	NTOD	366	2	S4RX, SVY		
"	"	1WT11217	NTOC	NTOD	354	2	C7, 7P2		
"	"	1WT11218	NTOC	NTOD	354	2	FP2, K7		

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49ML F 8449	12X3 TRAY	20	C	4981	BLIND END	1FA1C04C8	1 401	.18			
						1WG104C0	2 120	.10	✓		
						1WT11209	1 139	.74			
						1WT11210	1 138	.53			
						1WT11211	2 122	.10	✓		
						1WT11213	1 136	.33			
						1WT11216	2 122	.10	36Q1		
						1WT11217	2 122	.10	✓		
						1WT11218	2 122	.10	✓		
						1WW10305	1 136	.33			
						1XB0287P4	1 150	.77			
						1XT11438	1 237	.11			
						1XT11439	1 238	.13		3.64	10
49N0 8449	9X3 TRAY	20	B	49C4	FW PUMP G3B		10		5		
49P2 Y 8449	24X3 TRAY	18	E	4942	BLIND END	1NNR132	1 020	.16			
						1NNT114	1 020	.16			
						1VV30201	1 122	.05			
						1VV30202	1 122	.05			
						1VV30801	1 122	.05			
						1VV30802	1 122	.05		.54	0

CALCULATION SHEET

PROJECT: SONGS 1 JOB NO.: CALC. NO.:

SUBJECT: 600 V CABLE IDENTIFICATION SHEET NO.: 28

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

TRAY #	CODE	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #'S	DWG #	EQUIPMENT
49$1	122	1NB0128C2	SEE TRAY 36P1						
"	"	1NT11111	SEE TRAY 4GAE1						
"	"	1NT11112	SEE TRAY 4GAE1						
"	"	1WB0128C1	SEE TRAY 36Q1						
"	"	1WB0128P1	SEE TRAY 36Q1						
"	"	1WB0317C6	SEE TRAY 36Q1						
"	"	1WT110812	SEE TRAY 36Q1						
"	"	1WT110813	SEE TRAY 36Q1						
"	"	1WT11216	SEE TRAY 36Q1						
"	"	1WY10802	SEE TRAY 36Q1						
"	"	1YBS315C3	SEE TRAY 36Q1						
"	"	1YT10802	SEE TRAY 36Q1						

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SHT. 29

4981 W		0449	24X3	TRAY	18	E	46AF1	507	1W80128C2	2	122	.10			36Q1
									1WT11106	4X	~~137~~ 122	.37			46AE1
									1WT11107	4X	~~137~~ 122	.37			46AE1
									1WT11111	2	122	.10			46AE1
									1WT11112	2	122	.10			46AE1
									1W80128C11	2	122	.10			36Q1
									1W80128P1	3	122	.15			36Q1
									4W80317C6	2	122	.10			36Q1
									1WT10606	1	136	.33			
									1WT110812	2	122	.10			36Q1
									1WT110813	2	122	.10			36Q1
									1WT11216	2	122	.10			36Q1
									1WT11402	1	236	.10			
									1WT11403	1	236	.10			
									1WT11431	1	236	.10			
									1WT11432	1	237	.11			
									1WT11434	1	236	.10			
									4WT10802	2	122	.10			36Q1
									1X80210C1	1	136	.33			
									1X80210P2	1	136	.33			
									1XT11433	1	236	.10			
									1Y8S315C3	2	122	.10			36Q1
									1WT10802	2	122	.10	3.62	5	36Q1
49TL	F	0449	24X3	TRAY	13	E	49C3	BLIND END	1ABDN0209	3	408	.50			
									1ABDN0210	1	404	.33			
									1ABDN0244	1	136	.33			
									1ABDN0253	1	400	.17			
									1FA1C04C2	1	404	.33			
									1FA1C04C8	1	401	.18			
									1FA1C04C8	1	401	.18			
									1FA1C04C9	1	401	.18	2.19	3	
49VL	F	0449	18X3	TRAY	3	0	49F4W/49F36	49F1F/49F26	1ABDN0246	2	122	.10			
									1FA1C04C8	1	401	.18			
									1WA1C02A4	1	147	.82			
									1WA1C12K3	2	122	.10			
									1WT11213	1	136	.33			
									1X80229C1	2	122	.10			
									1X80229C3	4	300	.12			
									1X80229K2	2	300	.06			
									1X80230C2	2	122	.10			
									1XW101804	2	300	.06			
									1XW101805	2	300	.06			
									1XW101806	2	300	.06			
									1XW101807	2	300	.06	2.17	4	

BECHTEL

CALCULATION SHEET

PROJECT: Songs 1 | JOB NO. 15691-795 | CALC. NO.

SUBJECT: 600 V Cable Identification | SHEET NO. 30

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

REV. INDICATOR

TRAY #	COND.	SCHEME #	FROM	TO	LENGTH	CABLES	WIRE #s	DWG. #	EQUIPMENT
39W1	128	1GB$218P2	GB02	GB0518	45	9	A,B,C		SWGR #2 To MCC
							A,B,C		#2 FEEDER
							A,B,C		

LAO-3998.1 7/85

SHT. 31

39ML 6 8468	6X3 TRAY	26		A	41V31	MCC#2	1GBS218P2	9	128	4.53	4.53	25		
40A1 6 4448	9X4 TRAY	5	5	Q	5316	5408								I
41A1 F					* DELETED *									I
41A1 6 4441	12X3 TRAY	5	5	C	WPC 23	41B1								I
41B1 F					* DELETED *									I
41B1 6 4441	12X3 TRAY	15	15	C	41A1	JB 669								I
41V10 8441	12X3 TRAY	5		C	480V SWGR	39E4								
41V11Y 8441	6X3 TRAY	4		A	480V SWGR	39E3	1ABDN0285	2	134	.43				
							1WBS108C9	2	122	.10				
							1WBS303D1	2	122	.10				
							1XBS202K2	2	122	.10				
							1XBS203C5	2	122	.10				
							1XBS305C2	2	122	.10				
							1YBS303B1	1	137	.37				
							1YBS303C3	1	138	.53				
							1YBS303K1	1	136	.33	2.17	12		
41V12W 8441	24X3 TRAY	7		E	480V SWGR	39E5	1WBS103P2	3	129	3.23				
							1WBS103P3	3	129	3.23				
							1WBS103P4	3	129	3.23				
							1WBS103P5	3	129	3.23	12.92	17		
41V13H 8441	6X3 TRAY	4		A	480V SWGR 3	39E3	1ABDN0829	2	122	.10				
							1ABDN0550	3	411	2.75				
							1ABDN0551	2	122	.10				
							1ABDN0553	2	124	.20				
							1ABDN0555	1	705	.20				
							1ABDN0556	1	122	.05				
							1GBS221C4	1	122	.05				
							1GBS221C7	1	122	.05				
							1HB0305C6	1	138	.53				
							1HBS305C2	1	122	.05				
							1HBS305C4	1	122	.05				
							1HB0305CC	2	122	.10				
							1YBS305A1	2	124	.20				
							1YBS305K1	2	122	.10	4.57	25		
41V14W 8441	6X3 TRAY	5		A	480V SWGR 3	39E4	1NB0184JC	2	122	.10	.10	0		

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BECHTEL

CALCULATION SHEET

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT 600 V CABLE IDENTIFICATION SHEET NO. 32

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDI- CATOR
△					△					
△					△					

MOTOR CONTROL CENTER NO. 1

CRACKED OR DEGRADED JACKETS WERE FOUND IN THE TOP WIREWAY OF MCC # 1 (LOCATION FB01) LOCATED IN THE 4KV SWITCHGEAR ROOM.

THE FOLLOWING PAGES LIST 157 CIRCUITS (312 CABLES) OF SIMPLEX SINGLE CONDUCTOR 12 AWG CABLE NOT PREVIOUSLY LISTED. ALL OF THESE CIRCUITS ORIGINATE FROM MCC # 1.

SHT. 33

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MCC #1

(E553-R14)

DATE 17 DEC 85 LIST OF ALL CIRCUITS IN LOCATION NUMBER SEQUENCE REV. 28 RUN 51 PAGE 9

JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS							FIELD STATUS
	FB01 12	NC20		1WB0112C1				138	1	59	C1	C3	C4	C13	C23	X1	SP	
FB01 13																		
( )	FB01 13	GWPC4		1WB0113C3				137	1	171	C88	C89	X2	U2				
→	FB01 13	GWPC4		1WB0113C4				122	2	171	X1	C31						
	FB01 13	GWPC5		1WB0113P1				152	1	197	T1	T2	T3					
	FB01 13	NC20		1WB0113C1				138	1	72	C1	C3	C4	C13	C23	X1	U	
	FB01 13	NC20		1WB0113C2				137	1	72	X1	C31	C6	K11				
FB01 14																		
( )	NA32	FB01 14		1WB0114P1				125	3	33	L1	L2	L3					
FB01 15																		
( ) →	FB01 15	HB03 12		1WB0115K1				122	1	354	TP2							
	FB01 15	NK01		1WB0115K2				122	2	92	K36	TP2						
	FB01 15	NNK9		1WB0115C1				122	2	128	C1	X1						
	FB01 15	NNK9		1WB0115P1		(36P1)		122	3	200	T1	T2	T3					
FB01 16																		
( )	FB01 16	FEPC6		1WB0116P1				136	1	120	T1	T2	T3					
	FB01 16	NC20		1WB0116C1				138	1	48	C1	C3	C4	C13	C23	X1	SP	
FB01 17																		
( )	FB01 17	FEPC1		1WB0117P1				152	1	144	T1	T2	T3					
→	FB01 17	FEPC2		1WB0117C2				122	2	49	C1	C11						
	FB01 17	NC20		1WB0117C1				138	1	48	C1	C3	C4	C11	C13	C23	X1	
FB01 18																		
( )	FB01 18	FEPC4		1WB0118P1				126	3	120	T1	T2	T3					
FB01 19																		
( )	FB01 19	NX51		1WB0119P1				126	3	187	T1	T2	T3					
FB01 20																		
( )	FB01 20	FEPC1		1WB0120P1				136	1	148	T1	T2	T3					
	FB01 20	NC20		1WB0120C1				138	1	48	C1	C3	C4	C13	C23	X1	SP	
FB01 21																		
( ) →	FB01 21	FEPC2		1WB0121C2				122	2	201	C1	C11						
	FB01 21	FEPC6		1WB0121P1				152	1	144	T1	T2	T3					
	FB01 21	NC20		1WB0121C1				138	1	48	C1	C3	C4	C11	C13	C23	X1	
FB01 22																		
( )	FB01 22	GWPC5		1WB0122P2				152	1	198	T1	T2	T3					

SHT. 34

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(E553-R14)

DATE 17 DEC 85 — LIST OF ALL CIRCUITS IN LOCATION NUMBER SEQUENCE — REV. 28 RUN 51 PAGE 10

JOB NO. 11793- 1- 0 — SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
FB01 23												
( )	FB01 23	GWPC8		1WB0123C4				122	2	163	C23 C33	
	FB01 23	GWPC9		1WB0123P1				141	1	182	T1 T2 T3	
	NA1A 3	FB01 23		1WA1A03C1				122	2	201	C21 C1	
	NA1A 3	FB01 23		1WB0123C1				136	1	256	X1 C11 SP	
	FB01 23	NC09		1WB0123C2				270	1	136	X1 C1 C2 C3 C13	
	FB01 23	NC09		1WB0123C3				122	1	128	C23	
FB01 24												
( )	GA2C 4	FB01 24		1ABDND133				122	2	111	X1 C31	
	FB01 24	NC04		1WB0124C2				270	1	131	X1 C1 C2 C3 C13	
	FB01 24	NK01		1WB0124K1				122	2	86	AP1 K3	
	FB01 24	NMG3A		1ABDND243		(49F1)		122	3	184	T1 T2 T3	
	FB01 24	NPS17		1ABDND245				122	2	283	X1 C31	
	FB01 24	NPS46		1ABDND134				122	2	149	C21 C31	
	FB01 24	NPS59		1ABDND135				122	2	149	X1 C11	
FB01 25												
( )	FB01 25	FEPC2		1WB0125C2				122	2	49	C1 C11	
	FB01 25	FEPC6		1WB0125P1				152	1	144	T1 T2 T3	
	FB01 25	NC20		1WB0125C1				138	1	48	C1 C3 C4 C11 C13 C23 X1	
FB01 26												
( )	FB01 26	GWPC5		1WB0126P1				152	1	198	T1 T2 T3	
FB01 28												
( )	FB01 28	NMG40		1WB0128P1		(36Q1)		122	3	265	T1 T2 T3	
	FB01 28	NNG40		1WB0128C1		(36Q1)		122	2	217	X1 C1	
FB01 29												
( )	FB01 29	GB02 35		1ABDND271				145	1	222	A B C	
FB01 30												
( )	FB01 30	NHVDP		1WB0130P1				125	3	154	L1 L2 L3	
FB01 31												
( )	FB01 31	GB02 19		1XB0219C1				136	1	255	X1 C11	
	FB01 31	NJ358		1WB0131C1				136	1	256	X1 C1 C11	
	FB01 31	NJ358		1WB0131C2				136	1	256	3X1 C5 C15	
	FB01 31	NMG55A		1WB0131P1				136	1	244	T1 T2 T3	
FB01 32												
( )	FB01 32	FEPC4		1WB0132P1				141	1	114	T1 T2 T3	

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LOCATION NO. (CONN DWG NO)	CABLE FROM	DESTINATION TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FBO1 32	NCO8		1ABDND300				122	2	106	X1 C1	
FBO1 33 ( )	FBO1 33	NHWH		1WBO133P1				125	3	227	T1 T2 T3	
FBO1 34 ( )	FBO1 34	NNFBC		1WBO134P1				123	3	240	T1 T2 T3	
FBO1 36 ( )	FBO1 36	NNG65A		1WB136AP1				136	1	214	L1 L2 L3	
	FBO1 36	NNG65C		1WB136CP2				136	1	407	L1 L2 L3	
FBO1 37 ( )	FBO1 37	GBO2 36		1ABDND272				145	1	422	A B C	
FBO1 39 ( )	FBO1 39	NEF7		1WBO139P1				122	3	187	T1 T2 T3	
	FBO1 39	NNEF7		1WBO139C1				122	2	192	X1 C1	
FBO1 40 ( )	FA33	FBO1 40		1FBO140C1				122	7	160	U1 C2 C11 X2 C12 C21 SP	
	FBO1 40	FMA33		1FBO140P1				122	3	147	T1 T2 T3	
	FBO1 40	FNWER		1FBO140C4				137	1	33	X1 C1 C3 C13	
	FBO1 40	NC13		1FBO140C2				122	2	105	C21 X2	
	FBO1 40	NC20		1FBO140C3				122	2	48	C12 X2	
FBO1 41 ( )	FBO1 41	FMG9A		1FBO141C2				300	2	396	C1 C11	
	FBO1 41	FMG9A		1FBO141P1				136	1	396	T1 T2 T3	
	FBO1 41	FNG9A		1FBO141C3				137	1	401	C1 C2 C12 X1	
	FBO1 41	NCO3		1FBO141C1				122	5	122	C1 C3 C12 C13 X1	
FBO1 42 ( )	FBO1 42	FGOD1		1ABDND284				122	2	490	A B	
	FBO1 42	NHGP		1WB1428P2				141	1	451	A B C	
FBO1 43 ( )	FBO1 43	FMK12		1FBO143P1		8255		408	3	440	T1 T2 T3	
	FBO1 43	FNK12	C	1FBO143C1		8255		401	1	440	X1 C1 SP1	
	FBO1 43	FSV147	C	1FBO143C2		8255		400	2	440	C11 U SP1	
FBO1 44 ( )	FBO1 44	NCO9		1ABDND136				122	2	105	X1 C21	
	FBO1 44	NC10		1WBO144C2				122	2	17	1X1 1X7C	

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JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FB01 44	NCTS		1WB0144C3				122	4	42	X1 C1 C11 U	
	FB01 44	NMES		1WB0144P1				124	3	406	T1 T2 T3	
	FB01 44	NWER		1WB0144C4				122	3	112	C11 C31 X1	
FB01 45												
( )	FB01 45	GB0293A		1WB0145P1				150	1	252	A B C	
FB01 46												
( )	F19	FB01 46		1FB0146C1				138	1	425	X1 C11 C12 C23	
	F19	FB01 46		1FB0146P1				141	1	425	T1 T2 T3	
	FB01 46	NC09		1FB0146C2				138	1	123	C1 C11 C12 C2 C3 C13	
FB01 47												
( )	F1100B	FB01 47	A	1FB0147C1		8249		138	1	236	X1 C11 C1 C42 C32 C23 C21	
	F1100B	FB01 47	A	1FB0147P1		8249		141	1	236	T1 T2 T3	
	G1100C	FB01 47	A	1FB0147C2		8249		122	2	466	C12 C2	
	FB01 47	NB2A 76	A	1GB0147C9		8244		137	1	483	81 C1 C2 C22	
	FB01 47	NC09		1ABDND137				122	2	115	X1 C11	
	FB01 47	NC09		1ABDND138				122	2	115	X1 C11	
	FB01 47	NC09		1ABDND139				122	2	115	X1 C11	
	FB01 47	NC09		1ABDND140				122	2	115	X1 C11	
	FB01 47	NC09	A	1FB0147C3		8337		139	1	115	C21 C1 C32 C2 C3 C13 U C33 C42	
	FB01 47	NC22	A	1FB0147C8		8291		122	1	136	C12	
FB01 56												
( )	FB01 56	NMEF8C		1WB0156P1				122	3	33	T1 T2 T3	
	FB01 56	NNEF8C		1WB0156C2				122	2	33	X1 C1	
FB01 57												
( )	FB01 57	NMEF8D		1WB0157P1				122	3	33	T1 T2 T3	
	FB01 57	NNEF8D		1WB0157C2				122	2	33	X1 C1	
FB01 58												
( )	FB01 58	GWPC4		1FB0158C2				137	1	170	X1 C12 C23 C11	
	FB01 58	GWPC5		1FB0158P1				141	1	177	T1 T2 T3	
	FB01 58	NC09		1FB0158C1				138	1	135	C1 C11 C12 C2 C3 C13 U	
FB01 60												
( )	FB01 60	FEPC4		1WB160AP1				141	1	126	L1 L2 L3	
	FB01 60	NCPP		1WB160BP2				122	2	17	L1 L2	
FB01 63												
( )	FB01 63	FNX50B		1FB0163C1				137	1	671	X1 C1 C3 C13	

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DATE 17 DEC 85 LIST OF ALL CIRCUITS IN LOCATION NUMBER SEQUENCE REV. 28 RUN 51 PAGE 13

JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FB01 63	FX50B		1FB0163P1				136	1	684	T1 T2	
FB01 64 ( )	FB01 64	FEPC3		1FB0164C2				137	1	126	C22 X1 C23 C31	
	FB01 64	FEPC6		1FB0164P1				141	1	114	T1 T2 T3	
	FB01 64	NC09		1FB0164C1				139	1	90	C2 C11 C1 C12 C22 C3 C13 C31 U	
FB01 66 ( )	F851A	FB01 66		1ABDND142				122	2	160	C1 C11	
	F854A	FB01 66		1ABDND143				136	1	160	T1 T2 T3	
	F854A	FB01 66	C	1ABDND144				138	1	17	X1 C22 C2 C12 C23 C21	
	FB01 66	NC09		1ABDND145				139	1	127	C21 C11 C2 C22 X1 C12 C3 C13 U	
	FB01 66	NC09		1ABDND146				122	2	128	X1 C12	
FB01 67 ( )	F852A	FB01 67		1ABDND147				150	1	168	T1 T2 T3	
	F852A	FB01 67		1ABDND148				138	1	160	X1 C12 C23 C11 C2 C22	
	FB01 67	NC09		1ABDND149				139	1	127	C11 C1 C12 C2 X1 C22 C3 C13 U	
	FB01 67	NC09		1ABDND150				122	2	135	X1 C22	
FB01 69 ( )	FB01 69	FC22		1FB0169C2				122	2	83	C1 C21	
	FB01 69	FEPC1		1FB0169P1				136	1	131	T1 T2 T3	
	FB01 69	FEPC2		1FB0169C3				137	1	132	X1 C23 C31 C22	
	FB01 69	NC09		1FB0169C1				139	1	90	C2 C11 C21 C12 C22 C3 C13 C31 U	
FB01 70 ( )	FB01 70	FEPC3		1FB0170C2				137	1	132	X1 C23 C31 C22	
	FB01 70	FEPC6		1FB0170P1				141	1	120	T1 T2 T3	
	FB01 70	NC09		1FB0170C1				139	1	90	C2 C11 C1 C12 C22 C3 C13 C31 U	
FB01 72 ( )	F853A	FB01 72		1ABDND151				141	1	170	T1 T2 T3	
	F853A	FB01 72		1ABDND152				138	1	170	X1 C1 C31 C12 C23 C21	
	FB01 72	NC09		1ABDND153				139	1	116	C21 C1 X1 U C12 C2 C3 C13	
	FB01 72	NC09		1ABDND154				122	2	128	X1 C31	
FB01 73 ( )	F851A	FB01 73		1ABDND155				145	1	145	T1 T2 T3	

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LOCATION NO. (CONN DWG NO)	CABLE FROM	DESTINATION TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	F851A	FBO1 73		1ABDND156				138	1	160	X1 C11 C31 C21 C12 C23	
	F854A	FBO1 73		1ABDND157				122	2	160	C1 C11	
	FBO1 73	FMG3A		1ABDND161				122	2	163	C31 C51	
	GA2C 4	FBO1 73		1ABDND158				122	2	85	C51 C31	
	FBO1 73	NCO9		1ABDND159				139	1	128	C21 C11 X1 U C12 C2 C3 C13 SP	
	FBO1 73	NCO9		1ABDND160				122	2	128	X1 C51	
FBO1 76 ( )	FBO1 76	NCWU		1WBO176C1				122	2	157	24 25	
	FBO1 76	NMCWP		1WBO176P1				122	3	131	T1 T2 T3	
	FBO1 76	NNCWP		1WBO176C2				122	2	132	X1 C1	
FBO1 77 ( )	FBO1 77	GWPC4		1ABDND169				122	2	176	C2 C52	
	FBO1 77	GWPC4		1ABDND170				137	1	176	X1 C32 C23 C11	
	FBO1 77	GWPC4		1ABDND171				122	2	176	C22 C12	
	FBO1 77	GWPC4		1ABDND172				122	2	176	C12 C52	
	FBO1 77	GWPC5		1ABDND173				141	1	228	T1 T2 T3	
	FBO1 77	NCO9		1ABDND164				139	1	128	C41 C11 C31 C32 C2 C3 C13 U SP	
	FBO1 77	NCO9		1ABDND165				122	1	128	C11	
	FBO1 77	NCO9		1ABDND166				122	1	128	C11	
	FBO1 77	NCO9		1ABDND167				122	1	128	C11	
	FBO1 77	NC23		1ABDND168				122	2	71	X1 C42	
FBO1 78 ( )	FBO1 78	NSCU		1WBO178P1				124	3	137	L1 L2 L3	
FBO1 79 ( )	FBO1 79	NXO1		1WBO179P1				127	3	283	T1 T2 T3	
FBO1 80 ( )	FBO1 80	GWPC3		1GBO180C8				122	2	550	C22 C12	
	FBO1 80	GWPC3		1GBO180C9				137	1	550	X1 C32 C23 C11	
	FBO1 80	GWPC3		1GBO180CA				122	2	550	C2 C52	
	FBO1 80	GWPC3		1GBO180CB				122	2	550	C12 C52	
	FBO1 80	GWPC7		1GBO180P1				141	1	539	T1 T2 T3	
	FBO1 80	NCO9		1ABDND177				122	1	223	C11	
	FBO1 80	NCO9		1ABDND178				122	1	223	C11	
	FBO1 80	NCO9		1ABDND179				122	1	223	C11	
	FBO1 80	NCO9		1GBO180C3				139	1	223	C41 C11 C31 C32 C2 C3 C13 U	
	FBO1 80	NC23		1GBO180C7				136	1	213	X1 C42	
FBO1 81 ( )	FBO1 81	NC16		1FBO181				126	3	57	T1 T2 T3	

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JOB NO. 11793- 1- 0 — SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
FBO1 82 ( )	FBO1 82	FEPC1		1FBO182P1				141	1	168	T1 T2 T3	
	FBO1 82	FEPC2		1FBO182C2				137	1	190	X1 C12 C23 C11	
	FBO1 82	NCO9		1FBO182C1				138	1	116	C1 C11 C12 C2 C3 C13 U	
FBO1 83 ( )	FBO1 83	FEPC1		1ABDND187				141	1	257	T1 T2 T3	
	FBO1 83	FEPC2		1ABDND188				122	2	249	C12 C22	
	FBO1 83	FEPC2		1ABDND189				122	2	249	C12 C52	
	FBO1 83	FEPC2		1ABDND190				137	1	249	X1 C32 C23 C11	
	FBO1 83	FEPC2		1ABDND191				122	2	249	C2 C52	
	FBO1 83	NCO9		1ABDND182				139	1	88	C41 C11 C31 C32 C2 C3 C13 U	
	FBO1 83	NCO9		1ABDND183				122	1	88	C11	
	FBO1 83	NCO9		1ABDND184				122	1	88	C11	
	FBO1 83	NCO9		1ABDND185				122	1	88	C11	
	FBO1 83	NC23		1ABDND186				122	2	115	X1 C42	
FBO1 85 ( )	FBO1 85	FBO4 22		1WBO185C1				122	2	111	X1 C1	
	FBO1 85	FEPC6		1WBO185P1				136	1	158	T1 T2	
FBO1 87 ( )	F720B	FBO1 87		1FBO187C1				137	1	340	C11 C12 C23 X1	
	F720B	FBO1 87		1FBO187P1				141	1	340	T1 T2 T3	
	FBO1 87	FBO4 14		1FBO187C2				137	1	71	C1 C11	
	FBO1 87	NCO9		1FBO187C3				138	1	104	C1 C11 C2 C12 C3 C13 U	
FBO1 88 ( )	FBO1 88	NMEF8A		1WBO188P1				122	3	33	T1 T2 T3	
	FBO1 88	NNEF8A		1WBO188C2				122	2	33	X1 C1	
FBO1 89 ( )	FBO1 89	NMEF8B		1WBO189P1				122	3	33	T1 T2 T3	
	FBO1 89	NNEF8B		1WBO189C2				122	2	33	X1 C1	
FBO1 90 ( )	FBO1 90	NCO9		1ABDND193				122	2	122	C1 C11	
	FBO1 90	NMA29	A	1ABDND1C8				122	3	100	T1 T2 T3	
	FBO1 90	NNA29	A	1ABDND1C6				122	2	100	X1 C11	
FBO1 92 ( )	FBO1 92	GGOD2		1ABDND290				122	2	380	A B	
	FBO1 92	NHPT		1WB192BP2				122	2	17	A B	

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LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FB01 93	NY1A	D	1FB0193P1 CABLE D*E*L*E*T*E*D IN REV 28								
FB01 95 ( )	FB01 95	GB0293B		1WB0195P1				136	1	252	A B C	
	FB01 95	NAH1		1WB0144Y1				122	2	17	T1 T2	
	FB01 95	NAH3		1WB0144Y2				122	2	17	T1 T2	
	FB01 95	NAH4		1WB0144Y3				122	2	17	T1 T2	
	FB01 95	NAH5		1WB0144Y4				122	2	17	T1 T2	
	FB01 95	NAH6		1WB0144Y5				122	2	17	T1 T2	
	FB01 95	NX20		1WB0195P2				123	2	17	A B	
FB01 96 ( )	FB01 96	GB02 77		1WB0196C1				122	2	262	C1 C11	
	FB01 96	GB02 77		1XB0277C1				122	2	250	C1 C11	
	FB01 96	NC20		1WB0196C2				138	1	33	C1 C3 C4 C13 C23 X1	
	FB01 96	NC20		1WB0196K1				136	1	33	K10 C31 K9	
	FB01 96	NC20		1WM101C1				122	2	33	C167 C168	
	FB01 96	NDPS18		1WB0196C3				122	2	218	C21 X1	
	FB01 96	NMA24		1WB0196P1				152	1	218	T1 T2 T3	
	FB01 96	NP018		1WB0196C4				137	1	218	C148 C149 X2 U2	
FB01 97 ( )	FB01 97	NC04		1WB0197C4				405	1	97	C1 C2 C3 C12 C13 C21 C41 C42 U-97	
	FB01 97	NC09		1WB0197C2				400	1	81	X1 C31	
	FB01 97	NC09		1WB0197C3				400	1	110	X1 C31	
	FB01 97	NMOV20		1WB0197C1				404	1	110	X1 C12 C21 C23 C42 C52	
	FB01 97	NMOV20		1WB0197P1				401	1	110	T1 T2 T3	
FB01 1 ( )	FB01 1	NRECP		1WB0101P1				126	3	163	T1 T2 T3	
	FB01 1	NRECP		1WB0101P2				126	3	157	T1 T2 T3	
FB01 2 ( )	FB01 2	NC13		1WB0102C1				138	1	104	X1 C1 C11 C21 C3 C13 C23	
	FB01 2	NK01		1WB0102K1				122	2	69	AP3 K46	
	FB01 2	NMG28		1WB0102P1				145	1	460	T1 T2 T3	
	FB01 2	NPS88		1WB0102C2				122	2	480	C21 C31	
FB01 3 ( )	FB01 3	FEPC3		1WB0103C2				122	2	148	C21 C11	
	FB01 3	FEPC3		1WB0103C3				122	2	148	C1 C11	
	FB01 3	NC09		1WB0103K1				122	2	17	K66 NP8	

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JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FBO1 3	NC28		1WBO103C1				270	1	444	X1 C11 C21 C13 C3	
	FBO1 3	NEPC4		1WBO103P1				141	1	144	T1 T2 T3	
FBO1 4												
( )	FBO1 4	GWPC9		1WBO104P1				133	2	182	T2 T3	
	FBO1 4	GWPC9		1WBO104P2				126	2	182	T1 T1	
FBO1 5												
( )	FBO1 5	NRECP 5		1WBO105P3				126	3	97	T1 T2 T3	
	FBO1 5	NRECPA2		1WBO105P1				125	3	147	T1 T2 T3	
	FBO1 5	NTOC		1WBO105P2				125	3	176	T1 T2 T3	
FBO1 6												
( )	FBO1 6	NC21		1WBO106C1				270	1	106	X1 U1 C31 C3 C13	
	FBO1 6	NLS18		1WBO106C2				122	2	169	C11 C1	
	FBO1 6	NMG47		1WBO106P1				122	3	179	T1 T2 T3	
	FBO1 6	NNG47		1WBO106C3				122	2	174	C11 X1	
	FBO1 6	NSV11		1WBO106C4				122	2	169	U1 C31	
FBO1 7												
( )	FBO1 7	NFS3		1WBO107C1				122	2	268	1X7 C31	
	FBO1 7	NFS4		1WBO107C2		(49F2)		122	2	387	1X7 C41	
	FBO1 7	NLS21		1WBO107C3				122	1	179	C1	
	FBO1 7	NMG46A		1WBO107P1				122	3	179	T1 T2 T3	
	FBO1 7	NNG46A		1WBO107C4				122	1	174	X1	
	FBO1 7	NSV32		1WBO107C5				122	2	167	U C31	
	FBO1 7	NSV34		1WBO107C6				122	2	182	U C41	
FBO1 8												
( )	FBO1 8	NLS22		1WBO108C1				122	1	184	C1	
	FBO1 8	NMG46B		1WBO108P1				122	3	184	T1 T2 T3	
	FBO1 8	NNG46B		1WBO108C2				122	1	179	X1	
FBO1 9												
( )	FBO1 9	GWPC3		1WBO109C2				137	1	162	C98 C99 X2 U2	
	FBO1 9	GWPC3		1WBO109C3				122	2	162	C1 C11	
	FBO1 9	GWPC7		1WBO109P1				136	1	164	T1 T2 T3	
	FBO1 9	NC20		1WBO109C1				138	1	42	C1 C3 C4 C11 C13 C23 X1	
FBO1												
( )	F19	FBO1		1WY12201				122	2	17	U 1X22	
	F880	FBO1		1WY12202				122	2	385	1X22 U	
	F883	FBO1		1WY12203				122	2	307	1X22 U	
	FA31 1	FBO1		1FBO110P2				126	3	33	L1 L2 L3	

(17) (33)

SHT. 4

6-131

(E553-R14)

DATE 17 DEC 85 LIST OF ALL CIRCUITS IN LOCATION NUMBER SEQUENCE REV. 28 RUN 51 PAGE 18

JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO) CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
FA31	FBO1		1WBO156C3				122	2	135	V12 V14	
FA31	FBO1		1WBO156C4				122	2	135	M1 M2	
FA31	FBO1		1WBO156C5				122	2	135	M1 M2	
FBO1	FBO4 18		1FBS118P2				128	9	50	A B C A B C A B	
										C	
FBO1	FBO4		1ABDNDO26				122	1	63	C21	
FBO1	FBO4		1ABDND100				122	1	63	U	
FBO1	FEPC2		1WY11901				122	2	118	1X19 U	
FBO1	FEPC2		1WY12002				122	2	152	1X20 U	
FBO1	FEPC2		1WY12301				122	2	118	1X23 U	
FBO1	FEPC3		1WY12101				137	1	126	1X21 U 1X21 U	
FBO1	FEPC3		1WY12302				122	2	126	1X23 U	
FBO1	FEPC3		1WY12401				122	2	118	1X24 U	
FBO1	FEPC3		1WY12402				122	2	118	1X24 U	
G18	FBO1		1WY12001				122	2	17	U 1X20	
FBO1	GBO2		1ABDND359				136	2	237	A B C A B C	
FBO1	GWPC3		1WY11902				137	1	162	1X19 U 1X19 U	
FBO1	GWPC3		1WY12003				122	2	166	1X20 U	
FBO1	GWPC3		1WY12102				122	2	162	1X21 U	
FBO1	GWPC3		1WY12303				122	2	162	1X23 U	
FBO1	GWPC3		1WY12403				122	2	166	1X24 U	
FBO1	HCO9		1ABDND366	X			122	2		C31 X1	
FBO1	HCO9		1ABDND367	X			122	2		C31 X1	
NA28	FBO1		1WY10501				122	2	33	1X5 U	
NA32	FBO1		1WBO188C3				122	2	135	Z12 Z14	
NA32	FBO1		1WBO188C4				122	2	135	M1 M2	
NA32	FBO1		1WBO188C5				122	2	135	M1 M2	
NA32	FBO1		1WBO188C6				122	2	135	P2 P4	
FBO1	NB10		1ABDNDO92				122	1	350	C1	
FBO1	NCO9		1ABDND101				122	2	115	C17 C53	
FBO1	NC12		1WY10801				122	2	107	1X8 U	
FBO1	NC17		1WY11401				122	2	115	1X14 U	
FBO1	NC19		1WY10201				122	2	100	1X2 U	
FBO1	NC19		1WY10401				122	2	100	1X4 U	
FBO1	NC20		1WY10101				122	2	42	1X1 U	
FBO1	NC21		1WY11001				122	2	126	U 1X10	
FBO1	NC21		1WY11101				122	2	126	1X11 U	
FBO1	NC30		1WY11201				122	2	151	1X12 U	
FBO1	NFAX		1WY10301				122	1	263	U	
FBO1	NJ426		1WY10701				122	2	133	1X7 U	
NJB672	FBO1		1NBO148C1		4372		644	1	* 110	X11 C1 C2	P F T
FBO1	NMO1		1WY10901				122	2	193	U C1	
FBO1	NMA27		1WY10302				122	1	261	U	
FBO1	NMA34	A	1ABDND511				122	1	149	U	

(38) (70)

SHT. 45

6-132

(E553-R14)

DATE 17 DEC 85 LIST OF ALL CIRCUITS IN LOCATION NUMBER SEQUENCE REV. 28 RUN 51 PAGE 19

JOB NO. 11793- 1- 0 SAN ONOFRE UNIT 1-OUTSIDE SPHERE-KB

LOCATION NO. (CONN DWG NO)	CABLE DESTINATION FROM	TO	REV	SCHEME CABLE NUMBER	TO BE RTD	SCHEME DWG. NUMBER	SYSTEM NUMBER	CABLE CODE	NUMBER OF CABLES	LENGTH * IS ACTUAL	CONDUCTOR NUMBERS	FIELD STATUS
	FB01	NMG51		1WY11102				122	1	278	U	
	FB01	NNA27		1WY10304				122	1	264	1X3	
	FB01	NNA34	A	1ABDND510				122	1	150	1X3	
	FB01	NNG51		1WY11103				122	1	278	1X11	
	FB01	NP020		1WY11501				122	2	228	1X15 U	
	FB01	NRM28		1WY116				124	2	240	X16 U	
	FB01	NRM30		1WY11801				124	2	240	X18 U	
	FB01	NS01		1WY11202				122	2	117	X12 U	
	FB01	NT0B		1WY10802		(36Q1)		122	2	180	1X8 U	
	FB01	NT1M1		1WY10306				122	2	265	1X3 U	
	FB01	NX01		1WG101C1				136	1	269	W35 W36	
	FB01	NX21A		1NB0148P1		2165		418	1	* 140	H1 H2 H3	P F T
	FB01	NX51		1WB0119C1				122	2	187	M1 M2	
FB02 79 ( )	FB02 79	FB04		1FBS107C7				122	2	351	C7 C17	
FB04 00 ( )	FB04 00	NB10		1ABDND129				136	1	377	C1 C11	
	FB04 00	NC09		1ABDND130				136	1	97	C3 C13 P11	
	FB04 00	NK01		1ABDND131				136	1	46	K1-5 EP1	
FB04 10 ( )	FB04 10	FD02		1FBS110P1				154	3	181	T1 T2 T3	
	FB04 10	FD02		1WBS110A1				124	2	180	A1 A4	
	FB04 10	FD02		1WBS110C1				138	1	181	P11 C1 C2 C3 C13 C23	
	FB04 10	NK01		1WBS110K1				270	1	52	K2-6 EP1 K50 AP3 K3-0	
FB04 11 ( )	NB13	FB04 11		1NB0184LC		1734	88	122	2	* 143	X1 C1	P F T
	FB04 11	NC13		1WBS111A1				124	2	92	A1 A4	
	FB04 11	NC13		1WBS111C2				139	1	92	P11 C1 C11 C2 C3 C13 C23 C33 C4	
	FB04 11	NMK1A		1WBS111P2				133	3	414	T1 T2 T3	
	FB04 11	NPS56		1WBS111C3				122	2	437	C11 C1	
	FB04 11	NSV62		1WBS111C4				122	2	418	N1 C7	
	FB04 11	NTS15		1WBS111C5				122	2	418	P1 C32	
FB04 13 ( )	NB16	FB04 13		1NB0305HC		1654	88	122	2	* 445	X1 C1	P F T
	FB04 13	NC18		1WBS113C5				138	1	519	N1 C23 C13 C3 C2 C1 P11	
	FB04 13	NC18		1WBS213C4				136	1	519	C21 C11 C1	
	FB04 13	NK01		1WBS113K1				138	1	48	EP1 K2-2 K57 K3-1 AP4 K77 K3P	
	FB04 13	NMG43		1WBS113P2				127	3	562	T1 T2 T3	

(8) (12)

TOTAL (1 (312)

Air Oven Aging Tests

Insulation = ANHYDREX XX
Environment = Air
Accelerator = Temperature (Heat)
Parameter = Time

Unaged Characteristics

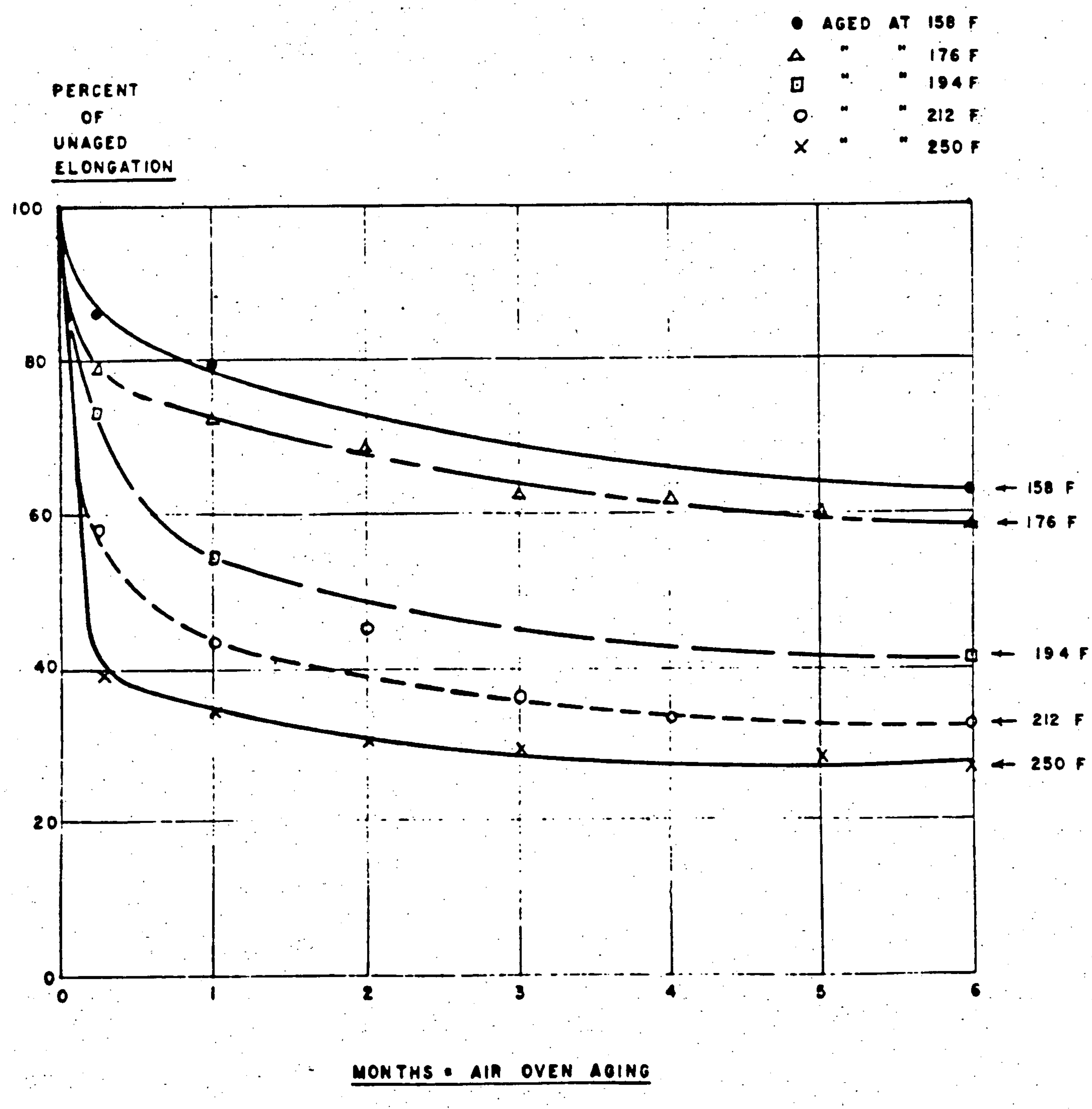
a) Tensile Strength = 828 psi
b) Elongation = 572%
c) Short Time Dielectric Strength = 460 volts/mil - A-C
= 1450 volts/mil - D-C

Time in Oven	Per Cent of Original Unaged Values-After Air Oven Aging at Various Temperature											
	158 F(70 C)		176 F (80 C)		194 F(90 C)		212 F(100 C)		250 F(121 C)			
	Tens.	Elong.	Tens.	Elong.	Tens.	Elong.	Tens.	Elong.	Tens.	Elong.	Volts/Mil A-C	Volts/Mil D-C
1 week	111	86	101	78	114	73	91	58	94	39	100	107
2 weeks			100						97	35		
1 month	112	79	100	72	109	54	94	43	86	34		
2 months			91	69			92	45	93	30		
3 months			83	62			103	36	86	29		
4 months			82	62			100	33				
5 months			80	60					72	28		
6 months	111	63	80	58	113	41	102	32	89	27	105	91

That ANHYDREX XX is a truly stable insulation under the service conditions of heat and time and in an environment of air is proved by the tabulated test data. Even after six (6) months of air oven aging at temperature ranging from 158 F(70 C) to 250 F (121 C), the tensile strength of ANHYDREX XX remains practically constant.

Although the per cent elongation of ANHYDREX XX decreased with time of exposure, the largest per cent of the decrease was during the first week of exposure. The following curves of Per Cent Elongation vs. Time of Exposure show that further decrease in elongation is slight after periods longer than one week in the air oven even at 250 F (121 C). After six (6) months at 250 F (121 C) ANHYDREX XX retains approximately 25% of its original per cent elongation and is still in a serviceable condition.

EFFECT OF AIR OVEN AGING ON ELONGATION OF ANHYDREX-XX



Representative test data obtained on several ozone resistant high voltage rubber compounds show that even at the end of only one week in the air oven at 250 F (121 C), these insulations are brittle and have no tensile strength or elongation.

ANHYDREX XX is not only stable physically but electrically. The dielectric strength (both A-C and D-C) was practically unaffected even after the insulation was aged for six (6) months at 250 F (121 C) in the air oven. The deviation from the unaged dielectric strength is within the normal range of values obtained on dielectric strength tests.

The effect of heat, air (oxygen) and time on ozone resistant, high voltage rubber insulations may be seen by studying the following photograph.

Two samples of ordinary ozone resistant, high voltage rubber insulated conductors were subjected to 250 F (121 C) for seven (7) days in air. The insulation on samples "A" and "B" became soft except for the outer "skin" which became hard and cracked. Not only does the data herein prove the stability of ANHYDREX XX when subjected to heat, air (oxygen) over a period of time, but it is also seen by a visual examination of such samples as shown in the photograph.

7/31

CALCULATION SHEET

PROJECT ______ JOB NO. ______ CALC. NO. ______

SUBJECT ______ SHEET NO. 2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

REV. INDI-CATOR

ENGINEERING CHECKLIST (SAMPLE)

AREA 1

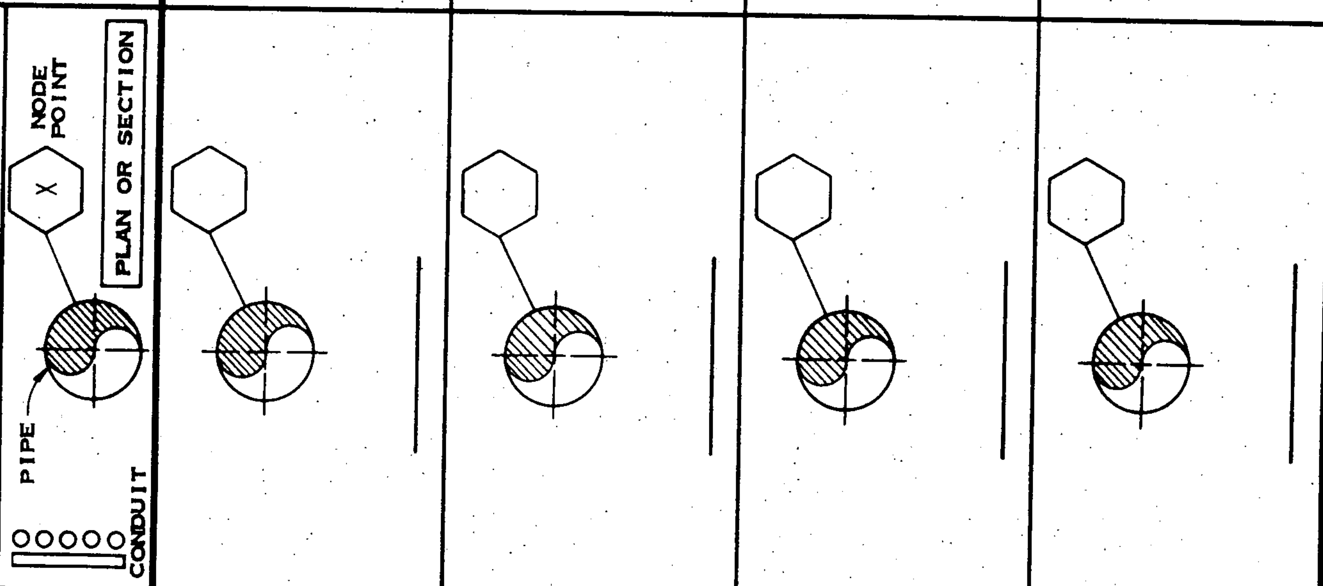
DRAWING 568568-13

LINE NO.	PIPE SIZE	INSUL. THK.	MAX OPER. TEMP.	SURF. TEMP >140°	W/D REQ	SEPARATION CRITERIA: CONDUIT WITH INSUL. (IN)	CONDUIT BARE PIPE (IN)	TRAY WITH INSUL. (IN)	TRAY BARE PIPE (IN)
6007	6	—	120	N	N	—	—	—	—
1209	3/4	2	545	Y	Y	2	5	4	10
1203	3/4	2	545	Y	Y	2	5	4	10
5003	2	1 1/2	570	Y	Y	2	5	4	10
2011	2	—	130	N	N	—	—	—	—
2092	2	—	130	N	N	—	—	—	—
3067	3	—	110	N	N	—	—	—	—
3083	3	—	150	Y	Y	2	2	4	4
3077	1 1/2	—	110	N	N	—	—	—	—
2020	2	—	200	Y	Y	2	2	4	4
5041	1	—	200	Y	Y	2	2	4	4
3082	1 1/2	—	150	Y	Y	2	2	4	4
515	3/8	—	AMB	N	N	—	—	—	—
516	3/8	—	AMB	N	N	—	—	—	—
1201	3/4	2	545	Y	Y	2	5	4	10
5011	3	1 1/2	570	Y	Y	2	5	4	10
756	8	—	115	N	N	—	—	—	—
743	8	—	115	N	N	—	—	—	—
892	4	—	125	N	N	—	—	—	—
765	4	—	120	N	N	—	—	—	—
5039	3/4	—	200	Y	Y	2	2	4	4
3004	4	—	140	N	N	—	—	—	—
5018	3/8	1 1/2	570	Y	Y	2	5	4	10
5035	10	—	470	Y	Y	2	12	4	24
1409	3/4	—	AMB	N	N	—	—	—	—
2532	3/4	—	120	N	N	—	—	—	—
5052	3/8	—	200	Y	Y	2	2	4	4
2014	2	—	200	Y	Y	2	2	4	4
5044	1	—	200	Y	Y	2	2	4	4

HOT PIPE TO CONDUIT/TRAY WALKDOWN VERIFICATION

PIPE AREA DRAWING	AREA NO.	LINE DESCRIPTION			INITIAL/DATE	
		LINE NO.	LINE SIZE	INSULATION	INSPECTED	VERIFIED
					___/___	___/___

REMARKS				
DISTANCE TO PIPEWALL OR INSULATION SURFACE (INCHES)				
TRAY/CONDUIT ORIENTATION TO PIPE				
PIPE INSULATED				
CONDUIT OR TRAY NUMBER				



CABLE TRAY WALKDOWN CHECKLIST

AREA	DRAWING NUMBER	TRAY NUMBER	CODE 122 S.R. CABLE SCHEME NUMBER	CRACKED JACKETS		OBSERVATIONS
				YES	NO	

SECTION 7.0

TOPICS RELATED TO THE MATERIAL CONDITION OF CABLES

7.0 TOPICS RELATED TO THE MATERIAL CONDITION OF CABLES

7.1 4kV CABLE MATERIAL CONDITION ASSESSMENT AND DESIGN CONSIDERATIONS

The following sections document assessments and information identified as the evaluation program evolved that are considered to be salient to the overall evaluation effort.

7.1.1 Review of Outdoor Termination Methods

The SONGS 1 Turbine Deck and Intake Structure are not housed in an enclosed structure. As a result, the turbine generator, the transformers and various pumps are exposed to the environment. Two of the 4kV cables which failed DC overvoltage tests passed subsequent DC Overvoltage tests after the outdoor termination was cut from the circuit.

The outdoor terminations installed on the original 4kV cables in the plant is an OZ Terminator with a zippered protective sleeve. OZ Terminators of various types are designed for both jacketed and non-jacketed metal clad cables for wet locations. The Simplex cable is not jacketed over the interlock armor and the procedure of using a separate loose outer sleeve has not been as effective as other termination methodology. Moisture has penetrated above and within the OZ fitting between the neoprene and butyl on individual phase conductors. This has resulted in electrical stress distortions both externally and within the cable insulation system as evidenced by the low DC overvoltage test breakdowns of the two outdoor OZ Terminators. The evaluations of the failed terminators follow in Attachments 7-1, 7-2, and 7-3. Additional information is found in References 7.6.43 and 7.6.44.

The experience with these same OZ Terminators throughout the SCE system indicates no service failures even though the outer aluminum armor has been severely corroded under the sleeves at other SCE fossil plant locations. This experience demonstrates no immediate or rapid degradation in electrical integrity for those circuits where the 28kV DC Overvoltage tests were satisfactorily passed. However, in order to mitigate the compromising effects of moisture ingress several recommendations concerning terminations were developed. These recommendations are as follows:

1. For existing OZ terminations using the loose sleeves, the bottom of the sleeve should be unfastened from the OZ housing to permit free draining of any condensate collecting within the sleeve prior to return to power from the current Cycle 9 outage.

2. Each of these 4kV circuits having a potentially "wet" outdoor OZ termination using the loose zipper jackets over the bare interlocked armored Simplex cable should be DC overvoltage tested at 28kV DC to check for further moisture-induced degradation. This should be done at the next refueling outage, and if leakage currents are not suspect, then routine SCE Test Procedures for frequency of testing would govern.

3. While periodic DC overvoltage testing should be sufficient to monitor for further moisture-induced degradation, to bring these circuits to their inherent reliability prudency dictates the subject outdoor terminations should eventually be replaced. However, a special effort to do so is not required. As appropriate opportunities present themselves, terminations can be replaced by the method described below.

4. A Raychem Heat Shrink Termination Boot (NHVT) (Attachment 7-4) in conjunction with an OZ compression-type terminator (e.g., type "PG" or "PG-A") should be utilized when replacing the existing OZ compound-fill type terminations at both indoor and outdoor locations. This type of arrangement is now utilized on the new jacketed 4kV cables for the charging pumps at Unit 1. Cables with this termination methodology do not require periodic testing.

Replacement cables having an outer jacket over the interlocked armor incorporating the heat shrink boot covering the entrance of cable into the OZ terminator, as utilized for the A, B and C Transformer feeders, should be an effective moisture seal. Routine periodic testing is not required for these terminations.

The status of all 4160V system terminations is documented in Table 7-1.

7.1.2 Electrical Loading of 4kV Cables

A cable ampacity calculation was performed (Reference 7.6.28) to determine the loading on the existing SONGS 1 5kV cables and also on the replacement cable for those circuits being replaced. This calculation was performed to ensure that the in-service failure was not caused or aided by electrically overloading the cable beyond its rated capacity.

Data used for the calculation was obtained from:

a) 4kVTF Task No. 11 (Reference 7.6.31) - Identify Cable Runs, Lengths, etc., and Cable Manufacturers.

b) SONGS 1 Control Room "Equipment Data and Trending Summary" data sheets which provide information on existing plant loading (included in Table 7-2).

c) SONGS 1 - 4.16kV bus connected equipment load data (Table 7-3).

Based on the results of that calculation, it is concluded that all of the existing 5kV Simplex cable circuits were correctly sized and operated within their temperature rating and electrical capacity. In addition, the replacement Kerite cable that has been purchased to replace some of the circuits (identified in Section 7.1.3) is also correctly applied. There is no indication that cable failure would have been caused by conductor self-heating.

7.1.3 Acceptability of Kerite Cables for Replacement of 4kV Transformer Feeders

As a direct result of the in-service failure of one of the four feeder cables from the X-Winding of the 'C' Transformer to Bus 1C, the following feeder cables were replaced:

- All four feeders from the 'C' transformer (X-Winding) to 4160V Bus 1C
- All four feeders from the 'C' transformer (X-Winding) to 4160V Bus 2C
- All four feeders from the 'A' Transformer to 4160V Bus 1A
- All four feeders from the 'B' Transformer to 4160V Bus 1C

As a result of the South Turbine Plant Cooling Water (TPCW) Pump (G6S) cable failing the DC overvoltage test subsequent to the in-service failure, the 4kV cable from the pump to Bus 1C was also replaced.

The above listed cables were replaced with cable of the following description manufactured by The Kerite Company:

Three conductors, 750 or 500 kcmil or 4/0 AWG, 5kV shielded, cabled, aluminum interlocked armor and PVC jacket.

In response to a 4kV Cable Task Force Action request (Reference 7.6.1), Nuclear Systems Engineering (NSE) reviewed the requirements that apply to the subject replacement feeder cable, and concluded the following:

1. Safety Classification - Reference 7.6.2 classified the subject transformers as nonsafety-related (NSR) and breakers which connect such NSR equipment to safety-related (SR) busses as SR. Because the associated feeder breakers are thus credited as SR isolation devices (for 4160V busses), the feeder cables between the transformers and these breakers are considered to be NSR, consistent with established SONGS 1 design practice.

2. Fire Protection - In accordance with Reference 7.6.4, the replacement cable must pass the flame test requirements specified in IEEE 383.

3. Seismic Design - Existing seismic analyses performed for the cable trays and raceways that support the subject cables remains valid since:

   a. The replacement cable's unit weight (i.e., lbs/ft) does not exceed 100 percent of that of the originally-installed cable.

   b. The original cable was physically removed from the trays, conduits and raceways.

   c. The replacement cable was routed in exactly the same trays, conduits and raceways as the original cable.

4. Environmental Qualification - Because the subject cable is NSR, the environmental qualification requirements of 10 CFR 50.49 (Reference 7.6.5) do not apply. The environmental parameters that describe the areas where the subject cable is used are as follows:

a. Pressure	0 psig.
b. Temperature	36-140°F
c. Relative Humidity	0-100 Percent
d. Radiation Dose	3×10^3 rads (integrated dose)

   e. Cable in outside areas shall be capable of withstanding salt spray, dirt and blowing dust, rain and the effects of incident solar radiation.

5. Other Design Criteria - Since the replacement cable is routed in exactly the same trays, conduits and raceways as was the original cable, analyses that have been performed or are in progress for High Energy Line Break (HELB), Tornados, Flooding and Internal Missiles will remain valid (Reference 7.6.3).

NSE has reviewed the data identified in Reference 7.6.7, and has found the Kerite cable procured under the purchase orders identified therein to be an acceptable replacement for the original feeders between the transformers and busses.

Additionally, the South TPCW Pump and cable is classified as NSR, as such the above information (with slight modification of the environmental requirements) is applicable. As such, the Kerite cable procured as replacement cable as identified in Reference 7.6.7 is an acceptable replacement.

It should be noted that the cables from the South Charging Pump (G-8B) to 4160V Bus 1C and from the North Charging Pump G-8A, were also replaced. These cables were replaced as part of the Appendix R and Dedicated Safe Shutdown modifications underway during the current refueling outage, not as a result of the November 1985 Transient or 4kVTF activities. Both of these Simplex cables that were replaced were also successfully DC overvoltage tested.

The replacement cable for both Charging Pumps is manufactured by Anaconda and is described as:

> 8kV shielded-3 conductor copper, 250 kcmil, with ethylene propylene insulation, with an overall shield and hypalon jacket meeting IEEE 383 (Vertical Tray Flame Test).

This cable is also qualified for its intended service including appropriate Environmental Qualification.

7.1.4 Reactor Coolant Pump (RCP) 4kV Containment Penetration Assessment

The 4kVTF reviewed the qualification of the 4kV RCP containment penetrations and, as an added measure, included the RCP cable circuit (including the penetration) in the scope of EG&G, Idaho ECCAD testing.

Per Reference 7.6.39, Nuclear Systems Engineering has verified that there are no age-degradable materials in the existing San Onofre Unit 1 4.16kV electrical penetrations for Reactor Coolant Pump power circuits. The penetration seal is provided exclusively by metal and ceramic fused to metal. Therefore, there is high confidence that these penetrations are qualified. An EQ document package for the existing penetrations has been developed on the basis of no age-degradable material (Reference 7.6.40).

Additionally, per Reference 7.6.41, the Reactor Coolant Pump motor power cables and interconnections were tested on 4-25-86 and 4-26-86 from the circuit breakers in the 4kV room through the penetrations to the point of connection to the motors. RCP-A, RCP-B, and RCP-C were tested as two conductor circuits for the following configurations:

phase A to phase B
phase A to phase C
phase B to phase C
phase A to ground
phase B to ground
phase C to ground

The power circuits were tested in the open circuit condition to give an excellent set of baseline data for the cables and and penetration. The data indicates an insulation resistance greater than 10^{13} ohms for each cable, a capacitance of 4×10^{-2} microfarads, and a dissipation factor of approximately 0.11. The time domain reflectometry (TDR) signatures indicate that the cables are similar for RCP-A and RCP-B outside containment, while RCP-C indicates a slight difference in routing outside containment at the circuit breaker. Inside containment all the circuits appear similar.

The initial data on RCP-A showed an anomalous TDR signature while the electrical measurements appeared normal. The data was retaken to determine whether the anomaly was related to the instrumentation or to the power cables. The RCP-A circuit was retested on 5-14-86 with the pump connected and it was confirmed that the RCP-A circuit was normal (Reference 7.6.41). The anomaly was traced to an instrumentation test lead failure.

The retest data on RCP-A provided additional data on the series connection to the motor and the motor inductance and quality factor. These values indicate good connections and will provide reference data to evaluate the condition of the connections and motor in the future. The retest data also confirmed the earlier good capacitance and dissipation factor data.

The data is indicative of dry cables and penetrations with no indications of any anomaly that might indicate any one circuit was electrically different from the others. No discrepancies were observed.

Further, the penetrations were DC overvoltage tested at approximately 8kV in conjunction with the RCP motor (voltage is limited by motor test procedure) with no failure.

SCE has no cause to suspect any anomaly or electrical concern that would indicate poor containment penetration material condition.

SCE Electrical Engineering has concluded that the subject penetrations are suitable for continued service and no further testing is required (Reference 7.6.42).

7.1.5 Temperature Profile of the 'C' Transformer Feeder Cable That Failed In-Service

4kV cable tray 36B2 located in the turbine building mezzanine area carries four 3-conductor 750kcmil power cables from auxiliary transformer C "X" winding to 4kV switchgear bus 1C. One of these cables developed the two phase to ground faults that initiated the feedwater incident in November, 1985. These cables, manufactured by Simplex, have an interlocked aluminum armor over three single conductor butyl rubber insulated, neoprene jacketed cables.

Crossing above this cable tray is feedwater line 325-10"-EG with bolted flange in the line directly above the tray (Figure 7.1). At the time of the cable failure, the line and flange were uninsulated.

In order to ascertain the effect of the uninsulated hot line and flange on the cable temperature, a calculation was performed (Reference 7.6.37). This calculation was based on the following assumptions and data:

a) Physical layout of pipe and tray was as shown in Figure 7.1.

b) Cable current loading was the actual maximum recorded under unit full load conditions (approximately 90 percent of rated plant thermal output) as identified in Section 7.1.2.

c) By calculation each cable heat dissipation is 4 watts/foot.

d) The pipe process temperature (and surface temperature) from San Onofre Unit 1 Heat Balance Diagram Drawing M568789 at unit full load conditions (approximately 90 percent rated output) was 407°F.

e) Calculations were performed with ambient temperatures of 40°C, 50°C and 60°C (104°F, 122°F and 140°F, respectively).

FIGURE 7.1

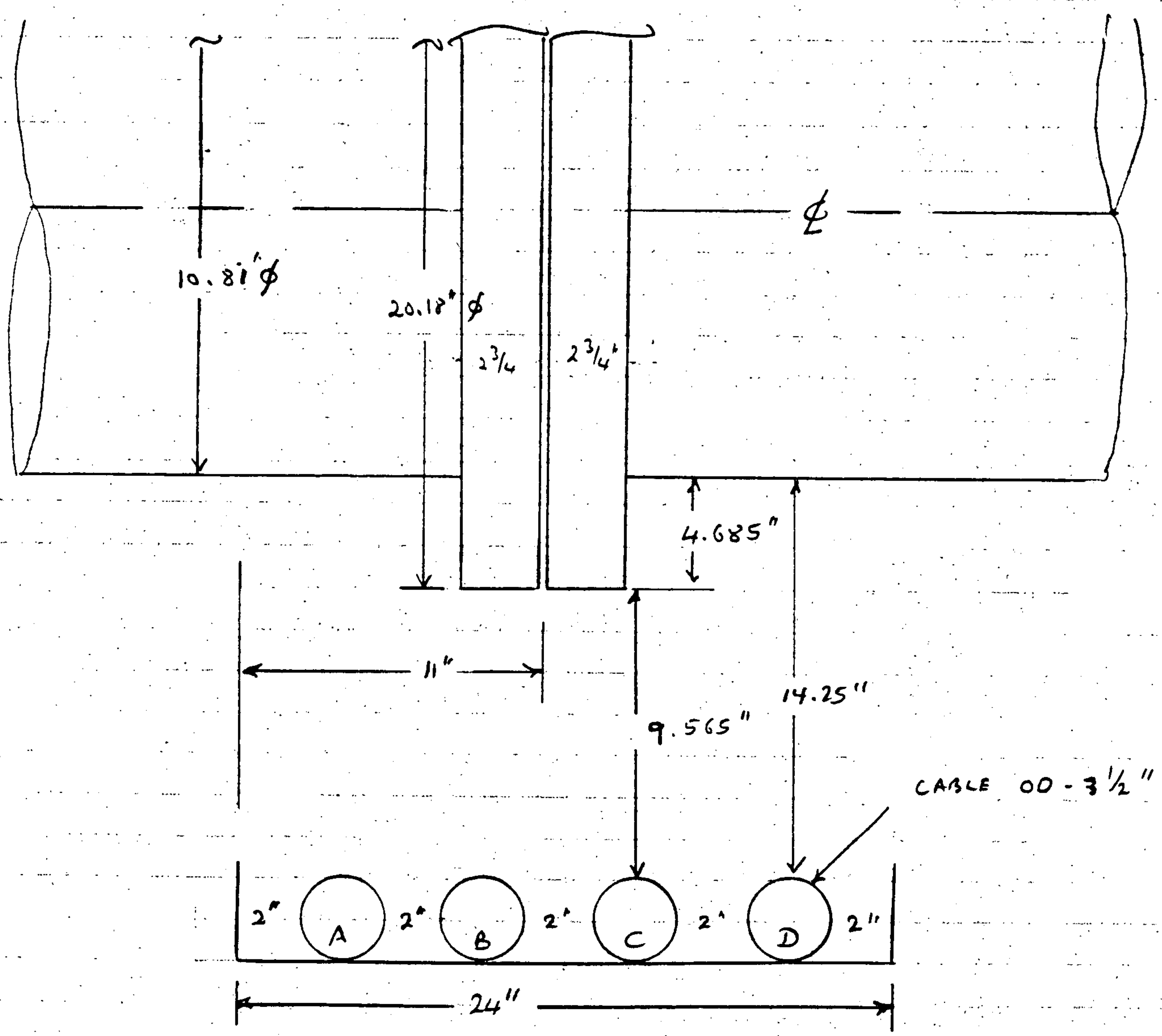
CALCULATION SHEET

PROJECT SONGS 1 JOB NO. 15691-795 CALC. NO.

SUBJECT PHYSICAL LAYOUT OF PIPE AND TRAY SHEET NO. 1

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV. INDI-CATOR
0	[signature]	4-2-86	[signature]	5/17/86						

FEEDWATER LINE NO. 375-10"-EG
CABLE TRAY NO. 36B2



f) Uninsulated pipe and flange is rusty colored with an emissivity of 0.9.

g) Aluminum interlocked armor on cable is slightly oxidized with an emissivity of 0.2.

The cable core temperature and cable surface temperature under the hot pipe and under the flange for various ambient temperatures is shown below in Figure 7.2. These temperatures are based on the cable carrying actual load current.

FIGURE 7.2

AMBIENT TEMPERATURE	CABLE UNDER FLANGE		CABLE UNDER PIPE**	
(°F)	Cable Surface Temp. (°F)	Cable Core* Temp. (°F)	Cable Surface Temp. (°F)	Cable Core* Temp. (°F)
104	203.4	248.0	160.8	184.0
122	220.4	265.2	177.8	201.0
140	237.4	282.3	195.0	218.2

* Cable core temperatures are conservatively estimated based on the Cable Surface Temperature calculation results.
** Hypothetical case ignoring actual field configuration (i.e., no flange considered).

From the results of the calculations the following observations can be made:

a) The 20 inch diameter flange on the pipe is in effect acting as a 20 inch pipe to the cables in the tray. A 20 inch uninsulated 407°F pipe 9.5 inches from the cables would not have met the San Onofre Unit 1 hot pipe separation criteria.

b) This uninsulated flange caused the cable core temperature to exceed its design rating of 194°F (90°C) in a 104°F ambient.

c) For ambient temperatures up to 140°F the cable core temperature is approximately 90°F above its rating with the actual cable load current.

d) Discounting the effect of the flange, the cable core temperature in a 104°F ambient for actual cable loading would have been within its rating, and would have met the hot pipe separation criteria. For ambient temperatures higher than 104°F the cable core temperature would have exceeded its design rating.

7.1.6 Generic Implications of the 4kV Cable In-Service Failure

The root cause of the 'C' Transformer cable in-service failure was excessive localized heating of the cable that resulted in a mechanical rupturing-splitting of the insulation wall. A significant contributor to the breakdown mechanism was the fabric tape between the insulation and jacket that tended to lock the two surfaces into the physical forces exerted by the thermal expansion within the limited confines of the outer aluminum interlocked armor. This is detailed in Section 6.2.4.

Since only the "C" Transformer cable, of all the 5kV Simplex cables at Unit 1, incorporated the fabric tape between the butyl insulation and the neoprene jacket (Attachment 7-5), the major contributor to the breakdown mechanism initiated by the excessive localized heat is not present in the remaining 5kV Simplex cables. This does not negate the need to avoid situations creating localized thermal excursions exceeding the design basis for the installed cables for extended periods. The high thermal environment at the failure location (Section 7.1.5), remains the fundamental cause for the ensuing in-service failure and would jeopardize any cable construction operating beyond its design basis for extended periods. Section 6.4.2, addresses the walkdowns that should eliminate other potentially detrimental localized hot-spot to cable raceway interfaces.

For other voltage classifications of Simplex butyl insulated cables, i.e., 600 volt power or control, the tearing mechanism due to pressures developed within the confines of an outer aluminum interlocked armor from thermal expansion, would not occur on the non-armored constructions.

There is not a generic weakness associated with the "C" Transformer cable failure mechanism for the remaining 4kV and 600 volt cables.

7.2 ASSESSMENT OF MATERIAL CONDITION OF 600V AND LOWER VOLTAGE POWER, CONTROL AND INSTRUMENTATION CABLE

The investigation of the 4160 volt cable in-service failure that occurred in November 1985 indicates that the cable insulation failure was caused by long-term exposure to a localized heat source ("hot spot"). This failure prompted an inspection of cable in cable trays throughout the plant to visually assess the condition of cable at San Onofre Unit 1. This inspection revealed that the cable was in acceptable condition with the exception of some Simplex, 1/C, No. 12 AWG, butyl-rubber insulated, neoprene-jacketed cable manufactured in 1965 that exhibited signs of accelerated aging of the jacket (jacket cracking). This phenomena has been found only in cable trays in areas of higher ambient plant temperatures (Turbine Plant Mezzanine and Reheater Areas) and in the top sections of 480V MCCs. Evaluation of the Simplex cable exhibiting cracked jackets is specifically addressed in Section 7.3.1 (References 7.6.23 and 7.6.24).

Since it is expected that the jacket cracking is caused by long- term exposure to elevated ambient plant temperatures, a general assessment of the material condition of cable at San Onofre Unit 1 was warranted to ensure acceptable cable condition in all areas of the plant.

This section documents the evaluation of the postulated effects of elevated plant ambient temperatures on, and a general assessment of the existing material condition of, 600 volt (and lower voltage) power, control and instrumentation cable utilized at San Onofre Unit 1.

The following discussion is germane to the balance (i.e., not exhibiting degraded jackets) of 600V and lower voltage power, control and instrumentation cable utilized at San Onofre Unit 1 (including all Simplex cable not exhibiting cracked jackets).

Power Cable Considerations

A variety of materials are used for 600 volt power cable insulation. Attachment 7-6 identifies the cable types used at San Onofre Unit 1. The materials predominantly used at SO1 are cross-linked (thermosetting) polyethylene, ethylene-propylene rubber, and butyl rubber. These are rated for 90°C operation. Jacket material for the majority of 600 volt cables is neoprene.

Power cable application engineering at the time of the original design was in accordance with Reference 7.6.15. Cable application engineering for retrofit plant modifications has been in accordance with References 7.6.15 and 7.6.16. These standards base the calculation of maximum allowable ampacity on a continuous ambient temperature of 40°C (104°F) and full rated cable loads. Actual plant ambient temperatures may sometimes have exceeded the design basis temperature of 40°C. As such, the power cable insulation temperature may have exceeded the 90°C rating only if carrying full rated load current. If such were the case, the effect would be accelerated aging of the cable. Long-term exposure to elevated ambient temperatures would also accelerate aging of the jacket.

Cables are generally not operated above 80% rated load and, in fact, are normally operated well below that level. The allowable continuous ambient temperature (at 80% of rated load) required to bring conductor temperatures to 90°C is approximately 60°C (140°F). It is unlikely that any areas of the generating unit with cable that has cracked jackets will experience a continuous (24 hours a day, each and every day) ambient temperature of 140°F or that cable conductors will experience a continuous temperature of 194°F (90°C). As such, the subject cable can be expected to perform reliably.

The recently completed SCE equipment qualification program includes qualification of 600 volt power cable for the expected remaining life of the generating unit (References 7.6.9 through 7.6.14 and 7.6.46 through 7.6.57). This qualification is based on design basis ambient and rated cable allowable operating temperatures. The qualification program included the testing of samples taken from power cable that has been installed in the generating unit since initial plant operation. As a result of the investigation of the 4kVTF, there may exist certain areas within the plant wherein the normal ambient temperature may be higher than was considered in the original design basis. The subject samples may not have been selected from these areas which may exhibit a normal ambient temperature higher than orginally considered. Therefore, if these cables had been operating above their full electrical loading and full load rated temperature, the qualified remaining expected life of that power cable insulation that may have exceeded rated temperature must be re-evaluated. The qualification program does, however, demonstrate that cable not exposed to higher ambient temperatures and operating within its rated temperature and rated electrical load is qualified for the remaining life of the plant. SCE has no cause to assume that cables have been operating above their full load rated temperature of full electrical load even if operating in a higher than normal ambient temperature. As such, SCE has cause to believe the environmental qualification program results are applicable to the power cables in use at San Onofre Unit 1. An assessment of the Environmental Qualification program implications is documented in Section 7.4 (Reference 7.6.25).

Heat transfer from power cable results in a thermal gradient from the conductor-insulation interface to ambient, e.g., a 50°C drop from 90°C rated temperature to 40°C ambient. The thermal gradient from the conductor-insulation interface for 600V power cable to the jacket is relatively small. For example, a three conductor 600 volt power cable carrying maximum allowable amperage and operating at 90°C can have a jacket temperature greater than 80°C. The power cable jacket can therefore be expected to be subjected to a temperature that is approximately that of the cable insulation.

Neoprene, the material used for the 600 volt power cable jacket, has a lower activation energy than cross-linked (thermosetting) polyethylene, ethylene-propylene rubber, or butyl rubber. At cable-rated temperatures, the lower activation energy of neoprene results in an estimated life that is significantly lower than the other materials. In addition, the neoprene jacket is thinner than the cable insulation layer, and the jacket is directly exposed to air and will more readily oxidize. It is expected that the 600 volt cable jackets will degrade and reach an end-of-life condition substantially sooner than the cable insulation. However, degradation of the jacket, which primarily provides mechanical protection, is not necessarily indicative of insulation degradation or unacceptable dielectric strength. The SCE environmental qualification program for cable demonstrated that the estimated life for butyl rubber exceeds neoprene by approximately 70 years. The jacket end-of-life condition is recognized as embrittlement and cracks. Again, embrittlement and cracking of the jacket does not dictate insulation end-of-life or the inability of the cable and insulation to perform their intended functions, particularly at lower voltages (600V and lower). Visual inspection of power cable jackets provides an early indication of potential degradation, well in advance of insulation failure.

Control and Instrumentation Cable Considerations

The 600 volt (and lower voltage) insulated cable is also used for control and instrumentation. Low voltage control and instrumentation cable provides low voltage signal transmission. The signal is usually a digital (on-off) voltage signal with negligible current flow. Signal current flow is typically the order of milliamperes. Control cable conductor size is 12 AWG, with an ampacity of several amperes. Actual control and instrumentation cable current is several orders of magnitude less than the rated ampacity of the cable, and cable conductor heating due to resistance losses is negligible. Therefore, there is no significant thermal gradient from the conductor-insulation interface to ambient. It is reasonable to conclude that the maximum temperatures of the cable insulation and jacket is approximately the maximum ambient environment temperature.

The SCE equipment qualification program has established that such cable is qualified for the remaining expected life of the generating unit (References 7.6.9 through 7.6.14 and 7.6.46 through 7.6.57). This qualification is based on installation of the cable under conditions in which the cable insulation rated temperature will not be exceeded.

Several different types of materials are used for control cable insulation. The materials predominantly used at SO1 include butyl rubber, ethylene-propylene rubber, and cross-linked (thermosetting) polyethylene. Jacket material is neoprene. The temperature ratings of these materials are part of national and industry standards, and temperature rating may be different for different materials. Manufacturers can establish material temperature ratings that exceed the ratings given in the national and industry standards. However, 75°C is the lowest temperature rating given in the standards for the cable insulation and jacket materials listed above. Since control and instrumentation cable maximum insulation temperature is approximately the ambient temperature, such cable insulation material temperature ratings could only be exceeded if the ambient temperatures exceeded 75°C (167°F).

It is highly unlikely that postulated elevated ambient temperatures could exceed 167°F during normal operation, and, as such, low voltage control and instrumentation cable insulation should not degrade to an end-of-life condition during the remaining life of the plant. However, the neoprene control cable jacket has an estimated life that is significantly less than the cable insulation. Again, degradation of the jacket is not necessarily indicative of a degraded insulation condition. Visual inspection of control cable jackets will provide indication of potential insulation degradation well in advance of actual insulation degradation.

General Considerations

1. Satisfactory power, control and instrumentation cable electrical or signal carrying service depends upon cable insulation integrity. As previously discussed, cable jackets will degrade at substantially faster rates than cable insulation. This phenomena is especially true for neoprene jackets. As such, a degraded jacket is an extremely early sign of potential cable degradation. Therefore, the

insulation associated with those cables not exhibiting jacket degradation, can be expected to be in satisfactory physical and electrical condition.

2. With the exception of the Simplex cable that exhibited cracked jackets, the balance of cable visually inspected appeared in good condition with resilient jackets. It stands to reason that if the cable in the worst condition (Simplex previously mentioned) from the areas of highest ambient temperature were physically analyzed and electrically tested as acceptable, the balance of plant cable can also be expected to be acceptable. Section 7.3.1 documents the acceptability of the Simplex cable exhibiting cracked jackets (References 7.6.23 and 7.6.24).

3. The elements in the environment of the plant that cause accelerated aging to cable are heat and radiation. Excessive radiation only occurs during postulated reactor accidents and the cables needed to achieve hot safe shutdown have been environmentally qualified for those environments. Environmental qualification of these cables was accomplished by identifying equipment required to be operable and documenting that the cable serving that equipment would function in adverse environments expected to exist during and after reactor accidents.

4. The in-service failure of the 4160V 'C" Transformer cable was due to long-term exposure to a localized heat source. SCE has undertaken an extensive field inspection program to identify and eliminate all such potential "hot spots" to cable raceway interfaces that could be detrimental to cable life (Reference 7.6.26) this inspection is documented in Section 6.4.2. As such, it is expected that all cable (including 600V and lower voltage power, control and instrumentation cable) should no longer be subject to that type of failure.

5. As mentioned above, an evaluation of potential locations of localized heat sources is presented in Section 6.4.2 (Reference 7.6.26). It was found that all other manufacturer's

cables routed with the No. 12 Simplex cable that exhibited cracked jackets do not have similar degradation. It is recognized in the industry that neoprene, the material in the No. 12 Simplex cable jacket, does not have extensive life at continued elevated temperatures, nor does it age as well as materials currently in use in cable jackets (the Simplex cable was manufactured in 1965). Also, multi-conductor constructions using the same material are less susceptible to aging because the jacket is thicker. The expected ambient temperature for the area that the No. 12 Simplex cable is installed in is 40°C (104°F) (Reference 7.6.3). Excursions in ambient temperature could be expected to accelerate jacket aging in that particular cable. As part of the Material Condition Monitoring Program, suspect plant areas will be monitored when the plant returns to service to verify the actual ambient temperature to ensure such excursions are not frequently encountered.

6. Megger testing of the suspect Simplex cable and other plant circuits has also been undertaken and results to date indicate the circuits are in acceptable condition. The circuits were tested at 1000V with measured resistance greater than 1000 megohms. As such, it can be expected that other circuits with cable exhibiting no degradation should also be in equally acceptable condition.

7. The subject cables have been in service at San Onofre Unit 1 since initial operation of the plant. There have been no indications of generic cable failures for any reason.

8. The aging process for cable insulation is very slow in normal plant environments. The process is still a long-term process even in general areas of elevated temperature of the type found in power plants. Jacket degradation (cracking) is generally the first sign of such aging and occurs well in advance of any potential insulation aging and degradation.

9. SCE has undertaken a joint effort with EG&G, Idaho to implement a long-term cable material condition monitoring program utilizing the

ECCAD System. Testing to date of various circuits at S01 (including 600V circuits with and without degraded jackets) has identified no anomalies that would indicate an unacceptable circuit condition as compared to baseline data from other sources. This program is expected to develop baseline data for circuits at San Onofre Unit 1 to provide information relative to trends in circuit condition observed from future testing.

Summary

Based on the information presented herein, it is concluded that the 600V and lower voltage power, control and instrumentation cable at San Onofre Unit 1 is in good material and electrical condition and is acceptable for continued plant operation.

As a precautionary measure, periodic visual inspections of cables in cable trays located in areas of highest area ambient temperatures to monitor cable condition may be warranted. This monitoring can, if desired, be accomplished as part of the Area Monitoring Program.

7.3 ASSESSMENT OF 600V CABLE EXHIBITING JACKET DEGRADATION

As a result of the field inspection of cable in cable trays throughout the plant, visual evidence of degraded cable jackets (cracks) for certain 600 Volt insulated cable was obtained. These cables are predominantly located in trays in areas of higher ambient temperature. This degradation is evidence of accelerated aging for the jacket material. The purpose of this section is to assess the present material condition of that cable.

The subject cable service includes low voltage power (less than 480V) and/or control and each circuit is identified in Attachment 6-3 of Section 6.0 (Reference 7.6.27). All of these circuits are nonsafety-related or associated circuits (safety-related source serving nonsafety-related equipment with the source breaker acting as an isolation device) with the exception of the cable in the MCCs discussed below. All observed degradation (with only one specific exception documented in Section 7.3.2) has been in the neoprene jackets of 600V, single conductor, No. 12 AWG, butyl rubber insulated cable that was manufactured by Simplex in 1965, located in cable trays or in the top section of 480V MCCs. Field Inspections, as documented in Section 6.4.3, have verified that none of the subject Simplex 600V cable located in cable trays serving safety- related circuits has cracked jackets (with exception of some cable in the 480V MCCs). An assessment of the subject Simplex cable located in the MCCs is discussed in Section 10.8.

7.3.1 Assessment of Simplex 600V, 1/C, No. 12 AWG, Butyl-Rubber Insulated, Neoprene Jacketed Cable

Acceptable power and control service can be achieved solely with cable insulation integrity (without the jacket). The design objective for the cable jacket is physical protection against possible hazards during installation of the cable. Once installed, cable jacket degradation does not preclude acceptable service.

The SCE environmental qualification program for cable (References 7.6.9 and 7.6.14) demonstrated that the estimated life for butyl rubber exceeds neoprene by approximately 70 years.

Samples of the subject cable have been forwarded to laboratories for physical analysis and electrical testing. Results, as documented in Section 6.3.2 (Reference 7.6.24), indicate that the cable has substantial residual electrical life and is suitable for continued service.

At the start of the Cycle 10 refueling outage (approximately the end of 1987), the cable will have been in service for approximately 20 years. Reference 7.6.14 demonstrates that the cable is qualified for 40 years at the temperature rating of the butyl rubber insulation. Using the industry accepted analytic technique given in Reference 7.6.14 for estimating life, the cable presently has an estimated remaining life of 20 years at an insulation temperature of 97°C.

Control and Insulation Cable Considerations

The information included in Reference 7.6.38 indicates that control cable insulation temperature is approximately the ambient temperature. Therefore, cable with degraded jacket material is qualified for service until the next unit outage providing the ambient temperature does not exceed 97°C (207°F). It is highly unlikely that any area of the generating unit will be subjected to a continuous elevated ambient temperature of 207°F during normal operation. Therefore, this cable can be assumed to have a useful life in excess of 20 years and well beyond that period since ambient plant temperatures are well below 207°F.

Power Cable considerations

Power cable application engineering at the time of the original design was in accordance with Reference 7.6.15. That standard provides for the calculation of maximum allowable ampacity with a continuous ambient temperature of 40°C (104°F). The manufacturer of the cable with the observed degraded jackets established a butyl rubber insulation rating of 90°C for the service life of the cable. Power cable application was, therefore, made with a maximum expected temperature rise of 50°C. Since the maximum thermally allowable insulation temperature for continued service to the end of 1987 is 97°C, then the maximum acceptable continuous ambient for power cable with cracked jackets operating at full rated electrical load (97°C conductor temperature) is 47°C (117°F). Cables are generally not operated above 80% rated load and, in fact, are normally operated well below that level. The allowable ambient (at 80% of rated load) required to bring conductor temperatures to 97°C is approximately 67°C (153°F). It is unlikely that any areas of the generating unit with cable that has cracked jackets will experience a continuous (24 hours a day, each and every day) ambient temperature of 153°F or that cable conductors will experience a continuous temperature of 207°F until the end of 1987. As such, the subject cable can be expected to perform reliably well beyond the end of 1987.

General Considerations

1. Satisfactory power, control and instrumentation cable electrical or signal carrying service depends upon cable insulation integrity. The jacket provides mechanical protection during cable installation and, during service, provides against mechanical abuse, oil and other liquid spills, and some small measure of fire protection. Once the cable is installed, the cable jacket is not required to meet electrical service objectives.

   The trays carrying the cables exhibiting cracked jackets are located at elevations in the plant that provide protection against mechanical abuse and minimize the probability of spills which could affect the cable. Additionally, while cracked, the jacket remains in place on the insulation unless purposely removed. As such the jacket still affords considerable mechanical and fire protection.

   During construction activities, procedures require that cable in trays be protected by plywood sheeting and fire retardant coverings.

2. Megger testing of the suspect Simplex cable (as well as other plant circuits) has also been undertaken and results indicate the circuits are in acceptable condition. The circuits were tested at 1000V with resistance greater than 1000 megohms.

3. The subject cables have been in operation at SO1 since initial operation of the plant. There have been no indications of generic cable failures for any reason.

4. Other information documented in Section 7.2 germane to generic cable properties (e.g., Environmental Qualification tests pertaining to butyl insulation, cable design application, temperature environments and cable ratings, results of localized heat source walkdowns, etc.) are also applicable to the cable with cracked jackets.

5. Laboratory physical analysis and electrical tests discussed in Section 6.3.2 conclude acceptable cable dielectric strength and suitable for continued use for the remaining design life of San Onofre Unit 1 even with the degraded jacket.

Summary

Based on the above, the Simplex cable with cracked jackets is suitable for continued power, control and instrumentation service for continued plant operation. It is expected that the subject cable will be adequate for the remaining design life of San Onofre Unit 1.

Periodic visual inspection of cable in the areas of expected higher ambient temperatures is recommended to verify that the subject cable has not become further degraded.

Further, as part of the EQ Condition Monitoring Program, certain areas of the Turbine Building susceptible to higher elevated ambient temperatures should be monitored (as discussed in Section 10.2) to verify design and EQ test program ambient temperatures.

In consideration of the above, continued use of the subject Simplex cable is acceptable.

Note these conclusions and recommendations obviously do not preclude the option of replacing the subject cable during convenient outages or other Design Change Package implementation for reasons of aesthetics (the appearance may chronically be cause for concern) or simply because the cable is not in the originally installed condition (with jacket intact). Further, the subject cable, in cable trays subjected to substantial rework or cable re-routing for any reason, should be replaced to ensure plant operation without concern for cable that may have been mechanically damaged as a result of the rework activities.

7.3.2 Assessment of 600V, 1/C, No. 4/0 AWG, Butyl-rubber Insulated, Neoprene Jacketed Cable

The only other cable in the plant found with a cracked jacket in addition to the Simplex discussed in Section 7.3.1, is single conductor, 4/0 AWG, Simplex, Anhydrex XX, neoprene jacketed cable, (Circuit No. 1GBS218P2), installed in a 6" x 3" ventilated cable tray (No. 39W1); however, the cracking is not extensive. This tray is located in the 480V Switchgear Room. The circuit consists of nine single conductor cables (3 per phase) and serves as the feeder cable from the 480V Switchgear No. 2 to Motor Control Center No. 2.

A calculation (Reference 7.6.22) prepared using the maximum sustained current in the cables indicates a neoprene jacket surface temperature of about 67°C. This assumes a 40°C (104°F) ambient; which is conservative assumption for an enclosed, air conditioned room. It is possible that ambient temperatures were higher prior to that area being enclosed and air conditioned and that previous environment accelerated the jacket aging.

Reference 7.6.21 shows a 2 to 3 year life for neoprene exposed to continuous temperatures in excess of 67°C in a circulating hot air oven. Under most operating conditions, the cable loading would be cycled; however, this circuit has a sustained loading during plant operation and cable temperatures would not fluctuate except as influenced by the ambient.

The neoprene is now hard throughout its run; however, the insulation is considered electrically satisfactory for continued operation for reasons discussed in Sections 7.2 and 7.3.1. The cracks in the jacket may become larger and more of them may develop at the current electrical loadings and under adverse area ambient temperatures. Again, since the room is air conditioned, the possibility of such adverse area ambient temperatures is minimized, if not eliminated.

It should be noted that jacket degradation will manifest itself long before unacceptable insulation degradation in normal operating environments. This cable is located in a mild, air conditioned environment (480V Switchgear Room). As such, the cable, even with a cracked jacket, is expected to provide satisfactory performance. Since the cracking currently appears to be very limited, it is recommended that these cables be visually monitored for further deterioration.

Since this cable is run with a limited number of other cables the possibility of further mechanical damage to the insulation as a result of design changes is minimized.

Summary

The suspect cable is acceptable for continued use. However, the cable in Cable Tray 39W1 should be visually inspected at each refueling outage for continued degradation. Should the inspection reveal the jacket has degraded to the point the jacket cracks had substantially widened and substantial insulation is exposed, an evaluation of insulation integrity should be performed or the cables should be replaced at the next scheduled refueling outage following the observation of unacceptable degradation.

7.4 ASSESSMENT OF THE ENVIRONMENTAL QUALIFICATION PROGRAM GERMANE TO CABLES IN SAN ONOFRE UNIT 1

The 4kV cable fault that occurred on November 21, 1985, has been determined to have been caused by long-term exposure to temperatures in excess of the cable's design temperature rating. The implications are that, while elevated temperatures above those expected are not generally present throughout the plant, there are certain selected locations wherein temperatures may be higher than previously expected.

The purpose of this section is to address the potential implications of this discovery on the SONGS 1 Environmental Qualification (EQ) Program and on the existing qualification of the 4kV power cable and 600V power, control, and instrumentation cables covered by the SONGS 1 EQ Program.

The potential implications to the EQ Program involve two concerns. The first concern pertains to the temperature of the cable's normal operating environment. The second concern is whether or not the discovery of some cracked cable jackets impacts the cable's fundamental environmental qualification.

Relative to the first concern, regulatory and industry standards require determination of qualified life based on the normal ambient temperatures in which equipment will be operating. The SONGS EQ Program has been developed in accordance with these regulatory and industry standards and accounts for these temperature considerations in determining a cable's qualified life. Because the San Onofre Unit 1 EQ Program required the use of engineering and plant data based on the equipment design parameters and specifications, the program for evaluating this data in determining the overall environmental qualification of specific equipment and materials is valid. As such, the November 21, 1985 cable fault should not represent a deficiency in the overall San Onofre EQ Program.

Reassessing the normal operating environments requires long-term monitoring while the plant is operating. Consequently, the adequacy of the environmental qualification of the cables in the near-term (i.e., for at least the next fuel cycle) had to be assessed. In this regard, it was determined that the originally installed cables could operate in as high as a 167°F (75°C) environment with reasonable assurance that they would remain in a qualified condition for the duration of the next fuel cycle. This determination was done by calculating (via Arrhenius methodology) the maximum normal ambient temperature that would result in the same total thermal input to the cable in one fuel cycle (i.e., 18 months) plus accident as was actually input to the cable (see Reference 7.6.33 and 7.6.34) for the remaining plant life plus accident. Consequently, while ambient temperatures may in certain locations exceed those previously expected (e.g., 104°F), it is believed that in all areas of concern, ambient temperatures below 167°F are anticipated to be encountered. Because of this, it can be concluded that the installed cable is qualified for in excess of one additional fuel cycle.

To determine if indeed normal ambient temperatures in excess of 104°F are present in the areas of concern, the Condition Monitoring Program (which is a part of the San Onofre EQ Program) will include detailed temperature surveys in these areas. Once this data is obtained, a more accurate assessment of remaining qualified life will be developed.

The concern pertaining to the cracked neoprene cable jacketing (as found in the course of performing 4kVTF activities) has been evaluated and has been determined to have no effect on the qualification of the safety-related cable installed at San Onofre Unit 1. The basis for this conclusion is summarized below.

The first consideration is the design function of the jacket. It is accepted industry practice that the cable's insulation provides the necessary dielectric barrier between the conductor and the outside environment. The jacket's design function is to protect the insulation from damage during cable pulling and initial installation. Therefore, cracking of the jacket does not necessarily imply a failure or degradation of the cable's insulating system.

Second, neoprene is much more sensitive to thermal aging than is butyl. (The activation energy for neoprene is 0.82 ev versus 1.02 ev for butyl.) Therefore, though a length of cable may have been exposed to a higher-than-anticipated temperature and the jacket may have displayed cracking, this does not necessarily mean that the insulation is beyond its design life. As indicated previously, it has been determined that the cable (insulation) will remain qualified for in excess of one additional fuel cycle.

Finally, a review of the germane EQ test parameters shows that the presence of the cracked jacketing does not invalidate the EQ testing done for the subject cable installed at San Onofre Unit 1.

Temperature: No impact. The thermal aging and HELB test were of such duration that the entire cable (i.e., jacket, insulation and conductor) can be considered to have been in thermal equilibrium. Therefore, the cable insulation was sufficiently aged to demonstrate the required qualified life regardless of condition of the jacket.

Radiation: Cable jackets provide protection from beta radiation for the cable insulation, however jackets provide virtually no protection from gamma radiation. There were no cracked jackets in areas of Beta Radiation. All of the cable testing has demonstrated that the butyl-rubber insulated, neoprene-jacketed cable in the EQ Program at San Onofre Unit 1 has adequate capability to withstand gamma radiation exposure. Therefore, it can be concluded that radiation qualification is maintained.

Chemical Spray: This is not applicable since the cables are installed outside containment.

Steam Exposure: Standard tests for cable show butyl insulation to be highly resistant to water absorption—even for periods of direct submergence of many days to several weeks. The limiting HELB environment at SONGS 1 would expose these cables to a steam environment for a period of only a few hours. Therefore, steam (and relative humidity) qualification is maintained.

In conclusion, it is determined that the safety-related cable installed at San Onofre Unit 1 is qualified for use for in excess of one additional fuel cycle. The need to replace any additional cable at the next or any subsequent refueling outages should be evaluated upon development of more detailed plant temperature profile data.

The following discussion gives consideration to the environmental qualification aspects of the various cable types evaluated within the scope of this Task Force.

4kV Cables

There are three types of 4kV cables installed at SONGS 1. These are Simplex, Anaconda, and Kerite. The Simplex and Anaconda 4kV cables are the only ones that need to be considered relative to EQ since, as discussed elsewhere in this report, the Kerite cables are used only in nonsafety-related applications.

The Simplex is a three conductor cable and is described in Section 1.3 of this report. The Anaconda cable utilized is of both the single conductor and three conductor types.

These cables have been determined to meet the necessary similarity requirements of the cable test specimens in References 7.6.33 and 7.6.34. In addition, the number of conductors does not adversely impact the validity of the qualification testing done and follows the same rationale discussed earlier in this section as pertaining to cracked neoprene jacketing. Therefore, the qualification of these cables in References 7.6.33, 7.6.34, and 7.6.51 remains valid.

The Simplex is butyl insulated and the Anaconda is ethylene-propylene rubber (EPR) insulated. Because butyl is more susceptible to the effects of aging than is EPR, the discussion earlier in this section demonstrating that an excess of one fuel cycle of qualified life exists bounds both these Simplex and Anaconda cables.

600V Power and Control Cables

All of the cable types installed at SONGS 1 for 600V power and control applications is delineated in Section 4.0 (Table 4-1). Of these, there are a number used in safety-related circuits in harsh environments and thus requiring EQ. The insulation types found in these cables are: butyl, silicone rubber, EPR, and cross-linked polyethylene (XLPE). Of these, butyl is the most susceptible to the effects of thermal aging. Therefore, the discussion earlier in this section demonstrating that an excess of one fuel cycle of qualified life exists also bounds all of these cable types as well.

Instrumentation Cables

Combined effects of environment and service-induced effects is less severe for instrumentation cable. Therefore, the instrumentation cables at San Onofre Unit 1 that require EQ are bounded by the discussion pertaining to the 600V power and control cable.

7.5 SPECIAL CONSIDERATIONS

The evaluations documented in this section are those not directly associated with the objectives of 4kVTF but were investigated in an ancillary capacity.

7.5.1 Cable Tray Covers

As part of 4kVTF activities, a concern regarding the need and criteria for cable tray covers was assessed.

The cable trays carrying 4160V circuits have cable that have insulation shielding, or have cable that is probably listed with a qualified laboratory and has 90 milli-inch thick insulation with an overall armor. In such cases, the National Electrical Safety Code does not require barriers and the cable tray does not require covers to conform to the NESC.

The IEEE standard for power generating station cable and raceway practices is IEEE 422. That standard recommends cable tray covers where cable might be subjected to falling objects or the tray might accumulate debris. Since uncovered horizontal runs of trays with 4160V cable are under suspended slabs, grating, or other trays, the cable is not subject to falling objects and debris accumulation. Therefore, the 4160V cable tray does not require covers to meet the recommendations of IEEE 422.

The IEEE Standard 690, IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations, is silent on cable trays and cable tray covers.

SCE Engineering Standards - Electrical Construction - Station Layout, Number 34-23-00 requires cable tray covers on the top run of cable tray that is "Exposed to direct sunlight and moisture" and on the top run of trays that are in "... areas exposed to dust, dirt, or falling objects."

SCE Standards - Electrical Construction - Station, Number 34-23-00 requires that "The side of the covers should project over the side of the tray..."

SCE Engineering Design Organization, Electrical Engineering Guide, Design of Thermal Electric Generating Stations, E8.2.2.4 requires that "Covers shall be provided for the top trays..." for "...areas exposed to dust, dirt, falling tools, or other objects." and "...trays exposed to sunlight, rain, moisture..."

The engineering and design criteria for the original plant design is given in the San Onofre Final Engineering Report and Safety Evaluation (dated prior to March 1966). This document is silent on cable tray covers.

The San Onofre Nuclear Generating Station, Unit 1 Retrofit General Design Criteria Manual (M-37387, Rev. 5) requires that "trays shall be provided with solid covers in areas of hazard (due to falling objects), dirt, contaminants..." (Reference 7.6.3).

With the exception of the National Electrical Safety Code and the San Onofre Final Engineering Report and Safety Evaluation, all of the above cited documents were apparently issued after the completion of the original design. Common industry cable tray design practice at the time of the original design was similar to the recommendations given in IEEE 422.

The existing design of indoor cable tray at San Onofre appears to be consistent with industry practice at the time of the original design and with the recommendation of IEEE 422. Therefore, the indoor cable tray runs do not need to be modified to add covers.

The existing design of outdoor cable tray at San Onofre appears to be consistent with SCE engineering standards. Therefore, the outdoor cable tray runs may remain covered. The documents cited above are silent on spacing of tray covers above the cable tray. The intent appears to be to reduce the sunlight exposure of cables in the tray. Therefore, spacing (if any) of tray covers may be dictated by engineering judgement and consideration of fire protection spray, conduit entrance, etc.

7.5.2 DC Overvoltage Testing at San Onofre Unit 1

The 4kV Cable Evaluation Task Force attempted to determine the extent of DC overvoltage testing on 4160 Volt cables at San Onofre Unit 1 and to provide data sheets from the tests, particularly on those cables which failed testing. The only historical information located is a list of License Event Reports for all plants licensed by the NRC. These reports do not contain detailed information concerning testing and are of no value to the 4kVTF. Subsequent to the phase-to-phase ground failure in an X-winding C transformer cable in November 1985, all 4160kV cables were DC overvoltage tested. The maintenance orders (which include data sheets) are included in Reference 7.6.32. All DC overvoltage testing of cables at SONGS is conducted in accordance with SCE SO123 Instrument and Test Procedure SO123-II-11.153 (Reference 7.6.35). The values of the test voltage and the frequency of testing is governed by the SCE Substation Test Manual (Reference 7.6.36). That manual requires DC overvoltage testing in-situ on any replacement or new cable and allows in-service testing (to approved voltages only) at the discretion of Station personnel. It seems likely that the original in-situ test is the only test to which each 4160V cable has been subjected; however, it is not possible to substantiate DC overvoltage testing over the life of each cable with documentation currently available at SONGS. Table 7-4 is a table which identifies the known testing for each 4160V cable and provides a variety of information which was obtained while researching DC overvoltage testing.

7.5.3 Applicability of DC Overvoltage Testing of 4kV Cables

Over the past thirty years hundreds of medium voltage, 4kV or higher, cables have been tested with Direct Current (DC) by the Southern California Edison Company. These tests have exposed manufacturing defects, shipping and installation damage, and in-service deterioration. All 4kV cables are tested after installation before being energized.

Routine testing has been scheduled based on operating history. Locations experiencing in-service failures would have cables tested at shorter intervals, while those with no failures may be tested infrequently or not at all.

In the case of three conductor, non-shielded, interlocked armored cable, there exist records of only two cables that failed the DC test in other SCE generating stations. These were 750 kcmil, 4kV, Simplex butyl rubber cables that failed the "after-installation" test before being energized at Etiwanda Units 3 and 4 in 1962. The failures were believed to be due to shipping or installation damage. These cables were replaced by Simplex, and all 4kV cables of this type have operated without failure to date at this station.

The DC test is considered to be a reliable method of evaluating cable condition if three conditions are met.

The first condition is the voltage level. This has been established from the National Standards and SCE procedures used over the past thirty-six years.

The second condition is time of application of voltage. This also is based on National Standards and SCE procedures used over the past thirty-six years.

The third and final condition is the current flow during the test. Experience shows that current will increase as the voltage is raised. However, upon reaching the final voltage, current is expected to stabilize or slightly decrease as the insulation capacitance becomes fully charged.

If current flow continues to increase during application of the final test voltage, the test is not considered to be successful.

It is concluded that the DC overvoltage test, conducted at multiples of normal operating voltage; will detect cable defects that would have failed at operating voltages; will not deteriorate good cable insulation; and will provide assurance of reliable operation for a number of years.

7.5.4 Applicability of Partial Discharge Test

As a result of discussions during a Material Condition Review Panel meeting, the applicability of "Partial Discharge" tests for evaluating the condition of 4kV power cables at San Onofre Unit 1 has been evaluated.

The partial discharge test was developed as a factory test to detect voids in cable insulation that could ionize when the cables are energized. The ionization or "corona" discharges in these voids could erode the insulation and eventually cause cable failures. When conducted in the factory under controlled conditions on shielded cable, a specified discharge level shows uniformity in the cable insulation and provides a baseline for later laboratory tests. The test is not suitable for non-shielded cable construction.

To perform a partial discharge test, an A.C. voltage is applied between a cable conductor and shield and discharge patterns are measured and monitored on a CRT or by an X-Y recorder.

The test equipment and cable must be located in a shielded room to block interference from fluorescent lights, electric equipment, welders, corona discharges from switchyards, or transmission lines. Such external interference sources will prevent use of this test in an operating plant.

A discussion of the feasibility of partial discharge field tests was held with Mr. Ben Neal, Application Engineer of the James G. Biddle Company, a manufacturer of this type of test equipment. It was concluded that external interference in an operating plant would render test results meaningless.

7.5.5 Evaluate Construction Weld Strike on 4kV Cable

During an inspection of the 4kV cables in the Unit 1 4kV Switchgear Room, a small hole, approximately 1/4 inch in diameter was found in the aluminum interlocked armor sheath on one of the two cables in the circuit to RCP motor G2B-N. The hole was located approximately 3 1/2 feet above the terminator on the southernmost cable.

Members of the 4kVTF examined the hole with a lighted magnifying glass. The aluminum armor had been melted, probably due to an accidental strike with a welding rod. Welding had been in progress nearby.

It was determined that the insulated conductors were not in contact with the armor at this point. The three single conductors are wrapped with an overall binding tape before the armor is applied. The surface of the tape beneath the hole was undisturbed. No burning, charring, or discoloration of the binder tape was seen. The binder tape also was not in contact with the armor.

It is concluded that the weld strike believed to have burned the hole in the armor did not contact the surface of the binder tape or insulated conductors and did not damage the insulation. This cable is considered to be in good condition and can remain in service. The small hole should not affect the overall integrity and mechanical protection afforded to the conductors by the armor.

7.5.6 Generic Implications of Splices Found in 600V Samples

During the process of removing the 600V Simplex cable samples, four single conductor No. 12 AWG 600V cables were found with crimp splices in an unscheduled junction box in a conduit run serving the lube oil conditioner level switch LS-49 (Circuit Nos. 1NBO128C2 and 1WBO128K1). Of all the circuits in the area removed or inspected, splices were found only in these two circuits.

The following sketch (Figure 7.3) shows the physical arrangement of the conduit and junction box with the location of the splices indicated.

Splices are currently normally allowed only under certain conditions and then only in accordance with Construction Specification CS-E03. When properly installed, splices are a reliable and acceptable method of modifying circuits. Splices, when utilized, are to be placed in junction boxes, terminal boxes, equipment cabinets or similar enclosures. As noted above, the subject splices were found in a junction box apparently installed solely to allow use of the splices for modification of this circuit.

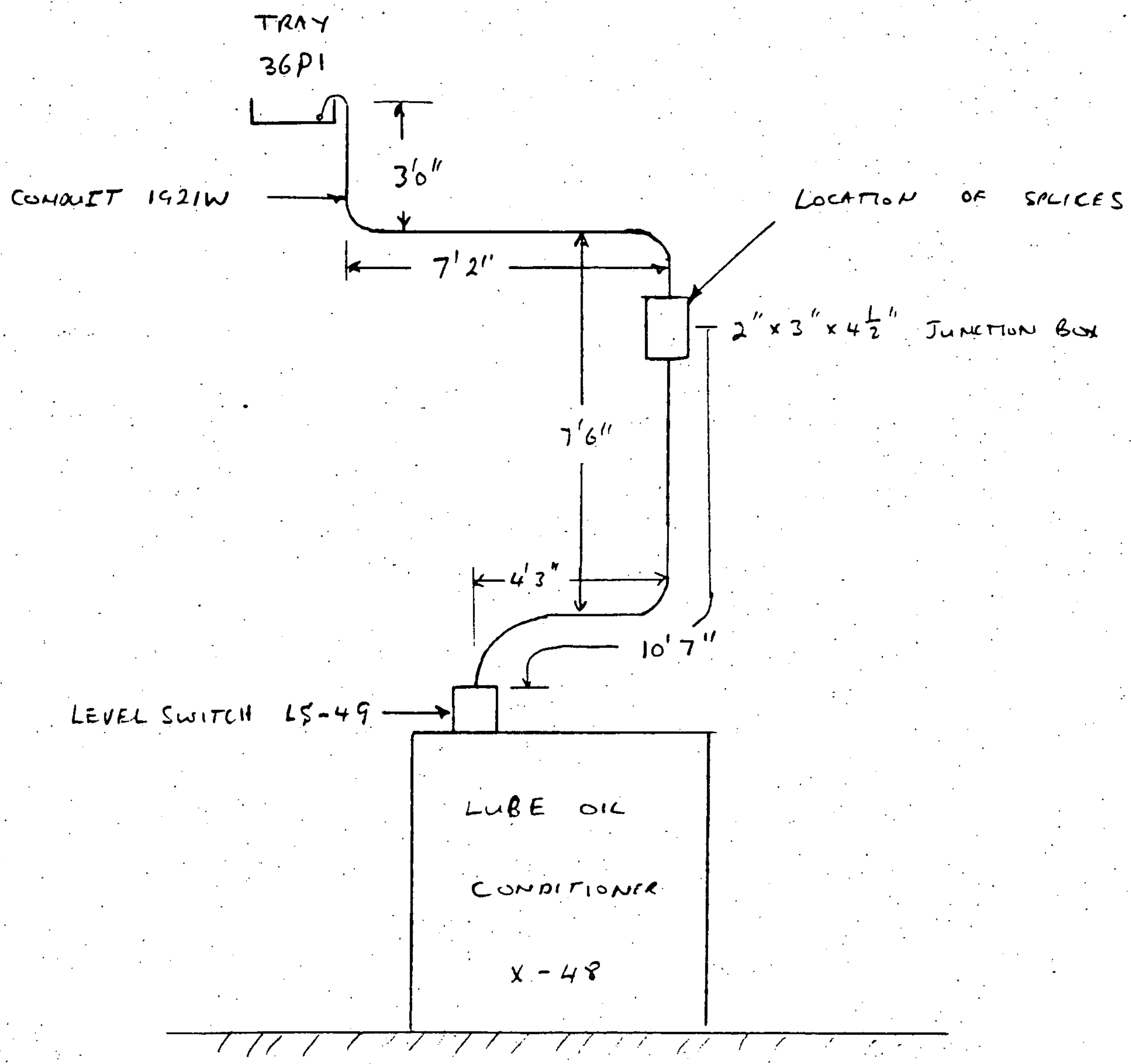
FIGURE 7.3

SAN ONOFRE UNIT 1

SUBJECT 600V CABLE SPLICES - TURBINE BUILDING MEZZANINE SHEET NO. 1

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE
△					△				
△					△				

REV. INDI-



CABLE LENGTH FROM SPLICE TO TERMINATION – 12' 6"

CONDUIT LENGTH FROM JUNCTION BOX TO LEVEL SWITCH		– 10' 7"
APPROXIMATE CABLE LENGTH INSIDE LEVEL SWITCH		– 1' 6"
	TOTAL	12' 1"

The splices found are considered to be an isolated occurrence for the following reasons:

1. Splices were found only in one conduit serving one device.

2. The splices were located in a small junction box in the conduit run to the device.

3. Splices were not utilized in the original construction of SONGS 1.

4. The splices appear to have been added after the original construction since a different cable was spliced onto the originally installed Simplex cable.

5. No other splices were found in the other samples of 600V cable removed from the plant for laboratory analysis or in any other circuits inspected.

6. No splices were found in the cable pulled for replacement as part of the current Environmental Qualification effort.

7. The current ECCAD cable testing effort (conducted by EG&G, Idaho personnel) has not identified use of splices in any of the cables tested to date.

As part of the on-going ECCAD effort, SCE will evaluate on case-by-case basis, any splices identified.

7.5.7 Commentary on the Simplex 5kV Rated Non-shielded Cable Construction

The accepted industry cable designs for non-shielded constructions were not as well defined in 1965 as they are in today's standards. The neoprene jackets were designed primarily for mechanical properties with little concern for any electrical requirement (relying for this property on the insulation). The Simplex cable, because of it being a three conductor construction within an overall aluminum interlock armor, has performed without serious electrical discharges occurring between phases and phase to ground, but discharge is present. Based on the cable's condition after 18 years of service, this low energy discharge is expected to continue at the same low rate of jacket degradation for the remaining design basis life of Unit 1 and have no affect on the integrity of the cable nor the conclusions and recommendations of this report.

7.5.8 Cable Abandoned in Raceways

As a result of the extensive cable tray inspection and 600V cable sampling programs conducted as part of 4kVTF activities, it became apparent that numerous cable trays and conduit contain cables that have been abandoned in place. The prevailing Engineering and Station practice has been to abandon a cable rather than remove it when replacing the cable or removing the circuit from service.

This practice could be detrimental for the following reasons:

1. It unnecessarily congests the cable tray, making retrofit activities more difficult.

2. It unnecessarily adds dead weight to the tray loading.

3. It unnecessarily adds dead weight to other cables in the tray possibly causing displacement of the cable insulation and thus weakens cable dielectric strength.

4. It increases the probability of cable damage when pulling new cable or performing other retrofit or maintenance activities.

5. Prevents normal ventilation of operating circuits and when carrying power loads.

6. Acts as a fuel source for any externally initiated fire.

While the 4kVTF is not advocating wholesale removal of any cable currently abandoned in raceways, removal of cable replaced or cable in circuits removed from service during future plant modifications or maintenance activities appears warranted and is recommended.

Further, it is recommended that cable currently abandoned in place be removed as opportunities become available.

7.6 REFERENCES FOR SECTION 7.0

7.6.1 Appendix A; 4kVTF Task No. 8

7.6.2 SONGS 1 Q-List; M-37560, Revision 1

7.6.3 SONGS 1 Retrofit Design Criteria Manual, M-37387, Revision 5

7.6.4 10 CFR 50, Appendix R

7.6.5 10 CFR 50.49

7.6.6 SONGS 1 UFHA: Appendix C

7.6.7 Kerite Company Letter, dated April 3, 1986; Subject: Cable Physical Data

7.6.8 MCRP Report, dated April 7, 1986; Subject: Evaluation of Power and Control Cables, SONGS 1

7.6.9 EQ Document Package - 600V Power and Control Cable, General Electric, EPR Insulation (SCE M38280) (See also References 7.6.51, 7.6.54, and 7.6.55)

7.6.10 EQ Document Package - 600V Power and Control Cable, General Electric, Vulkene Insulation (SCE 38281)

7.6.11 EQ Document Package - Power, Instrument and Control Cable, Rockbestos Company, Firewall EP (SCE 38285)

7.6.12 EQ Document Package - Power and Control Cable, Raychem, Flametrol Insulation (SCE M38291)

7.6.13 EQ Document Package - Power, Instrumentation and Control Cable, Rockbestos, Firewall III Insulation (pre-1978) (SCE M38299)

7.6.14 EQ Document Package - Cable: Simplex, Anhydrex XX; Rome, Rozone A/Roorene: Okonite, Okonex/Okoprene (SCE M38302)

7.6.15 IEEE/ICEA S-135, Power Cable Ampacities, 1962

7.6.16 ICEA P-54-440, Ampacities in Open Top Cable Trays

7.6.17 MCRP Report, dated April 7, 1986; Subject: Evaluation of Power and Control Cables, SONGS 1

7.6.18 Appendix A - 4kVTF Task No. 32

7.6.19 IEEE/ICEA S-135, Power Cable Ampacities, 1962

7.6.20 Appendix A - 4kVTF Task No. 41 - Identify Appropriate 480V Cracked Jacket Circuits for Sampling

7.6.21 Arrhenius Plot, dated April 23, 1968, Subject: Neoprene and Butyl

7.6.22 Calculation, Job No. 15691-795, dated May 7, 1986

7.6.23 Appendix A - 4kVTF Task No. 33

7.6.24 Appendix A - 4kVTF Task No. 54

7.6.25 Appendix A - 4kVTF Task No. 59

7.6.26 Appendix A - 4kVTF Task No. 51

7.6.27 Appendix A - 4kVTF Task No. 32

7.6.28 SONGS 1 - 5kV Cable Ampacities Calculation, Revision "O" dated April 4, 1986

7.6.29 SONGS 1 - Existing Cable Data - See Task No. 11

7.6.30 San Onofre Unit 1 4.16kV Cables Maximum Loading

7.6.31 Appendix A - 4kVTF Task No. 11

7.6.32 Appendix A - 4kVTF Task No. 25

7.6.33 Wyle Laboratories Test Report No. 57710-1 (Simplex, Okonite, and Anaconda Cable) dated December 30, 1985

7.6.34 Wyle Laboratories Test Report No. 53424 (Rome Cable) dated February 7, 1986

7.6.35 SCE Instrument and Test Procedure SO123-II-11.153

7.6.36 SCE Substation Test Manual

7.6.37 Calculation, 'C' Transformer Faulted Cable Temperature Profile dated May 5, 1986

7.6.38 Appendix A - 4kVTF Task No. 48

7.6.39 Letter, S. D. Root to C. K. Balog dated July 26, 1985; Subject: Environmental Qualification of Reactor Coolant Pump Electrical Penetrations, San Onofre Unit 1

7.6.40 EQ Document Package: High Voltage Power Electrical Penetration Assemblies (No. M38757)

7.6.41 Letter, R. D. Meininger to Chane Balog dated May 16, 1986; Re: RCP ECCAD Tests

7.6.42 Appendix A - 4kVTF Task No. 46

7.6.43 Office Memorandum, W. W. Steinke to C. K. Balog dated April 30, 1986; Subject: DC Hi-Pot Test of Non-Shielded Armored Power Cables and Trifurcators (Terminations)

7.6.44 Memo to W. Steinke from L. C. Callaway dated May 8, 1986; Subject: Hi-Pot of Cable for SONGS 1

7.6.45 Appendix A - 4kVTF Task No. 60

7.6.46 EQ Document Package - Galite Thermocouple Cable (SCE M38289)

7.6.47 EQ Document Package - Rockbestos Coaxial Cable (SCE M38295)

7.6.48 EQ Document Package - Brand Rex Coaxial Cable (SCE M38752)

7.6.49 EQ Document Package - Brand Rex Instrumentation, Power, and Control Cable (SCE M38762)

7.6.50 EQ Document Package - Anaconda Power and Control Cable (SCE M38763)

7.6.51 EQ Document Package - Simplex Power and Control Cable (SCE M38765)

7.6.52 EQ Document Package - Anaconda EP, EPR, FR-EP, Power and Control Cable and XPLE Instrumentation Cable (SCE M38767)

7.6.53 EQ Document Package - General Electric Power and Control Cable FR/XLP (SCE M38768)

7.6.54 EQ Document Package - Okonite Power and Control Cable (SCE M38769)

7.6.55 EQ Document Package - Rome Power and Control Cable (SCE M38771)

7.6.56 EQ Document Package - Rockbestos Firewall III Power and Control Cable (Post-1978) (SCE M38773)

7.6.57 EQ Document Package - Okonite Power and Control Cable (Post-1978) (SCE M39078)

7.6.56 EQ Document Package - Rockbestos Firewall III Power and Control Cable (Post-1978) (SCE M38773)

7.6.57 EQ Document Package - Okonite Power and Control Cable (Post-1978) (SCE M39078)

TABLES

SECTION 7.0

7.0 TABLE LISTING

TABLE 7-1

5kV CABLE TERMINATION LIST

EQUIPMENT	QC	CIRCUIT NO.	CABLE QUANTITY - SIZE - MANUFACTURER	SWITCHGEAR END		EQUIPMENT END			
				NO. TERMINATORS	REMARKS	NO. TERMINATORS	INDOOR	OUTDOOR	REMARKS
1. Transformer C "X" Winding to Bus 1C	NSR	1WA1C02P1 1WA1C02P2 1WA1C02P3 1AA1C02P4	4-3/C 750 MCM - Kerite	4	Replaced March, 1986	4	–	X	Replaced March, 1986 with Raychem heat shrink sleeve
2. Transformer C "Y" Winding to Bus 2C	NSR	1XA2C02P1 1XA2C02P2 1XA2C02P3 1XA2C02P4	4-3/C 750 MCM - Kerite	4	Replaced March, 1986	4	–	X	Replaced March, 1986 with Raychem heat shrink sleeve
3. Transformer A Feeder to Bus 1A	NSR	1NA1A04P1 1NA1A04P2 1NA1A04P3 1NA1A04P4	4-3/C 500 MCM - Kerite	4	Replaced March, 1986	4	–	X	Replaced March, 1986 with Raychem heat shrink sleeve
4. Transformer B Feeder to Bus 1B	NSR	1NA1B04P1 1NA1B04P2 1NA1B04P3 1NA1B04P4	4-3/C 500 MCM - Kerite	4	Replaced March, 1986	4	–	X	Replaced March, 1986 with Raychem heat shrink sleeve
5. Circulating Water Pump G-4B	NSR	1WA1C03P1	1-3/C 350 MCM - Simplex	1	—	1	X	–	Terminates to 3-1/C cables in termination box, no sleeve
	NSR	1WA1C03P2	3-1/C 350 MCM - Anaconda	3	Termination box	3	–	X	Conduit to motor terminal box, no sleeve
6. Circulating Water Pump G-4A	NSR	1XA2C03P1	1-3/C 350 MCM - Simplex	1	—		X	–	Terminates to 3-1/C cables in termination box, no sleeve
	NSR	1XA2C03P2	3-1/C 350 MCM - Anaconda	3	Termination box	3	–	X	Conduit to motor terminal box, no sleeve
7. Feedwater Pump G-3B	SR	1FA1C04P1 1FA1C04P2	2-3/C 350 MCM - Simplex	2	—	2	X	–	No sleeve
8. Feedwater Pump G-3A	SR	1GA2C04P1 1GA2C04P2	2-3/C 350 MCM - Simplex	2	—	2	X	–	No sleeve
9. Safety Injection Pump G-50B	SR	1FA1C05P1	1-3/C 4/0 AWG - Simplex	1	—	1	–	X	Sleeve to be opened at terminator
10. Safety Injection Pump G-50A	SR	1GA2C05P1	1-3/C 4/0 AWG - Simplex	1	—	1	–	X	Sleeve to be opened at terminator
11. Condensate Pump G-1D	NSR	1WA1C06P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve

TABLE 7-1

5kV CABLE TERMINATION LIST

EQUIPMENT	QC	CIRCUIT NO.	CABLE QUANTITY - SIZE - MANUFACTURER	SWITCHGEAR END NO. TERMINATORS	SWITCHGEAR END REMARKS	EQUIPMENT END NO. TERMINATORS	INDOOR	OUTDOOR	REMARKS
12. Condensate Pump G-1C	NSR	1WA1C08P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
13. Condensate Pump G-1B	NSR	1XA2C06P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
14. Condensate Pump G-1A	NSR	1XA2C08P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
15. Charging Pump G-8B	SR	1FA1C07P1	1-3/C 250 MCM - Anaconda	1	Replaced March, 1986 (DCP 3341.02)	1	X	–	Replaced March, 1986, conduit to motor terminal box
16. Charging Pump G-8A	SR	1GA2C07P1	1-3/C 250 MCM - Anaconda	1	Replaced March, 1986 (DCP 3009.05)	1	X	–	Replaced March, 1986, conduit to motor terminal box, no sleeve
17. Heater Drain Pump G-36B	NSR	1WA1C09P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
18. Heater Drain Pump G-36A	NSR	1XA2C09P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
19. Station Service Transformer No. 1 Feeder	SR	1FA1C10P1	3-1/C 750 MCM - Anaconda	3	Replaced, 1976	1	–	X	Replaced, 1976, cable in conduit, no sleeve
20. Station Service Transformer No. 3 Feeder	SR	1WA1C11P1	1-3/C 4/0 AWG - Simplex	1	—	1	–	X	Sleeve to be opened at terminator
21. Station Service Transformer No. 2 Feeder	SR	1GA2C10P1	1-3/C 4/0 AWG - Simplex	1	—	1	–	X	Sleeve to be opened at terminator
22. Station Service Transformer No. 3 Feeder	SR	1XA2C11P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	In Switchgear Room, no sleeve
23. Turbine Plant Cooling Water Pump G-6S	NSR	1WA1C12P1	1-3/C 4/0 AWG - Kerite	1	Replaced April, 1986	1	–	X	Replaced April, 1986, with Raychem heat shrink sleeve
24. Turbine Plant Cooling Water Pump G-6N	NSR	1XA2C12P1	1-3/C 4/0 AWG - Simplex	1	—	1	–	X	Repaired May 1986 - will be replaced next refueling outage
25. Lighting Transformer Normal	NSR	1WA1C13P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve
26. Lighting Transformer Standby	NSR	1XA2C13P1	1-3/C 4/0 AWG - Simplex	1	—	1	X	–	No sleeve

TABLE 7-1

5kV CABLE TERMINATION LIST

EQUIPMENT	QC	CIRCUIT NO.	CABLE QUANTITY - SIZE - MANUFACTURER	SWITCHGEAR END NO. TERMINATORS	SWITCHGEAR END REMARKS	EQUIPMENT END NO. TERMINATORS	EQUIPMENT END INDOOR	EQUIPMENT END OUTDOOR	EQUIPMENT END REMARKS
27. Switchyard Supply Transformer	NSR	1XA2C14P1	1-3/C 4/0 AWG - Simplex	1	—	-	-	-	Transformer removed, no termination
28. Diesel Generator No. 1 Exciter	SR	1FA1C14P1 1FA1C14P2 1FA1C14P3	9-1/C 750 MCM - Anaconda	9	In D.G. Building, replaced, 1976, no sleeves	9	X	-	Replaced, 1976, no sleeves
29. Diesel Generator No. 2 Exciter	SR	1GA2C15P1 1GA2C15P2 1GA2C15P3	9-1/C 750 MCM - Anaconda	9	In D.G. Building, replaced, 1976, no sleeves	9	X	-	Replaced, 1976, no sleeves
30. Diesel Generator No. 1	SR	1FA1C14P4 1FA1C14P5 1FA1C14P6 1FA1C14P7	12-1/C 750 MCM - Anaconda	12	Replaced, 1976	12	X	-	Replaced, 1976, no sleeves
31. Diesel Generator No. 2	SR	1GA2C15P5 1GA2C15P6 1GA2C15P7 1GA2C15P8	12-1/C 750 MCM - Anaconda	12	Replaced, 1976	12	X	-	Replaced, 1976, no sleeves
32. Spare Exciter	NSR	1WA1B01P1	1-3/C 500 MCM - Simplex	1	—	1	-	X	Sleeves to be opened at terminator
33. Exciter	NSR	1WA1B02P1	1-3/C 500 MCM - Simplex	1	—	1	X	-	No sleeve
34. Reactor Coolant Pump G-2B	NSR	1WA1B03P1 1WA1B03P2	2-3/C 500 MCM - Simplex	1	—	1	X	-	In Penetration termination box, no sleeve
		1NA1B03P3 1NA1B03P4	2-3/C 500 MCM - Simplex		In Containment Penetration termination box, no sleeve	1	X	-	In Containment, no sleeve
35. Reactor Coolant Pump G-2C	NSR	1WA1A01P1 1WA1A01P2	2-3/C 500 MCM - Simplex	1	—	1	X	-	In Penetration termination box, no sleeve
		1NA1A01P3 1NA1A01P4	2-3/C 500 MCM - Simplex	1	In Containment Penetration termination box, no sleeve	1	X	-	In Containment, no sleeve
36. Reactor Coolant Pump G-2A	NSR	1XA1A03P1 1XA1A03P2	2-3/C 500 MCM - Simplex	1	—	1	X	-	In penetration termination box, no sleeve
		1NA1A03P3 1NA1A03P4	2-3/C 500 MCM - Simplex	1	In Containment Penetration termination box, no sleeve	1	X	-	In Containment, no sleeve

EQUIPMENT DATA AND TRENDING SUMMARY

COMPONENT ID	DESCRIPTION	Date	Date 1/31	Date 3/2	Date 7/6	Date 8/20	Date 10/15	Date	Date	Date	Date	Date	Date	Date
		MWe	MWe 417	MWe 292	MWe 240	MWe /	MWe 400	MWe	MWe	MWe	MWe	MWe	MWe	MWe
		CHARGING PUMP ROOM (Continued)												
VCC-TI-1404	North Charging Pump Oil Cooler Inlet		122	126	102									
VCC-PI-1402	North Charging Pump Oil Pressure		10	9	0									
CCW-FIC-609A	North Charging Pump CCW Flow		*8½	15	215		15							
VCC-LG-1400	North Charging Pump Oil Level		½	1/2	1/2		1/2							
VCC-TI-1402	North Charging Pump Outboard Bearing		124	126	166									
VCC-PI-1400	North Charging Pump Oil Cooler Outlet		14	14	0									
VCC-TI-1400	North Charging Pump Oil Cooler Outlet		104	109	102									
		FILTER VAULT ROOM												
LDS-PI-1107B	RCS Filter Inlet			21	26		30							
LDS-PI-1107C	RCS Filter Outlet			23	26		29							
LDS-PI-1107A	Letdown Pressure			38	49		58							
		CONTROL ROOM - DG No. 1												
DFS-LI-14A	Diesel Fuel Stor. Tk. Level		84	81			82							
DG1-JI-100	Generator Vars					3000	3000							
DG1-II-101A	Field Current					250	250							
DG1-EI-102A	Field Voltage					100	99							
DG1-JI-101	Gen. Megawatts					4500	4.5							
DG1-II-100A	Gen. Current A Phase					700	.69							
DG1-II-100B	Gen. Current B Phase					720	.71							
DG1-II-100C	Gen. Current C Phase					730	.71							
DG1-EI-100A	Gen. Voltage					4400	4.35							
DG1-SI-102	Gen. Frequency					60	60							
DG1-SI-103	4kV Bus Running Freq.						60							
DG1-EI-101	4kV Bus Running Volts						43							

*Broken

1985

EQUIPMENT DATA AND TRENDING SUMMARY

COMPONENT ID	DESCRIPTION	Date 3/2	Date 6/1	Date 7/5	Date 8/6	Date 9/3	Date 10/15	Date	Date	Date	Date	Date	Date	Date
		292 MWe	403 MWe	230 MWe	— MWe	— MWe	401 MWe	MWe	MWe	MWe	MWe	MWe	MWe	MWe
	CONTROL ROOM - DG No. 2													
DFN-LI-15A	Diesel Fuel Stor. Tk. Level	80	83				84							
DG2-JI-110	Generator Vars				2700	2650								
DG2-II-121A	Field Current				247	246								
DG2-EI-122A	Field Voltage				97	97								
DG2-JI-111	Generator Megawatts				4500	4450								
DG2-II-120A	Gen. Current A Phase				67	64								
DG2-II-120B	Gen. Current B Phase				70	68								
DG2-II-120C	Gen. Current C Phase				68	67								
DG2-EI-120A	Gen. Voltage				4450	4400								
DG2-SI-112	Gen. Frequency				59.9	60								
DG2-SI-113	4kV Bus Running Freq.													
DG2-EI-121	4kV Bus Running Volts													
	CONTROL ROOM - SOUTH VERTICAL BOARD													
	System Voltage	219	226	226			227							
	System Frequency	60	60	60			60							
	220kV E. Bus Kilovolts	218	229	230			227							
	220kV E. Bus Frequency	60	60	60			59.9							
	Incoming Volts		117	117			117							
	Running Volts		113	113			112							
	Incoming Frequency		60	61.2			60							
	Running Frequency		60	61.6			60							
	220kV W. Bus Kilovolts	221	228	230			227							
	220kV W. Bus Frequency	60.1	60	60			60.05							
	Turbine RPM	1800	1800	1800			1800							
	Generator Gross MW	392	560	311			401							

1985

EQUIPMENT DATA AND TRENDING SUMMARY

CONTROL ROOM - SOUTH VERTICAL BOARD (Continued)

COMPONENT ID.	DESCRIPTION	3/2 Date	6/1 Date	7/5 Date	10/12 Date	Date	Date	Date	Date	Date	Date	Date	Date	Date
		292 MWe	403 MWe	230 MWe	401 MWe	MWe	MWe	MWe	MWe	MWe	MWe	MWe	MWe	MWe
	Interchange MW	750	1.5	75	10									
	Main Transformer Neutral K Amps		.005	005	005									
	4kV Bus 1A kV	4.42	4.45	4.5	4490									
	4kV Bus 1A Ground Percent	0	0	0	0									
	4kV Bus 1B kV	4.28	4.3	4.3	4300									
	4kV Bus 1B Ground Percent	0	0	0	<0									
	Aux. Trans. A&B Megawatts	7.7	7.7	7.5	7.5									
	Aux. Trans. A Kiloamps	7.3	7.2	.71	7									
	Aux. Trans. B Kiloamps	5.5	5.5	.5	.53									
	4kV 1A 1C Bus Tie Kiloamps	.05		.05	.05									
	4kV 1B 2C Bus Tie Kiloamps	0		0	0									
	AC Volts 480V Whse Bus			005	005									
	Percent 480V Whse Bus Ground			005	005									
	4kV SW Yard Supply Amps		0	0	<0									
	4kV Bus 1C kV	4.05	4.15	4.2	4150									
	4kV Bus 1C Ground Percent	0	.01	0	.1									
	4kV Bus 2C kV	4.15	4.28	4.3	4250									
	4kV Bus 2C Ground Percent	0	.01	0	0									
	Aux. Transformer "C" MW	9.5	12.1	10	11									
	Aux. Trans. CX Kiloamps	7.6	.97	.78	.99									
	Aux. Trans. CY Kiloamps	8.2	.97	.7	.99									
	Station Service Trans 1 Amps	180	125	135	95									
	Station Service Trans 2 Amps	120	117	115	127									
	Station Service Trans 3 Amps	55	38	100	80									
	Station Service Trans 3 Amps			0	0									
	480V Bus 1 Volts	455	470	470	469									

(1)

TABLE 7-3

SAN ONOFRE UNIT I 4.16-KV CABLES MAX. LOADING

FROM	POS.	TO	SIZE TYPE *	LENGTH(FT)	IMPEDANCE (OHMS) R	X	MAX. LOAD (AMPERES) (AT 4.16 KV)	
4.16-KV BUS 1A	1	REACTOR COOLANT P.C	2- 500MM3	102	0.00150	0.00152	540	
4.16-KV BUS 1A	3	REACTOR COOLANT P.A	2- 500MM3	248	0.00365	0.00371	540	
4.16-KV BUS 1A	4	AUX TRANSF.1A	4- 500MM3	284	0.00209	0.00212	1943	(14 MVA 65°C FA Rating)
4.16-KV BUS 1B	1	SPARE EXCITER	1- 500MM3	172	0.00506	0.00514	292	
4.16-KV BUS 1B	2	EXCITER	1- 500MM3	237	0.00697	0.00709	292	
4.16-KV BUS 1B	3	REACTOR COOLANT P.B	2- 500MM3	113	0.00166	0.00169	540	
4.16-KV BUS 1B	4	TRANSFORMER 1B	4- 500MM3	274	0.00201	0.00205	1943	(14 MVA 65°C FA Rating)
4.16-KV BUS 1C	1	TIE TO BUS 1A	2- 500MM3	0	0.0	0.0	1111	[1943 – [540 + 292]]
4.16-KV BUS 1C	2	TRANSFORMER C	4- 750MM3	391	0.00209	0.00278	2332	(16.8 MVA 65°C Rating)
4.16-KV BUS 1C	03	CIRC WATER PUMP B	1- 350MM3	255	0.01033	0.00796	209	
4.16-KV BUS 1C	04	FEEDWATER PUMP B	2- 350MM3	100	0.00202	0.00156	409	
4.16-KV BUS 1C	05	SAFETY INJECTION P,	1- 4/0MM3	347	0.02131	0.01156	85	
4.16-KV BUS 1C	06	CONDENSATE PUMP D	1- 4/0MM3	282	0.01731	0.00939	86	
4.16-KV BUS 1C	07	CHARGING PUMP B	1- 4/0MM3	337	0.02069	0.01122	72	
4.16-KV BUS 1C	08	CONDENSATE PUMP C	1- 4/0MM3	252	0.01547	0.00839	86	
4.16-KV BUS 1C	09	HEATER DRAIN PUMP B	1- 4/0MM3	211	0.01296	0.00703	70	
4.16-KV BUS 1C	10	SERVICE TRANSF.1	1- 4/0MM3	120	0.00737	0.00400	194	(1400 KVA 65°C OA Rating)
4.16-KV BUS 1C	11	SERVICE TRANSF.3	1- 4/0MM3	335	0.02057	0.01116	194	(1400 KVA 65°C OA Rating)
4.16-KV BUS 1C	12	COOLING PUMP G6S	1- 4/0MM3	402	0.02468	0.01339	40	
4.16-KV BUS 1C	13	LTG. TRANSF. NORMAL	1- 4/0MM3	309	0.01897	0.01029	55	
4.16-KV BUS 1C	14	EMER DIESEL GEN. 1	4- 750MM3	730	0.00391	0.00518	1041	
4.16-KV BUS 2C	1	TIE TO BUS 1B	4- 750MM3	0	0.0	0.0	863	(1943 – (540 + 540))
4.16-KV BUS 2C	2	TRANSFORMER C	4- 750MM3	374	0.00200	0.00266	2332	(16.8 MVA 65°C Rating)

* Legend: MM3 = 3ϕ cable – Medium Voltage Cable in Magnetic conduit or tray

PSR 3-21-86

(2)

SAN ONOFRE UNIT 4-16-KV CABLES MAX. LOADING

FROM	POS. TO	SIZE TYPE *	LENGTH(FT)	IMPEDANCE (OHMS) R	X	MAX. LOAD (AMPERES) (AT 4.16-KV)	
4.16-KV BUS 2C	03 CIRC WATER PUMP A	1- 350MM3	248	0.01004	0.00774	209	
4.16-KV BUS 2C	04 FEEDWATER PUMP A	2- 350MM3	89	0.00180	0.00139	409	
4.16-KV BUS 2C	05 SAFETY INJECT. P. A	1- 4/0MM3	260	0.01596	0.00866	85	
4.16-KV BUS 2C	06 CONDENSATE PUMP B	1- 4/0MM3	204	0.01253	0.00679	86	
4.16-KV BUS 2C	07 CHARGING PUMP A	1- 4/0MM3	387	0.02376	0.01289	72	
4.16-KV BUS 2C	08 CONDENSATE PUMP A	1- 4/0MM3	169	0.01038	0.00563	86	
4.16-KV BUS 2C	09 HEATER DRAIN PUMP A	1- 4/0MM3	99	0.00608	0.00330	70	
4.16-KV BUS 2C	10 SERVICE TRANSF. 2	1- 4/0MM3	249	0.01529	0.00829	194	(1400 kVA 65°C OA Rating)
4.16-KV BUS 2C	11 SERVICE TRANSF. 3	1- 4/0MM3	335	0.02057	0.01116	194	(1400 kVA 65°C OA Rating)
4.16-KV BUS 2C	12 COOLING PUMP G6N	1- 4/0MM3	326	0.02002	0.01086	40	
4.16-KV BUS 2C	13 LTG TRANSF STAND BY	1- 4/0MM3	183	0.01124	0.00609	55	
4.16-KV BUS 2C	14 WAREHOUSE SWYD FEED	1- 4/0MM3	675	0.04144	0.02248	VACANT	(To be connected to 3rd Aux FW
4.16-KV BUS 2C	15 EMER DIESEL GEN. 2	4- 750MM3	730	0.00391	0.00518	1041	

* Legend: MM3 = 3-φ Cable - Medium voltage in Magnetic conduit or tray

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER		REMARKS
A. Bus 1C												
#11C02	Transformer C "X" Winding to Bus 1C	19kV (P)	NSR	1WA1C02P1	3/C 750 MCM —	391	391	—	—	Simplex		Simplex cable replaced with Kerite cable, March, 1986 Simplex cable P4 failed in service phase-to-phase ground, November, 1985. Hi-Pot test data in MO #85121064000
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P1	3/C 750 MCM R					Kerite		
		13kV (F)	NSR	1WA1C02P2	3/C 750 MCM —	391				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P2	3/C 750 MCM R					Kerite		
		19kV (F)	NSR	1WA1C02P3	3/C 750 MCM —	391				Simplex		
	(Replacement Cable)	36kV (9)	NSR	1WA1C02P3	3/C 750 MCM R					Kerite		
		3kV (F)	NSR	1WA1C02P4	3/C 750 MCM —	391				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1WA1C02P4	3/C 750 MCM R					Kerite		
#11C03	Circulating Water Pump G-4B	28kV (P)	NSR	1WA1C03P1	3/C 350 MCM NR	255	255	—	—	Simplex	Indoor	B/M BSO-3008 12-10-64
		28kV (P)	NSR	1NA1C03P2	1/C 350 MCM NR (3)	279	—	93	—	Anaconda	Outdoor	B/M BSO-3006 12-01-64
*11C04	Feedwater Pump G-3B	28kV (P)	SR	1FA1C04P1	3/C 350 MCM NR	200	200	—	—	Simplex		B/M BSO-3008 12-10-64
		28kV (P)	SR	1FA1C04P2	3/C 350 MCM NR	200				Simplex		

* DCP 3420.00BE (To replace 4kV Simplex cable for SR circuits, if required)
# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
*/#11C05	Safety Injection Pump G-50B	28kV (P)	SR	1FA1C05P1	3/C 4/0 AWG NR	347	347	—	—	Simplex	B/M BSO-3008 12-10-64
11C06	Condensate Pump G-1D	28kV (P)	NSR	1WA1C06P1	3/C 4/0 AWG NR	282	282	—	—	Simplex	B/M BSO-3008 12-10-64
11C07	Charging Pump G-8B	28kV (P)	SR	1FA1C07P1	3/C 4/0 AWG —	337	337	—	—	Simplex	Simplex cable replaced with Anaconda cable by DCP 3341.02
	(Replacement Cable)	36kV (P)	SR	1FA1C07P1	3/C 250 MCM R	—	—	—	—	Anaconda	
11C08	Condensate Pump G-1C	28kV (P)	NSR	1WA1C08P1	3/C 4/0 AWG NR	252	252	—	—	Simplex	B/M BSO-3008 12-10-64
11C09	Heater Drain Pump G-36B	28kV (P)	NSR	1WA1C09P1	3/C 4/0 AWG NR	211	211	—	—	Simplex	B/M BSO-3008 12-10-64
#11C10	Station Service Transformer No. 1 Feeder	28kV (P)	SR	1FA1C10P1	1/C 750 MCM R (3)	360	110	10	—	Anaconda	Procured under specification S023-304-8
*/#11C11	Station Service Transformer No. 3 Feeder	28kV (P)	SR	1WA1C11P1	3/C 4/0 AWG NR	276	276	—	—	Simplex	B/M BSO-3008 12-10-64

* DCP 3420.00BE
# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
#11C12	Turbine Plant Cooling Water Pump G-6S	0kV (F) 28kV (P)	NSR	1WA1C12P1	3/C 4/0 AWG —	402	402	—	—	Simplex	Simplex Cable replaced with Kerite cable, March 1986. Cable in O-Z termination failed initial Hi-Pot at starting voltage
	(Replacement Cable)	36kV (P)	NSR	1WA1C12P1	3/C 4/0 AWG R					Kerite	MO #86032395000
11C13	Lighting Transformer Normal	28kV (P)	NSR	1WA1C13P1	3/C 4/0 AWG NR	309	309	—	—	Simplex	B/M BSO-3008 12-10-64
11C14	Diesel Generator No. 1 Exciter	28kV (P)	SR	1FA1C14P1	1/C 750 MCM R	243	81	—	—	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1FA1C14P2	1/C 750 MCM R	243				Anaconda	
		28kV (P)	SR	1FA1C14P3	1/C 750 MCM R	243				Anaconda	
11C14	Diesel Generator No. 1	28kV (P)	SR	1FA1C14P5	1/C 750 MCM R	1812	—	—	604	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1FA1C14P6	1/C 750 MCM R	1812			604	Anaconda	
		28kV (P)	SR	1FA1C14P7	1/C 750 MCM R	1812			604	Anaconda	
		28kV (P)	SR	1FA1C14P8	1/C 750 MCM R	1812			604	Anaconda	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER		REMARKS
B. Bus 2C												
#12C02	Transformer C "Y" Winding to Bus 2C	19kV (P)	NSR	1XA2C02P1	3/C 750 MCM —	374	374	—	—	Simplex		Simplex cable replaced with
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P1	3/C 750 MCM R					Kerite		Kerite cable, March, 1986
		19kV (P)	NSR	1XA2C02P2	3/C 750 MCM —	374				Simplex		Simplex cable Hi-Pot test data in
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P2	3/C 750 MCM R					Kerite		MO #85121064000
		19kV (P)	NSR	1XA2C02P3	3/C 750 MCM —	374				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P3	3/C 750 MCM R					Kerite		
		19kV (P)	NSR	1XA2C02P4	3/C 750 MCM —	374				Simplex		
	(Replacement Cable)	36kV (P)	NSR	1XA2C02P4	3/C 750 MCM R					Kerite		
#12C03	Circulating Water Pump G-4A	28kV (P)	NSR	1XA2C03P1	3/C 350 MCM NR	248	248	—	—	Simplex	Indoor	B/M BSO-3008 12-10-64
		28kV (P)	NSR	1XA2C03P2	1/C 350 MCM NR (3)	279	—	93	—	Anaconda	Outdoor	B/M BSO-3006 12-01-64
*12C04	Feedwater Pump G-3A	28kV (P)	SR	1GA2C04P1	3/C 350 MCM NR	89	89	—	—	Simplex		B/M BSO-3008 12-10-64
		28kV (P)	SR	1GA2C04P2	3/C 350 MCM NR	89				Simplex		

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
*/#12C05	Safety Injection Pump G-50A	28kV (P)	SR	1GA2C05P1	3/C 4/0 AWG NR	268	268	—	—	Simplex	B/M BSO-3008 12-10-64
12C06	Condensate Pump G-1B	28kV (P)	NSR	1XA2C06P1	3/C 4/0 AWG NR	204	204	—	—	Simplex	B/M BSO-3008 12-10-64
12C07	Charging Pump G-8A	28kV (P)	SR	1GA2C07P1	3/C 4/0 AWG —	387	387	—	—	Simplex	Simplex cable replaced with Anaconda cable by DCP 3009.05
	(Replacement Cable)	36kV (P)	SR	1GA2C07P1	3/C 250 MCM R	—	—	—	—	Anaconda	
12C08	Condensate Pump G-1A	28kV (P)	NSR	1XA2C08P1	3/C 4/0 AWG NR	169	169	—	—	Simplex	B/M BSO-3008 12-10-64
12C09	Heater Drain Pump G-36A	28kV (P)	NSR	1XA2C09P1	3/C 4/0 AWG NR	99	99	—	—	Simplex	B/M BSO-3008 12-10-64
*/#12C10	Station Service Transformer No. 2 Feeder	28kV (P)	SR	1GA2C10P1	3/C 4/0 AWG NR	249	249	—	—	Simplex	B/M BSO-3008 12-10-64
*12C11	Station Service Transformer No. 3 Feeder	28kV (P)	SR	1XA2C11P1	3/C 4/0 AWG NR	59	59	—	—	Simplex	B/M BSO-3008 12-10-64

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
#12C12	Turbine Plant Cooling Water Pump G-6N	25kV (F) 28kV (P)	NSR	1XA2C12P1	3/C 4/0 AWG NR	326	326	—	—	Simplex	B/M BSO-3008 12-10-64. Cable injulation repaired under terminator May 1986. Replacement cable ordered.
12C13	Lighting Transformer Standby	28kV (P)	NSR	1XA2C13P1	3/C 4/0 AWG NR	181	181	—	—	Simplex	B/M BSO-3008 12-10-64
#12C14	Switchyard Supply Transformer	28kV (P)	NSR	1XA2C14P1	3/C 4/0 AWG NR	675	—	—	675	Simplex	Abandoned - breaker to be used for 3rd AFW Pump
12C15	Diesel Generator No. 2 Exciter	28kV (P)	SR	1GA2C15P1	1/C 750 MCM R	243	81	—	—	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1GA2C15P2	1/C 750 MCM R	243	81	—	—	Anaconda	
		28kV (P)	SR	1GA2C15P3	1/C 750 MCM R	243	81	—	—	Anaconda	
12C15	Diesel Generator No. 2	28kV (P)	SR	1GA2C15P5	1/C 750 MCM R	705	—	—	705	Anaconda	Procured in 1975 under Specification S023-304-8 (P.O. D8200002)
		28kV (P)	SR	1GA2C15P6	1/C 750 MCM R	705	—	—	705	Anaconda	
		28kV (P)	SR	1GA2C15P7	1/C 750 MCM R	710	—	—	710	Anaconda	
		28kV (P)	SR	1GA2C15P8	1/C 750 MCM R	710	—	—	710	Anaconda	

* DCP 3420.00BE
# Terminations outdoors
(P) PASSED
(F) FAILED
0135CKB

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
C. Bus 1A											
11A01	Reactor Coolant Pump G-2C		NSR	1WA1A01P1	3/C 500 MCM NR	102	107	——	——	Simplex	B/M BSO-3008 12-10-64
			NSR	1WA1A01P2	3/C 500 MCM NR	107	161			Simplex	
			NSR	1NA1A01P3	3/C 500 MCM NR	107	107	——	——	Simplex	B/M BSO-3008 12-10-64
			NSR	1NA1A01P4	3/C 500 MCM NR	107				Simplex	
11A03	Reactor Coolant Pump G-2A		NSR	1XA1A03P1	3/C 500 MCM NR	248	248	——	——	Simplex	B/M BSO-3008 12-10-64
			NSR	1XA1A03P2	3/C 500 MCM NR	248	161			Simplex	
			NSR	1NA1A03P3	3/C 500 MCM NR	76	76	——	——	Simplex	
			NSR	1NA1A03P4	3/C 500 MCM NR	76				Simplex	
#11A04	Transformer A Feeder to Bus 1A	28kV (P)	NSR	1NA1A04P1	3/C 500 MCM —	284	284	——	——	Simplex	Simplex cable replaced with Kerite cable, March, 1986
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P1	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P2	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P2	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P3	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P3	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1A04P4	3/C 500 MCM —	284				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1A04P4	3/C 500 MCM R					Kerite	

* DCP 3420.00BE
# Terminations outdoors
(P) PASSED
(F) FAILED

TABLE 7-4

5kV CABLE

FEEDER BREAKER	DESCRIPTION	Hi-Pot Test	QC	CIRCUIT	CABLE	LENGTH (FEET)	RACEWAY (FEET) T	C	U/G	CABLE MANUFACTURER	REMARKS
D. Bus 1B											
#11B01	Spare Exciter	28kV (P)	NSR	1WA1B01P1	3/C 500 MCM NR	172	172	—	—	Simplex	B/M BSO-3008 12-10-64
11B02	Exciter	28kV (P)	NSR	1WA1B02P1	3/C 500 MCM NR	237	237	—	—	Simplex	B/M BSO-3008 12-10-64
11B03	Reactor Coolant Pump G-2B		NSR	1WA1B03P1	3/C 500 MCM NR	108	113	—	—	Simplex	B/M BSO-3008 12-10-64
			NSR	1WA1B03P2	3/C 500 MCM NR	113	161			Simplex	
			NSR	1NA1B03P3	3/C 500 MCM NR	106	106	—	—	Simplex	
			NSR	1NA1B03P4	3/C 500 MCM NR	106				Simplex	
#11B04	Transformer B Feeder to Bus 1B	5kV (F) 28kV (P)	NSR	1NA1B04P1	3/C 500 MCM —	274	274	—	—	Simplex	Simplex cable replaced with Kerite cable, March, 1986 Hi-Pot test data in MO #86020663000 cable P1 failed at 5kV, then passed after O-Z termination at XFMR was removed
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P1	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P2	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P2	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P3	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P3	3/C 500 MCM R					Kerite	
		28kV (P)	NSR	1NA1B04P4	3/C 500 MCM -	274				Simplex	
	(Replacement Cable)	36kV (P)	NSR	1NA1B04P4	3/C 500 MCM R					Kerite	

* DCP 3420.00BE
\# Terminations outdoors
(P) PASSED
(F) FAILED
0135CKB

ATTACHMENTS TO SECTION 7.0

7.0 ATTACHMENT LISTING

7-1 Shop Services and Instrumentation Division Application Test Report

7-2 OZ Terminator Examination (Sample 23A)

7-3 OZ Terminator Examination (Sample 16B)

7-4 Raychem Heat Shrink Terminator Boot (NHVT) Literature

7-5 5kV Simplex Cable Construction (Cross-section)

7-6 List of Cable Types at San Onofre Unit 1

ATTACHMENT NO. 7-1

Shop Services and Instrumentation Division

Application Test Report

Wolfgang Steinke

Engineering Division

SUBJECT: DC Dielectric Test of 5kV Cable Terminations from San Onofre Nuclear Generating Station, Unit 1

Purpose of Test:

Subject three samples to an increasing DC voltage until insulation breakdown occurs,

Test Equipment:

110kV DC Biddle Hipot Test Set,

Biddle Handcrank Megger

ATTACHMENT NO. 7-1

(Continued)

Test Procedure:

After all short ends of cable samples were stripped of their outer insulating jackets, each sample was suspended from a crane by non-conductive dacron string. All three spades on each sample bonded together with copper wire. Applied Station ground was to metal coupling.

Using a portable DC hi-potential test set all three samples were stressed as follows:

1. Raised voltage to 50kV DC and held for five minutes.

2. From 50kV DC increased voltage in 10kV steps holding each step for five minutes until failure occurred.

After each sample failed, cable failed with a megger insulation tester.

Test Results:

1. All samples withstood the routine dielectric test voltage of 29kV DC to ground.

2. Insulation breakdown occurred between 80 and 120kV DC.

NOTE: See attached sheets for test measurements and diagrams.

ATTACHMENT NO. 7-1

(Continued)

All questions regarding this report should be directed to Mr. Robert Peck at PAX 46131.

(original signed)

ROBERT PECK
Apparatus Test Supervisor

Tested By: Gilbert Lemos
Harold Yoshimura

Witnessed By: Wolfgang W. Steinke
Engineering Division
G.O. 3

ATTACHMENT NO. 7-1

(Continued)

TEST MEASUREMENTS

Sample #1

Hi-POT Test:

kVDC	uA@5 min.
50	6.5
60	9.5
70	13.5
80	18 * Failure occurred at three minutes into test @ 80kV

Megger Results: (each phase to ground)

AØ = 20 Megohm (failed)

BØ = N/A

CØ = N/A

ATTACHMENT NO. 7-1

(Continued)

TEST MEASUREMENTS

Sample #3

Hi-POT Test:

kVDC	uA@5 min.
50	250
60	275
70	300
80	315
90	375 *Failure occurred at one minute into test @ 90kV

Megger Results:

AØ = 6 Megohm (failed)

BØ =

CØ =

ATTACHMENT NO. 7-1

(Continued)

TEST MEASUREMENTS

Sample #4

Hi-POT Test:

kVDC	uA@5 min.
50	.9
60	2.25
70	9
80	14
90	19
100	26
110	34
120	41.5 *Failure occurred at one minute into test @ 120kV

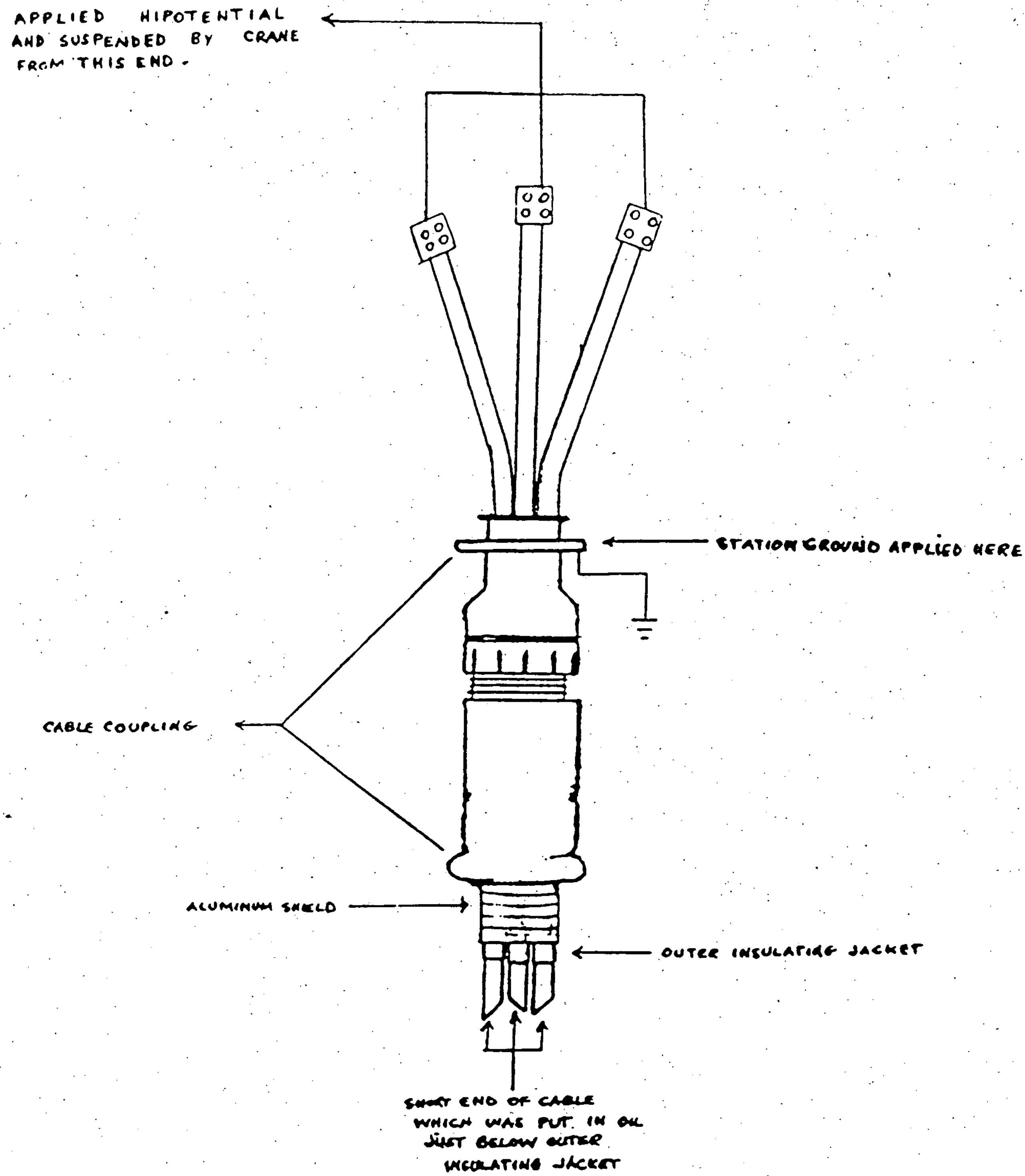
Megger Results:

AØ = .8Megohm (failed)

BØ =

CØ =

ATTACHMENT NO. 7-1
(Continued)



ATTACHMENT 7-2

SUBJECT: OZ Terminator Examination, Samples 23A Visual and Microscopic Examination

REFERENCE: OZ Terminator Examination 16B, dated April 4, 1986

There were two Hi-POT failures on OZ terminations - Sample 16B at 9kV and Sample 23A at 19kV. The conclusions reached in the reference reports continue to be valid.

The examination of Samples 23A and companion phases 23B and 23C revealed considerable wetness between the insulation and jacket on the individual conductors, extending at least 6 inches above the top of the terminator and down into the fitting's sealing bushing. In this instance, the interface between the insulation and jacket below the sealing bushing was dry.

The actual 19kV Hi-POT puncture in Sample 23A was located 6" above the mechanical clamp of the OZ terminator. It was a direct puncture with some overheating (porosity) in the neoprene jacket immediately at the puncture location. This same area had a ripple effect from mechanical compression from an excessive clamping action at the OZ device, severely reducing the insulation thickness under the armor on all three conductors. The measured remaining wall was one third of normal (60 mils) at the worst section.

In addition to the moisture ingress, the severity of the mechanical clamping further compromised the electrical integrity of the cable and terminator assembly.

This Sample 23A, B, and C from the TCPW line will be retained until the completion of the 4kV TF responsibilities.

ATTACHMENT 7-3

SUBJECT: OZ Terminator Examination - Sample 16B - Type "SPKT"
Hi-Pot Puncture, Cable 1 at Auxiliary Transformer B

REFERENCE: A) March 26, 1986 Material Condition Review - Preliminary Team Report by A. Jurszewicz, et al.

B) OZ Terminator Examination - Sample 23A dated April 4, 1986

<u>CABLE DESCRIPTION</u>: Three - 1/c 500 kcmil (37) tinned copper, semi-conductive extruded layer bonded to 172 mil of butyl insulation, with 63 mil of neoprene jacket. (Each 28" in length which includes OZ area.)

The OZ terminator, type "SPKT" is designed for jacketed metal clad cables. In this instance, the termination was located outdoors at Auxiliary Transformer B. The cable was of aluminum interlock outer construction without an overall jacket. To provide for water penetration protection since the cable was not jacketed, an oversize overall sleeve was used covering the armor from the vertical entrance at the Transformer Compartment onto the horizontal section of the tray run. This procedure was ineffective as condensate collected at the bottom of the boot.

The Hi-Pot Test Voltage at breakdown was reported at 9kV. This low value indicates that a major portion of the insulating system had been compromised. The factors to be considered are: Moisture penetration into the OZ fitting bringing "Ground" into the area of the pin-hole leak and mechanical disruption which weakened the insulating system. Another concern is the electrical stress distortion due to the long-term moisture penetration that would contribute to a lower DC voltage strength for the insulating system. It should be noted that once water is present within the outer sleeve, there is no other effective moisture seal into the OZ terminator. All the above factors were in evidence.

Examination revealed a pin-hole puncture on one of the single conductors approximately one inch from the deformed area at the sealing bushing within the terminator body. Both the insulation and jacket materials are pliable and generally in good physical condition.

The 9kV puncture on Hi-POT test was initiated outside of the Neoprene Jacket and progressed inwardly to the copper conductor. This indicates a more severe electrical stress pattern on the outside of the insulation which would be expected with ingress of moisture along the cable insulation/jacket/filling compound interfaces.

ATTACHMENT 7-3
(Continued)

Another observation was the just perceptible "lifting" of the insulation system from the conductor on either side of the compressed area under the OZ Sealing Bushing. This, however, was not involved in the Hi-POT puncture. Other observations for the record are noted below:

There was moisture between the neoprene and butyl insulation extending from 9 inches above the OZ Sealing Bushing to 3 inches below the Bushing. This is towards the terminal lug inside the compartment. Removing the neoprene jacket during examination showed areas of looseness. Discharge was evident at the sealing bushing between the insulation and jacket.

It is evident that the cause of the problem in the OZ terminator is the long-term presence of moisture. Once the cable/fitting interfaces are "wet," they are compromised and should be scheduled to be replaced to return the circuit integrity to its original level.

Routine Hi-Pot testing at the standard of 28kV DC should be done at least every refueling cycle, but replacement is recommended of all outdoor OZ terminations used on bare interlocked armor cables. Any replacement cables should have protective jacket and the entrance into the inverted OZ terminator sealed to this jacket. This is the approach being taken on replacement cable/OZ terminators for auxiliary transformers A, B, and C.

Indoor OZ terminators should be dry, but if there is evidence of corrosion of the aluminum interlock at the OZ fitting, then the above recommendations apply.

The sample will be retained until the 4 kV T.F. program has been completed and then disposed. Sample 16B is from the cable with the OZ Terminator from auxiliary Transformer B - Cable #1.

Raychem

NHVT

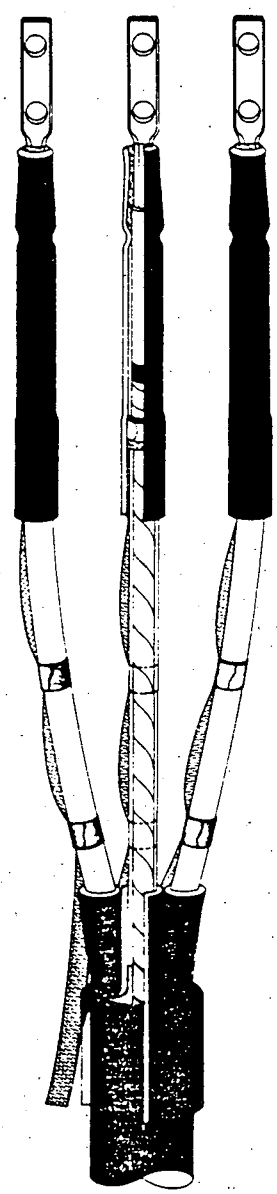
Nuclear High Voltage Termination

3/C Shielded Cables 5-15kV
(Without Ground Wires)

Selection Guide

1. NHVT kits are designed to properly terminate and environmentally seal shielded, medium voltage, indoor power cable terminals rated to 15kV. These functions are performed by heat shrinkable stress control tubing, heat shrinkable non-tracking tubing, and the red nuclear grade adhesive.

2. NHVT kits have been qualification tested for Class IE service on indoor terminations, including 40 year aging and radiation resistance, in normal service conditions where design basis event performance is not a requirement.



How to specify

To order an NHV termination simply specify the prefix, the type letter (for indoor) the voltage range letter and cable range number, and if required, cable accessory number. **™Anaconda

Example

NHVT-3-I-A-02-00

00 = Standard termination kit
11 = Termination for use on Unishield** type cable
GO = For copper tape, non-solder grounding clamp and strap accessory kit

Kit size ranges
Insulation class
Phase to phase
A/01 = 5kV
A = 8.7
B = 15
I = indoor
3 = 3 Conductor
Prefix

Kit Number	Minimum Dia. over Primary Insulation (Inches)	Maximum Dia. over Shielding Layer (Inches)	Dia. over Cable Jacket Min. (Inches)	Max.	Min. Connector Lug Barrel O.D. (Inches)
NHVT-3-I-A/01-01-00	0.42	0.60	.90	2.25	0.40
NHVT-3-I-A-02-00	0.42	0.60	1.125	3.00	0.40
NHVT-3-I-A/01-12-00 NHVT-3-I-A-12-00 NHVT-3-I-B-12-00	0.59	0.87	1.125	3.00	0.50
NHVT-3-I-B-22-00	0.80	1.05	1.20	3.00	0.65
NHVT-3-I-A/01-23-00 NHVT-3-I-A-23-00 NHVT-3-I-B-23-00	0.80	1.20	2.30	4.65	0.65
NHVT-3-I-A/01-33-00 NHVT-3-I-A-33-00 NHVT-3-I-B-33-00	1.15	1.65	2.30	4.65	0.90

Raychem

NHVT

Nuclear High Voltage Termination

1/C Shielded Cables 5-15kV
Selection Guide

1. NHVT kits are designed to properly terminate and environmentally seal shielded, medium voltage, indoor power cable terminals rated to 15kV. These functions are performed by heat shrinkable stress control tubing, heat shrinkable non-tracking tubing, and the red nuclear grade adhesive.

2. NHVT kits have been qualification tested for Class IE service on indoor terminations, including 40 year aging and radiation resistance, in normal service conditions where design basis event performance is not a requirement.

How to specify

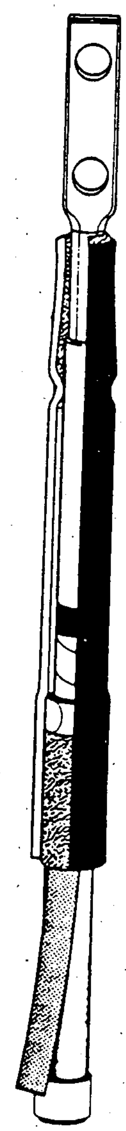
To order an NHV termination simply specify the prefix, the type letter (for indoor) the voltage range letter and cable range number, and if required, cable accessory number. **™Anaconda

Example

NHVT-I-A-2-00

00 = Standard termination kit
11 = Termination for use on Unishield** type cable
G0 = For copper tape, non-solder grounding clamp and strap accessory kit

Kit size ranges
Insulation class
Phase to phase
A/01 = 5kV
A = 8.7
B = 15
I = indoor
Prefix



SELECTION FOR COPPER TAPE OR WIRE SHIELDED CABLES

Catalog Number	Minimum diameter over primary insulation (Inches)	Maximum diameter over cable jacket (Inches)	Minimum connector barrel diameter (Inches)
NHVT-I-A/01-0-00 NHVT-I-A-0-00	0.42	0.80	0.40
NHVT-I-A/01-1-00 NHVT-I-A-1-00 NHVT-I-B-1-00	0.59	1.10	0.50
NHVT-I-A/01-2-00 NHVT-I-A-2-00 NHVT-I-B-2-00	0.80	1.40	0.65
NHVT-I-A/01-2-88 NHVT-I-A-2-88 NHVT-I-B-2-88	1.02	1.75	0.90
NHVT-I-A/01-3-00 NHVT-I-A-3-00 NHVT-I-B-3-00	1.15	1.75	0.90
NHVT-I-A/01-3-88 NHVT-I-A-3-88 NHVT-I-B-3-88	1.15	2.10	1.14
NHVT-I-A/01-4-00 NHVT-I-A-4-00 NHVT-I-B-4-00	1.55	2.60	1.40
NHVT-I-A/01-4-88 NHVT-I-A-4-88 NHVT-I-B-4-88	1.73	3.40	1.93

SELECTION FOR UNISHIELD CABLES

Catalog Number	Conductor Size
NHVT-I-A/01-0-11	#2 - 1/0 AWG
NHVT-I-A/01-1-11	2/0 - 250 MCM
NHVT-I-A/01-2-11	350 - 500 MCM
NHVT-I-A/01-3-11	750 - 1000 MCM
NHVT-I-B-1-11	#2 - 2/0 AWG
NHVT-I-B-2-11	4/0 - 350 MCM
NHVT-I-B-3-11	500 - 1000 MCM

Raychem

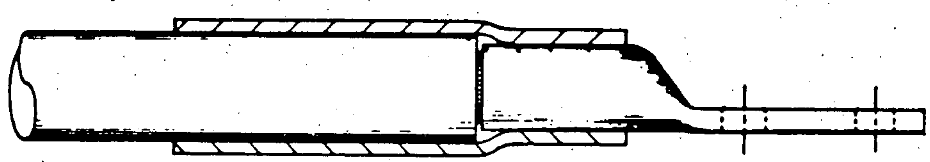
NHVT-U

Nuclear High Voltage Termination

Non-Shielded 5-8kV

Selection Guide

1. NHVT-U Kits are designed to environmentally seal non-shielded medium voltage power cables to medium voltage sealed compression terminals.
2. NHVT-U Kits have been qualification tested for Class IE, non-LOCA service. These kits are non-tracking and corona resistant.
3. Raychem qualification type tests are valid when kits are used within the specified range on the included table. Use of product beyond these ranges may invalidate the applicability of these tests.



Single Conductor Cable

Kit Number	Cable Jacket & Lug O.D. Range	Nominal Conductor Gauge 5 kV	Nominal Conductor Gauge 8 kV
NHVT-I-U-1	0.47" - 0.94"	#1 AWG to 2/0 AWG	-
NHVT-I-U-2	0.55" - 1.10"	3/0 AWG to 250 MCM	1/0 AWG to 4/0 AWG
NHVT-I-U-3	0.75" - 1.50"	350 MCM to 500 MCM	250 MCM to 350 MCM
NHVT-I-U-4	1.02" - 1.87"	750 MCM to 1000 MCM	500 MCM
NHVT-I-U-5	1.14" - 2.16"	-	750 MCM to 1000 MCM
NHVT-I-U-6	1.5 " - 2.8 "	1250 MCM to 2000 MCM	1250 MCM to 2000 MCM

3 Conductor Cable with Jacketed Individuals

Kit Number	Lug O.D. Range	Phase Cable Jacket O.D. Range	Overall Cable Jacket O.D. Range
NHVT-3-I-U-1	0.47" - 0.94"	0.55" - 0.94"	1.28" - 2.32"
NHVT-3-I-U-2	0.55" - 1.1"	0.55" - 1.02"	1.28" - 2.32"
NHVT-3-I-U-3	0.75" - 1.5"	1.1" - 1.5"	2.38" - 4.37"
NHVT-3-I-U-4	1.02" - 1.87"	1.1" - 1.84"	2.38" - 4.37"

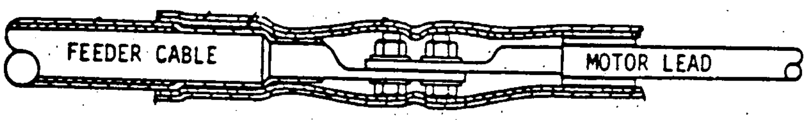
Raychem **NMCK8**

Nuclear Motor Connection Kit
5-8kV In-line
SELECTION GUIDE

1. The NMCK8-L is a heat-shrinkable motor connection kit for in-line configurations in the 5-8kV motor class. The NMCK8-L is designed to provide a seal on the cables and to allow the connection area to remain clean. This facilitates easy re-entry when motors are replaced or serviced. When the feeder cable is shielded, a Raychem NHVT should be installed first.

2. Raychem has performed qualification testing to demonstrate the suitability for use on Class IE equipment in a nuclear power generating station during normal environmental conditions or HELB accident conditions.

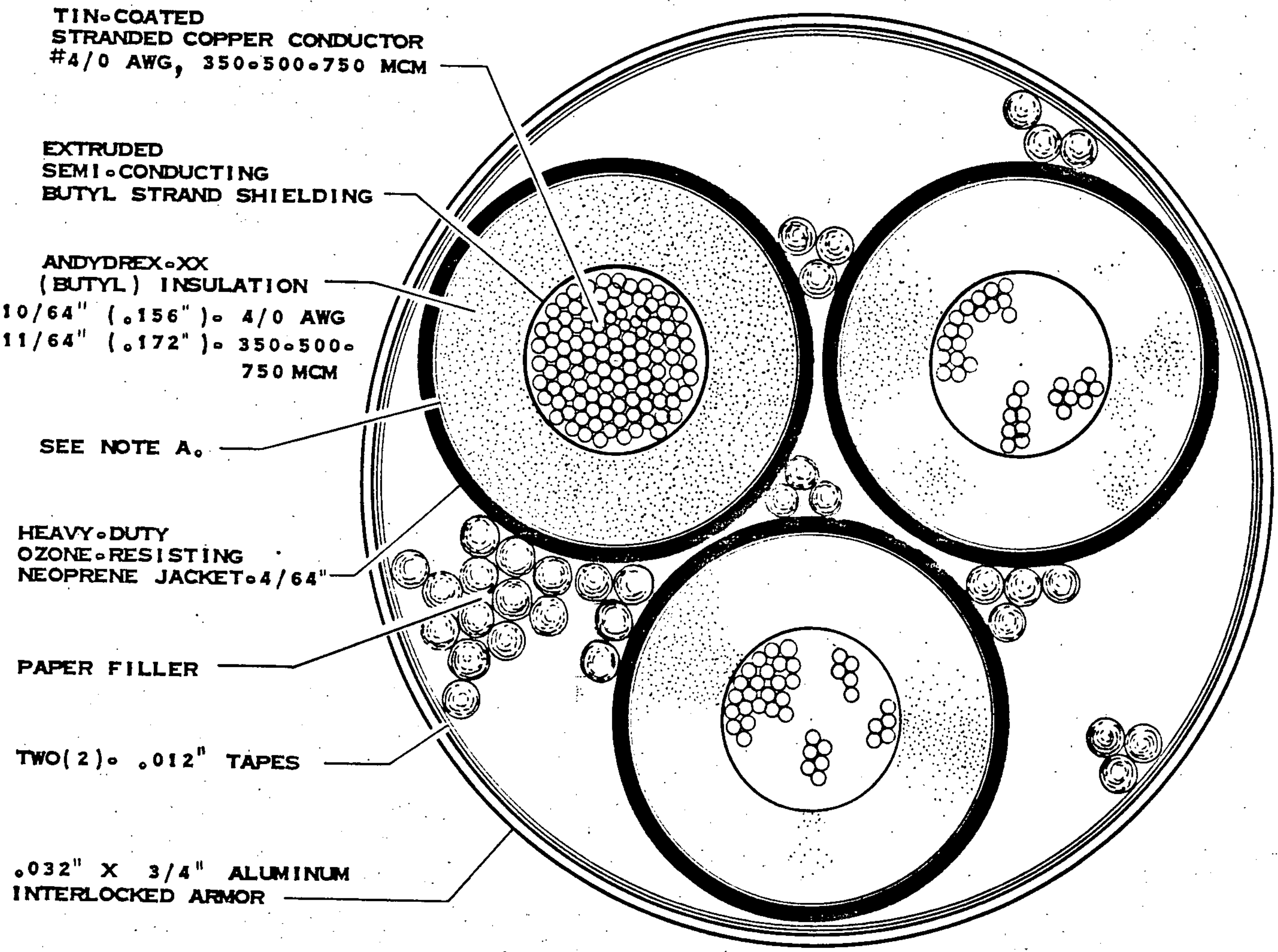
3. Raychem qualification-type tests are valid when kits are used within the specified range on the included table. Use of product beyond these ranges may invalidate the applicability of these tests. (Nominal wire gauges are included for reference only--actual diameter should be verified.)



SELECTION CRITERIA	KIT PART NUMBER (3 Phases/kit) NMCK8-1L	NMCK8-2L
Nominal Feeder Cable size range	2/0-250 MCM	350-500 MCM
Feeder Cable Diameter Range		
Shielded Cable (O.D. over insulation)	0.53" - 1.1"	0.87" - 1.5"
Non-Shielded Cable (O.D. over jacket)	0.70" - 1.26"	1.06" - 1.6"
Motor Lead Diameter Range	0.41" - 1.26"	0.79" - 1.6"
Max. Bolt Size (Dia. x Length)	0.50" x 1.0"	0.50" x 1.25"
Max. Lug Width	1.26"	1.8"
Max. Connection Length	9.0"	9.0"
Slip Back Space	21"	21"

SIMPLEX 5KV 750Kcmil CONSTRUCTION DRAWING (CROSS-SECTION)

SIMPLEX 3/C-ANHYDREX-XX INSULATED ALUMINUM INTERLOCKED ARMORED CABLE. 5KV N.S. PER SOUTHERN CALIFORNIA EDISON CO. MS 228-64 & BECHTEL CORPORATION BSO-3008



NOTE A. ONLY THE 750 MCM CABLE UTILIZES THIS CLOTH TAPE BETWEEN THE NEOPRENE JACKET AND THE BUTYL INSULATION.

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

SIMPLEX WIRE & CABLE CO., FACTORY ORDER #16712 THRU 5

FACTORY ORDER - SIZE	APPROXIMATE O.D.	#/m' - NET
#16712 - #4/0	2.51"	4020#
#16713 - 350 MCM	2.92"	5930#
#16714 - 500 MCM	3.22"	7720#
#16715 - 750 MCM	3.64"	10660#

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT | EE553 REVIEW/P.O. REVIEW | POSSIBLE CABLE CODES

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
006 or 011	26 PR #22	300V ?	PE	PE	EE553 BSO-3003-C	COMM. CABLE ANACONDA 10/14/65 Item 5
007 or 014	51 PR #22		PE	PE	EE553 BSO-3003 (Shows as 50-Pair)	ANSONIA 12/10/64 Item 3
009	6 PR #22		PE	PE	EE553 BSO-3003-C	ANACONDA 10/14/65 Item 2
011 SEE '006'	26 PR #22					
014 SEE '007'	51 PR #22					
018	1 PR #22		PLASTIC		EE553 B/M 3003	No P.O. Found
020	2 (41C) PR #19 Shld.		PE	PE	EE553 BSO-3003	ANSONIA 12/10/64 Item 1
021	6 (12/C) PR #22		PE	PE	EE553 BSO-3003	ANSONIA 12/10/64 Item 2

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
121	2/C #12	600V				
122	1/C #12	600V	BUYTL	NEOPRENE	BSO-3005	SIMPLEX
136	3/C #12	"	"	"	"	03/22/65
137	4/C #12	"	"	"	"	ITEMS 1 - 22
270	5/C #12	"	"	"	"	
138	7/C #12	"	"	"	"	
139	9/C #12	"	"	"	"	
123	1/C #10	"	"	"	"	
142	4/C #10	"	"	"	"	
124	1/C #8	"	"	"	"	
145	3/C #8	"	"	"	"	
147	4/C #8	"	"	"	"	
125	1/C #6	"	"	"	"	
151	4/C #6	"	"	"	"	
126	1/C #4	"	"	"	"	
134	1/C #2	"	"	"	"	
133	1/C #0	"	"	"	"	
127	1/C #00	"	"	"	"	
128	1/C #0000	"	"	"	"	
155	1/C #250 MCM	"	"	"	"	
154	1/C #350 MCM	"	"	"	"	
129	1/C #500 MCM	"	"	"	"	
130	1/C #1000MCM	"	"	"	"	
300	1/C #12	600V	VULKENE	NEOPRENE	BSO-3005-A	G.E.
301	1/C #6	"	XLPE	OR	-H	04/12/65
302	1/C #4	"	"	HYPALON	-E	04/19/67
303	1/C #2	"	"	"	"	02/07/66
304	1/C #1	"	"	"	"	ITEMS 23-29
305	1/C #00	"	"	"	"	"
306	1/C #0000	"	"	"	"	"
158	1/C #2000MCM		BUYTL	NEOPRENE	BSO-3005-B	G.E.
306	1/C #0000		VULKENE (XLPE)	FLAMENOL		08/04/65 ITEMS 1 & 2

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
312	3/C #16/Shld	600V	TEFLON	TEFLON	BSO-3005-D	MIL-SPEC SUPPLY, INC. 11/02/65 ITEMS 1 & 2
313	2/C #16/Shld					
	7/C #14 Sphere Water Level Indication	600V	MI (Mineral Insulation)		BSO-3005-M	GENERAL CABLE CORP. 10/04/66 ITEM 32 (Prefab)
411	1/C #500 MCM CAT #SI58073	600V	ETHYLENE-PROPYLENE	NEOPRENE	BSO-3005-K KB EXPL. REPORT	G.E. 09/26/66 ITEM 1
(122)	1/C #12		BUTYL	NEOPRENE	BSO-3005-L	SCE 09/27/66 ITEM 31
(300)	1/C #12	600V	VULKENE (XLPE)	NEOPRENE OR HYPALON	BSO-3005-O	CABLE CON 11/10/66 ITEM 1 (DYED BLACK)
(122)	1/C #12 Job 5145 Addition of Under-Frequency Relays SC #7 Job 3246 Westinghouse Changes to Reheater Valves (Code 132.15)	600V	BUTYL	NEOPRENE	BSO-3005-P	ANACONDA WIRE & CABLE 12/09/66 ITEM 1
N/A	5/C #12	600V	PORTABLE CHORUS		BSO-3005-R	GRAYBAR ELECTRIC CO. 12/18/67 ITEMS 1 & 2
N/A	3/C #12 TRASH HANDLING	"	"		"	
150	3/C #6	600V	OKONEX	PVC	BSO-3005-S	OKONITE CO. 04/15/68 ITEMS 1 & 2
152	3/C #4	"	"	"	"	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
178	1/C #350 MCM	5kV	AB	NEOPRENE	BSO-3006	ANACONDA 12/01/64 ITEM 1 UNDERGROUND CABLE
	1/C #0000	5kV	BUTYL		BSO-3006-A	SIMPLEX 05/17/65 ITEM 1 UNDERGROUND CABLE
	1/C #6	5kV	PVC		BSO-3007	ANACONDA 10/06/64 ITEMS 1 & 2 DIRECT BURIAL
	1/C #6	5kV	BUTYL	PVC	BSO-3007-A	GRAYBAR 09/14/66 ITEMS 2 DIRECT BURIAL
	1/C #6	5kV	PVC		BSO-3007-B	CALIFORNIA WHOLESALE ELECTRIC CO. 07/14/67 ITEMS 1 DIRECT BURIAL
159	3/C #0000	5kV	BUYTL (ANHYDREX XX)	ARMORED (NEOPRENE) & ALUMINUM CONDEX)	BSO-3008	SIMPLEX 12/10/64 ITEMS 1 - 4
160	3/C 350 MCM	"			"	
161	3/C 500 MCM	"			"	
162	3/C 750 MCM	"			"	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
274	COAX (621-100)	3kV	PE		BSO-3009 EE553	AMPHENOL 09/01/64 ITEMS 1 & 2 CAT # 621-100 621-102
273	TRIAX (621-102)					
307	COMPOSITE 8/C: 6/C #18 2/C #22	600V " " "	PVC " " "	PVC " " "	BSO-3009-A " " "	TRACERLAB 11/01/65 ITEMS 3 & 4 (RMS CHANNELS)
308	6/C: 1-RG-62/U 1/C #22 4/C #22	 3kV 600V	" " " " "	" " " " "	" " " " "	
236	2/C #16 SHLD		PVC "	PVC "	BSO-3010 "	ROME 10/26/64 ITEMS 1, 2&3
237	3/C #16 SHLD		" " "	" " "	" " "	
238	4/C #16 SHLD		" " " "	" " " "	" " " "	
	2/C SHLD FOXBORO FLOW XMTR				BSO-3010-A	FOXBORO 03/31/65 ITEM 1 PRE-FAB #W-176-PP
153	12/C #12 SHLD FDW FLOW CONT		BUTYL (KB EXPL. REPORT)		BSO-3010-B	HAGAN CONTROLS 07/29/65 ITEMS 1, 2&3 PRE-FAB
	6/C (3STP) SHLD					
	8/C (4STP) SHLD					

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
248	12/C #20 SHLD VECTOR-VANE UNIT	600V	TYPE 'BN' WIRE PVC		BSO-3010-C EE553	METEROLOGY RESEARCH 02/15/66 ITEM 1
	SPECIAL ELECTRODE CABLE pH7. pH8				BSO-3010-D EE553	BECKMAN 01/18/66 ITEM 4 Part #76594
	SPECIAL ELECTRODE CABLE pH7 pH8				BSO-3010-D EE553	BECKMAN 01/18/66 ITEM 4 Part #76594
	3/C #16 SHLD	600V	POLYETHYLENE		BSO-3010-E	ROME 05/01/69
	2/C #16 SHLD		POLYETHYLENE	PVC	BSO-3010-F	LEWIS ENGRG 07/12/68 ITEMS 1 & 2 R.C.P. COLD LEG RTD
703	4/C #16 SHLD					
	16/C #16	600V	POLYETHYLENE	PVC	BSO-3036	GRAYBAR 02/02/65
	#14, #12, #10, #8 & #6 LIGHTING	300/600V	AF TW THW AVA		BSO-3012	CALIFORNIA WHOLESALE ELECTRIC CO. ITEMS 1 - 32

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT P.O. REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
	2/C #8	600V	(DIRECT BURIAL)		BSO-3012-A	GARNETT YOUNG & CO. (SIMPLEX) ITEM 33
	1/C #0 2/C #10 3/C #10	600V	RHW (DIRECT BURIAL)		BSO-3012-B	CALIFORNIA WHOLESALE ELECTRIC CO. ITEMS 34 - 36
	2/C #16 T/C EXT. WIRE TYPE TX		POLYVINYL " " "	POLYVNYL " " "	BSO-3013 " " "	THERMO ELECTRIC 09/21/64 ITEMS 1, 2&3
	TYPE JX		" "	" "	" "	
	TYPE KX		" "	" "	" "	
	2/C #16 T/C EXT. WIRE TYPE TX		PVC " " "	PVC " " "	BSO-3013-A " " "	PALL TRINITY MICRO 02/15/66 ITEMS 1, 2&3
	TYPE JX		" "	" "	" "	
	TYPE KX		" "	" "	" "	
	2/C #30 T/C EXT. WIRE (CV-CONST)		L & N CATALOG #30-55-1		BSO-3013-B	LEEDS & NORTHRUP 02/12/68 ITEM 1

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
132	1/C 750 MCM	600V	BUTYL		EE553	SUSPECT SIMPLEX NO. P.O. FOUND
141	3/C #10	600V	BUTYL		EE553	SUSPECT SIMPLEX NO. P.O. FOUND
157	1/C 1750 MCM	600V	BUTYL		EE553	SUSPECT SIMPLEX NO. P.O. FOUND
185	2 (4/C) PR #16	600V	CC		EE553	
186	2 (4/C) PR #16	600V	IC		EE553	
187	2 (4/C) PR #16	600V	CA		EE553	
195	1 COAX RG 8u				EE553	
240	2/C #20	600V	PVC		EE553	
241	16/C #16	"	"			
245	8/C #16	"	"			
249	6/C #20	600V	PVC		EE553	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
250	1/C #12	600V	SIL		EE553	
280	1/C #250 MCM	600V	BUTYL		EE553	SAME AS 155
281	1/C 2000 MCM	600V	BUTYL		EE553	SAME AS 158
299	12* (24/C) PR #19		PE	NEOPRENE	EE553	COMM. CABLE *SUSPECT '6-PAIR' FROM BSO-3003 (SIMILAR)
309	1/C #8	600V	VULKENE (XLPE)		EE553	G.E. NO P.O. FOUND
310	2 PR #14	300V	TYRX		EE553	
311	2 PR #14	600V	TYRX		EE553	
314	1/C #12	600V	TEFLON		EE553	
315	1/C #0	600V	VULKENE (XLPE)		EE553	G.E. NO P.O. FOUND
316	1/C #10	600V	VULKENE (XLPE)		EE553	G.E. NO P.O. FOUND
355	1/C #8	600V	TEFLON		EE553	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
360	3/C #22	600V	PVC		EE553	
361	25/C #16	"	"		"	
362	9/C #16	"	"		"	
363	12/C #22	"	"		"	
364	5/C #14	600V	XLPE		EE553	
365	4/C #6					
400	2/C #12	600V	XLPE	NEOPRENE	EE553	
401	3/C #12	"	"	"	"	
402	4/C #12	"	"	"	"	
403	5/C #12	"	"	"	"	
404	7/C #12	"	"	"	"	
405	9/C #12	"	"	"	"	
407	3/C #10	"	"	"	"	
408	1/C #4	600V	EPR	NEOPRENE	EE553	
409	2/C #8	600V	XLPE	NEOPRENE	EE553	
410	1/C #00	600V	EPR	NEOPRENE	EE553	
414	1/C #0000	600V	EPR	NEOPRENE	EE553	

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SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
416	2/C #16	600V	P	P	EE553	
417	1/C 750 MCM	8kV	EPR	HYPALON	EE553	
418	3/C #4	600V	XLPE		EE553	
419	1/C #0	600V	EPR	NEOPRENE	EE553	
1X1	3PR #24	600V			EE553	COMM. CABLE
500	1/C # 2/0	600V	EPR		EE553	
501	1/C # 4/0	600V	EPR		EE553	
502	1/C # 500 KCMIL	600V	EPR OR XLPE		EE553	
503	1/C # 750 KCMIL	600V	EPR		EE553	
504	1/C # 1/0	600V	EPR OR XLPE		EE553	
505	1/C # 2	600V	EPR		EE553	
506	3/C # 12	600V	EPR OR XLPE		EE553	
507	3/C # 10	600V	EPR OR XLPE		EE553	
508	3/C # 6	600V	EPR		EE553	
509	1/C # 350 KCMIL	600V	EPR		EE553	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
510	1/C # 250 KCMIL	600V	EPR		EE553	
511	1/C # 750 KCMIL	5000V	EPR		EE553	SHIELDED
512	3/C # 14	600V	XLPE		EE553	
513	5/C # 14	600V	XLPE		EE553	
514	7/C # 14	600V	XLPE		EE553	
515	10/C # 14	600V	XLPE		EE553	
516	2/C # 16	600V	XPLE		EE553	STP
517	2/C # 14	600V	XPLE		EE553	
518	2/C # 16		XPLE		EE553	T/C TYPE JX
519	1/C # 2/0		HIGH MOLECULAR POLYETHYLENE		EE553	CATHODIC PROTECT
520	1/C # 2		HIGH MOLECULAR POLYETHYLENE		EE553	CATHODIC PROTECT
521	1/C # 6		HIGH MOLECULAR POLYETHYLENE		EE553	CATHODIC PROTECT
522	1/C # 12	600V	TW		EE553	
523	3/C # 16	600V	XLPE		EE553	SHIELDED RTD
524	2/C # 12	600V	XPLE		EE553	
525	2/C # 10	600V	XPLE		EE553	
526	4/C # 10	600V	XPLE		EE553	
527	2/C # 6	600V			EE553	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT — EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
528	4/C # 6	600V	XPLE		EE553	
530	4/C # 14	600V	XPLE		EE553	
601	2/C # 6	1000V	XPLE		EE553	
602	2/C # 6	1000V	XPLE		EE553	
604	2/C # 6	1000V	XPLE		EE553	
611	3/C # 10	1000V	XPLE		EE553	
612	3/C # 10	1000V	XPLE		EE553	
614	3/C # 10	1000V	XPLE		EE553	
621	2/C # 12	1000V	XPLE		EE553	
622	2/C # 12	1000V	XPLE		EE553	
623	2/C # 12	1000V	XPLE		EE553	
624	2/C # 12	1000V	XPLE		EE553	
631	2/C # 14	1000V	XPLE		EE553	
632	2/C # 14	1000V	XPLE		EE553	
633	2/C # 14	1000V	XPLE		EE553	
634	2/C # 14	1000V	XPLE		EE553	
641	4/C # 14	1000V	XPLE		EE553	
642	4/C # 14	1000V	XPLE		EE553	
643	4/C # 14	1000V	XPLE		EE553	
644	4/C # 14	1000V	XPLE		EE553	
651	2/C # 16	600V			EE553	SHIELDED
652	2/C # 16	600V			EE553	SHIELDED

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
653	2/C # 16	600V			EE553	SHIELDED
670	1/C # 4	600V	XPLE		EE553	
680	3/C # 16	600V			EE553	SHIELDED
701	1/C # 12	600V	EPR OR XPLE		EE553	
713	1/C # 5	600V	XPLE		EE553	
730	3/C # 10	600V	XPLE		EE553	SHIELDED
731	4/C # 6	600V	XPLE		EE553	SHIELDED
732	5/C # 12	600V	XPLE		EE553	SHIELDED
733	4/C # 4	600V	XPLE		EE553	SHIELDED
734	2/C # 6	600V	XPLE		EE553	SHIELDED
735	4/C # 8	600V	XPLE		EE553	SHIELDED
736	9/C # 12	600V	XPLE		EE553	SHIELDED
737	1/C # 14	600V	XPLE		EE553	
738	50/C #19				EE553	COMM. CABLE
739	50/C # 24				EE553	COMM. CABLE AL. SHEATH
740	1/C # 8	600V	XPLE		EE553	
741	50/C # 28	2000V	XPLE		EE553	COAX
742	1/C # 12	600V	XPLE		EE553	
743	3/C # 4	600V	EPR		EE553	
744	24 PR # 22	600V			EE553	COMM. CABLE
747	2 PR # 16	600V	XPLE		EE553	SHIELDED

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
748	2/C # 16	300V	XPLE		EE553	T/C TYPE KX
749	4 PR # 16	600V	XPLE		EE553	SHIELDED
750	1/C RG62A/U	750V	PE		EE553	COAX
751	30/C # 24	600V	XPLE		EE553	FOXBORO INSTR.
752	COAX # 22		XPLE		EE553	
753	COAX # 36	2200V	XPLE	HYPALON	EE553	RG-59B/U
754	25 PR # 24				EE553	COMM. CABLE
755	2/C # 20		PE		EE553	T/C TYPE JX
756	600 PR # 24		PE *		EE553	COMM. CABLE
757	50 PR # 24	PT&T	PE *		EE553	COMM. CABLE
758	300 PR # 24		PE *		EE553	COMM. CABLE
759	900 PR # 24		PE *		EE553	COMM. CABLE
760	1200 PR #24		PE *		EE553	COMM. CABLE
761	1500 PR #24		PE *		EE553	COMM. CABLE
762	1800 PR #24		PE *		EE553	COMM. CABLE
763	2700 PR #26		PE *		EE553	COMM. CABLE
764	3600 PR #26		PE *		EE553	COMM. CABLE
765	600 PR # 24		PE *		EE553	GREASE FILLED
766	2/C # 16	300V	GLASS BRAID		EE553	T/C TYPE JX
600	3/C # 0000	1000V	XLPE		EE553	
603	2/C # 6	1000V	XLPE		EE553	
			*SUSPECTED			

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
654	2/C # 16	600V			EE553	SHIELDED
702	1/C # 10	600V	XLPE		EE553	
704	2/C # 16	600V	CC		EE553	
705	7/C # 16	600V	XLPE		EE553	SHIELDED
706	4/C # 10	600V	XLPE		EE553	
707	2/C # 8	600V	XLPE		EE553	
708	2/C # 10	600V	XLPE		EE553	
709	2/C # 14	600V	XLPE		EE553	
710	10/C # 14	600V	XLPE		EE553	
711	1/C # 0000	600V	XLPE		EE553	
712	1/C # 0	600V	XLPE		EE553	
714	1/C # 0	600V	EPR		EE553	
715	2 PR # 18	600V	NEOPRENE		EE553	
716	4 PR # 18	600V	NEOPRENE		EE553	
717	6 PR # 18	600V	NEOPRENE		EE553	
718	1/C 250 MCM	600V	XLPE		EE553	
719	24 PR # 18	600V	NEOPRENE		EE553	
720	30 PR # 20	600V	PVC		EE553	
721	50 PR # 18	600V	NEOPRENE		EE553	
722	50 PR # 19	600V	PVC		EE553	
723	6/C # 18	600V	XLPE		EE553	
724	6 PR # 19		PVC		EE553	

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SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
725	50 PR # 22	600V	PVC		EE553	
726	3/C # 12	600V	XLPE		EE553	
727	1/C # 22	600V			EE553	SHIELDED
728	6 PR # 19	600V			EE553	SHIELDED
729	2/C # 18	600V			EE553	SHIELDED
901	2/C # 16	600V	TEFZEL		EE553	OKONITE SHIELDED #264-40-4401
902	2/C # 12	1000V	EPR	HYPALON	EE553	OKONITE #202-11-2301
903	2/C # 10	1000V	EPR	HYPALON	EE553	OKONITE #202-11-2402
904	3/C # 22	300V	PVC		EE553	FLAIR ELECTRONICS #1000-64
905	2/C # 22	300V	PVC		EE553	FLAIR #1000-65A
906	1/C # 12	600V	EP-HYPALON	HYPALON	EE553	OKONITE #112-11-2101
920	4 PR # 18	300V	PVC	PVC	EE553	4-STP OKONITE #261-10-3304
921	8 PR # 18	300V	PVC	PVC	EE553	8-STP OKONITE #261-10-3308
922	24 PR # 18	300V	PVC	PVC	EE553	24-STP OKONITE #261-10-3324

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
923	2/C # 16	600V	TEFZEL		EE553 (See '901')	STP OKONITE #264-40-4401
924	7/C # 14	1000V	EPR	HYPALON	EE553	OKONITE #202-11-2207
931	5/C # 14	1000V	EPR	HYPALON	EE553	
932	2/C # 14	1000V	EPR	HYPALON	EE553	
933	3/C # 12	1000V	EPR	HYPALON	EE553	
934	2/C # 14	2000V	EPR		EE553	
935	1/C RG62A/U		PE		EE553	COAX
936	9/C # 14	1000V	EPR		EE553	
937	1/C # 14	2000V	EPR		EE553	
A30	50 PR # 22				EE553	STPS COMM. CABLE
AA1	1/C 350 MCM	600V	EPR	HYPALON	EE553	
AA2	1/C # 0000	600V	EPR	HYPALON	EE553	
AA3	1/C # 2	600V	EPR	HYPALON	EE553	
AA4	1/C # 14	600V	EPR	HYPALON	EE553	
AA5	1/C # 4	600V	EPR	HYPALON	EE553	
AA6	1/C # 8	600V	EPR	HYPALON	EE553	
AA7	1/C # 14	600V	EPR	HYPALON	EE553	OKONITE #112-11-2071
AA8	1/C # 12	600V	EPR	HYPALON	EE553	OKONITE #112-11-2101

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
AA9	3/C # 16	600V	EPR	HYPALON	EE553	SHIELDED OKONITE #264-25-4401
AB1	2/C # 16	600V	XLPE		EE553 SO23-304-6A	ROCKBESTOS FIREWALL III
AB2	2/C # 12	600V	XLPE	HYPALON	EE553	
AB3	1/C 350 MCM	600V	XLPE	HYPALON	EE553	
AB5	3/C # 14	600V	XLPE	HYPALON	EE553	
AB6	3/C # 10	600V	XLPE	HYPALON	EE553	
AB7	3/C # 14	600V	XLPE	HYPALON	EE553	
AB8	2/C # 12	600V	XLPE	HYPALON	EE553	
AC1	12/C # 14	600V	XLPE	NEOPRENE	EE553	ROCKBESTOS FIREWALL III
AC2	5/C # 14	600V	XLPE	NEOPRENE	EE553	ROCKBESTOS FIREWALL III
CM1	HELIAX			F.R.	EE553	COMM. CABLE ANDREW #41690-9
CM2	RADIAX			F.R.	EE553	ANDREW #RX5-1R
CM3	3 PR # 18	600V	XLPE		EE553	
MS1	5/C # 14	600V	TEFZEL		EE553	
MS2	6/C # 14	600V	TEFZEL		EE553	
MS3	8/C # 14	600V	TEFZEL		EE553	
MS4	4/C # 14	600V	TEFZEL		EE553	
MS5	3/C # 14	600V	TEFZEL		EE553	

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT

EE553 REVIEW

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
MS6	8/C # 14	600V	TEFZEL		EE553	
MS7	7/C # 14	600V	TEFZEL		EE553	
N85	2 PR # 16	600V	CC		EE553	
N86	4 PR # 16	600V	XLPE	F.R.	EE553 S023-304-06	RAYCHEM OR ROCKBESTOS
N87	2 PR # 16	600V	CA		EE553	
PTL	1/C # 6	600V	XLPO		EE553	
SIS	1/C # 12	600V	XLPO		EE553	
VCT	10/C # 18	800V	XLPE		EE553	VICTOREEN DETECTOR CABLE
TCC	2/C # 16				EE553	T/C TYPE TX
VS1	18/C	600V	XLPE		EE553	
XT6	2/C # 16	300V	XPCC		EE553	
XT7	3 PR # 19	600V			EE553	COMM. CABLE
XT8	3/C # 16	600V	XLPE	PVC	EE553	ALS TYPE CANADA # 1862686CFP
XT9	2/C # 12	600V	XLPE	PVC	EE553	CANADA #122CFP
VEN					EE553	VENDOR SUPPLIED SEE WIRING DIAGS
XTG	2/C # 16	300V	XPCC		EE553	SHIELDED

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT FROM SO23

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
E1F	1/C # 0	600V	EPR	NEOPRENE	SO23-304-11 & EE553	G.E. (POWER) 03/04/76 D4103051 (TYPICAL 'E' CODES)
E1I	1/C # 0000	600V	EPR	NEOPRENE	SO23-304-11 & EE553	G.E.
E27	2/C # 14	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM KERITE ROCKBESTOS
E38	3/C # 12	600V	EPR	NEOPRENE	SO23-304-11 & EE553	G.E.
E39	3/C # 10	600V	EPR	NEOPRENE	SO23-304-11 & EE553	G.E.
E77	7/C # 14	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM ROCKBESTOS
G28	2/C # 12	600V	VULKENE SUPREME (XLPE)	NEOPRENE OR HYPALON	SO23-304-11 & EE553	G.E.
G38	3/C # 12	600V	VULKENE SUPREME (XLPE)	NEOPRENE OR HYPALON	SO23-304-11 & EE553	G.E.

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT FROM SO23

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
H28	2/C # 12	600V	FR-EPR	CHLOR. POLYETH-LENE (CPE)	SO23-304-11-2 & EE553	ANACONDA 03/11/85 V4103052
N26	2/C # 16 SHLD	600V	XLPE	FR	SO23-304-6 & EE553	RAYCHEM ROCKBESTOS
N36	3/C # 16 SHLD	600V	XLPE	FR	SO23-304-6 & EE553	RAYCHEM ROCKBESTOS
N46	4/C # 16 SHLD	600V	XLPE	FR	SO23-304-6 & EE553	RAYCHEM ROCKBESTOS
E57	5/C # 14	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM KERITE ROCKBESTOS
E37	3/C # 14	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM KERITE ROCKBESTOS
E1D	1/C # 2	600V	EPR	NEOPRENE	SO23-304-11 & EE553	G.E.
A37	3/C # 14 (RED)	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM ROCKBESTOS
A57	5/C # 14 (RED)	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM ROCKBESTOS

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT FROM SO23

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
A77	7/C # 14 (RED)	600V	XLPE	FR	SO23-304-11 & EE553	RAYCHEM ROCKBESTOS
A1N	1/C # 0	600V	VULKENE SUPREME (XLPE)		SO23-304-11 & EE553	G.E.
H38	3/C # 12	600V	FR-EPR	CHLOR-POLYETH-YLENE (CPE)	SO23-304-11-2 & EE553	ANACONDA 03/11/85
H39	3/C # 10					
H3B	3/C # 6	600V	FR-EPR	CHLOR-POLYETH-YLENE (CPE)	SO23-304-11-2 & EE553	ANACONDA
H1I	1/C # 0000	600V	FR-EPR		SO23-304-11-2 & EE553	ANACONDA
53J	3/C #250 MCM	8kV	EPR		SO23-304-8 & EE553	ANACONDA
P38	3/C # 12 (RED)	600V	FR-EPR	CHLOR-POLYETH-YLENE (CPE)	SO23-304-11-2 & EE553	ANACONDA
Q38	3/C # 12 (YELLOW)					
R38	3/C # 12 (GREEN)					

ATTACHMENT 7-6

SONGS 1 CABLE LIST

ORIGINAL PLANT FROM S023

CABLE CODE	CONDUCTORS/ SIZE	VOLTAGE RATING	INSULATION TYPE	JACKET TYPE	SOURCE OF DATA	REMARKS
YF4	12 PR # 19	300V	PE		EE553 S023-304-3	COMM. CABLE I.T.T. 24/C, NON-SHIELDED
ZB4	2 PR # 19	300V	PE		EE553 S023-304-3	I.T.T. 4/C, SHIELDED
ZD4	6 PR # 19	300V	PE		EE553 S023-304-3	I.T.T. 12/C, SHIELDED
ZF4	12 PR # 19	300V	PE		EE553 S023-304-3	I.T.T. 24/C, SHIELDED
ZH4	25 PR # 19	300V	PE		EE553 S023-304-3	I.T.T. 50/C, SHIELDED
63I	3/C # 0000	8kV	HI TEMP KERITE	FR	S023-304-8-1 & EE553	KERITE
63K	3/C 350 MCM					
71D	1/C # 2	5kV	XLPE	PVC	S023-304-8-2 & EE553	ANACONDA
CX2	(2) 1/C #14	600V	KAPTON			CONAX
CX4	(4) 1/C #14					
CX8	(8) 1/C #14					

SECTION 8.0

SUMMARY OF CONCLUSIONS

8.0 SUMMARY OF CONCLUSIONS

The conclusions drawn in the following sections are based primarily on the information contained in Sections 6.0 and 7.0 of this report.

8.1 ROOT CAUSE AND MECHANISM OF THE IN-SERVICE FAILURE OF THE 4kV CABLE

The mechanism involved in the actual in-service failure was analyzed to assess if this was an isolated incident due to unusually severe local circumstances or whether there was a general problem associated with this cable design or its application.

The failure location was near and under an uninsulated ten-inch diameter 407°F feedwater pipe and a flange that periodically leaked. The ambient temperatures were in excess of the normal 40-50°C operating levels, and the conductor temperature was calculated to be well in excess of 100°C (Section 7.1.5). These cables are rated for 90°C conductor temperatures in a normal environment. The cable was subjected to localized ambient conditions beyond the design basis and established piping to cable raceway separation criteria.

The basic mechanism involved in the insulation breakdown was the splitting of the surface from the excessive temperatures and confined pressures under the interlocked armor. Specifically, exposure to the localized heat source caused the jacket to split and caused intense adhesion of both the jacket and insulation to the fabric tape (Attachment 8-1). Thus, as the jacket split, the splits were propagated through the tape to the insulation.

The neoprene jacket over the individual conductors was hardened and cracked at the interface contact between phases. In this same area the fabric tape between the jacket and insulation was torn apart. It was only in the phase contact areas that this jacket hardening and cracking, the torn tape, and the splits in the insulation were evident. The splits found penetrated one-third through the insulation thickness on these samples (non-faulted conductors) and undoubtedly were deeper in locations in the conductors that failed in-service. This mechanism of degradation could only occur in an environment well beyond the design basis for the cable.

Portions of these same cables away from the hostile localized area were pliable and without jacket cracking, which further supports the localized severity conclusion.

It is further concluded, based on Section 7.1.2 and the above information, that there exists no general concern associated with the cable design or its application. It is also unlikely that the remaining 4kV Simplex cable is vulnerable to the same failure mechanism as the construction is different; i.e., the other conductor sizes do not have a fabric tape between the jacket and the insulation, which appeared to be a major contributing factor in the insulation splitting. This conclusion is also applicable to 600V and lower voltage power, control and instrumentation cable, as well as the replacement 4kV cable.

The localized heat source has also been eliminated as discussed in Sections 6.2.4, 9.5, and 9.6. As such, neither the 4kV cable remaining in service nor replacement 4kV cable is subject to the same hostile localized environment as the 4kV cable failing in-service.

8.2 MATERIAL CONDITION ASSESSMENT OF 4kV AND TERMINATIONS CABLES REMAINING IN-SERVICE

Laboratory and on-site test results of both the electrical and physical properties of the Simplex 4kV cables, show the cable insulation material condition is excellent and the jacket, while aged, is in good electrical and physical (functional) condition. These cables should perform reliably for the remaining design life of Unit 1 under the same general operating conditions previously experienced by the representative cable samples analyzed that did not fail in-service or that were in the immediate vicinity of the uninsulated feedwater line. (All those cables have been replaced.) Independent laboratories have also reached the same conclusions.

It should be noted that although the faulted 4kV cables were substantially overheated, this condition alone would not have accounted for the in-service failure. This information is discussed in detail in Section 6.2.

As indicated in Section 6.2.5, continued use of the indoor 4kV terminations not replaced during this outage is acceptable. Continued use of the outdoor 4kV terminations not replaced during this outage is acceptable within the guidelines delineated in Sections 9.9 and 10.4.

8.3 MATERIAL CONDITION ASSESSMENT OF 600V AND LOWER VOLTAGE POWER, CONTROL AND INSTRUMENTATION CABLE

The following material condition assessment conclusions for the subject cables are based on the information contained in Sections 6.3, 6.4, 6.5.2, 7.3, and 7.4.

8.3.1 Assessment of Simplex, 600V, 1/C Cables Exhibiting Cracked Jackets

Laboratory physical analysis and electrical tests indicate acceptable cable dielectric strength and a remaining insulation life even with the degraded jacket. As documented in detail in Section 7.3.1, the subject Simplex cable with cracked jackets is suitable for continued power, control, and instrumentation service for the remaining design life of San Onofre Unit 1.

However, certain precautionary remedial long term measures are necessary to provide continued verification of cable integrity, as delineated in Sections 7.3.1, 10.2, and 10.5. Generally, these measures include a temperature monitoring survey in conjunction with the EQ Condition Monitoring Program and periodic inspections of cables in cable trays, particularly in the turbine building mezzanine and reheater areas.

As discussed in Section 7.3.1, replacement of the subject cables is always a viable option, especially in conjunction with plant retrofit projects.

8.3.2 Assessment of the Balance of Power, Control and Instrumentation

Based on the information presented in this report (primarily Sections 7.2 and 7.4), it is concluded that the 600V and lower voltage power, control and instrumentation cable at San Onofre Unit 1 is in good material and electrical condition and is acceptable for continued plant operation for the balance of the design life of San Onofre Unit 1. This conclusion is valid, despite the appearance of some cable (i.e., dust, cracked jacket, etc.).

Again, as indicated in Section 8.3.1 certain remedial measures are warranted to ensure acceptable cable material condition is maintained.

8.4 REFERENCES FOR SECTION 8.0

There are no references for Section 8.0.

TABLES

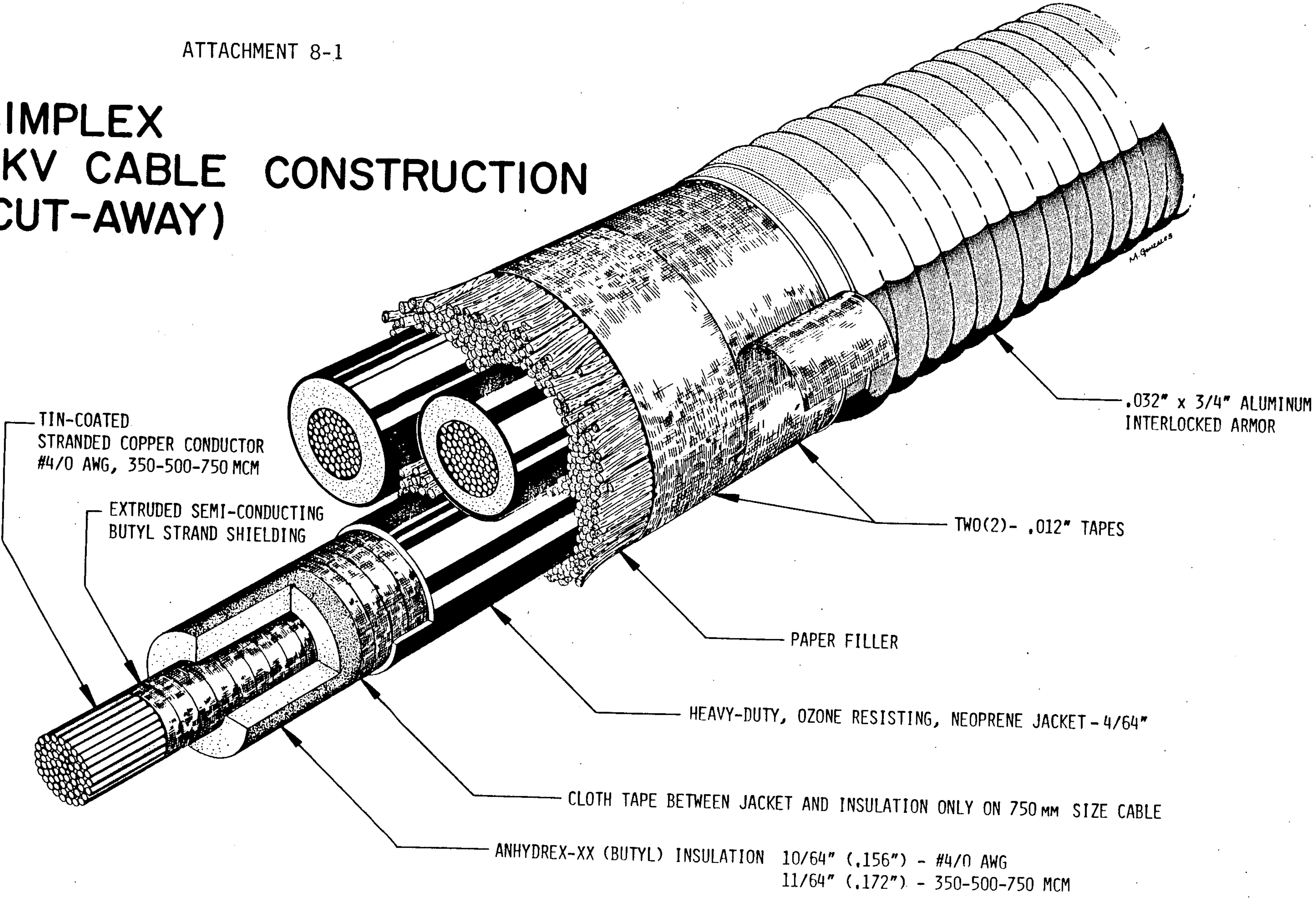
There are no Tables for Section 8.0.

ATTACHMENTS

SECTION 8.0

ATTACHMENT 8-1

SIMPLEX 5KV CABLE CONSTRUCTION (CUT-AWAY)



SECTION 9.0

NEAR-TERM RECOMMENDATIONS

9.0 NEAR TERM RECOMMENDATIONS

The 4kVTF offers the following recommendations for implementation. These recommendations should be implemented prior to return to power from the current San Onofre Unit 1 Cycle 9 refueling outage unless otherwise noted.

Implementation of some of these recommendations was initiated prior to formation of the 4kVTF or have been completed as part of 4kVTF activities; however, those recommendations are documented herein for completeness.

9.1 DC OVERVOLTAGE TESTING OF 4kV CIRCUITS

As documented in Sections 6.1.4 and 6.2.1, DC Overvoltage testing of all 4kV Circuits (including the replacement Kerite cables) has been completed. Appropriate remedial action has been taken for those circuits failing the DC Overvoltage testing.

9.2 LOCALIZED HEAT SOURCE (HOT PIPE) WALKDOWNS

As documented in Section 6.4.2, the 4kVTF conducted extensive walkdowns to identify potential localized heat sources that could adversely affect the material condition of any cable installed in San Onofre Unit 1. The results of these walkdowns predicated recommendations and actions to relocate eight (8) conduit and to ensure forty-six (46) piping locations were insulated in accordance with design drawings or for cable raceway protection (Sections 9.4 and 9.5, respectively). With the completion of these walkdowns, performance of subsequent interface analyses, and implementation of the recommendations of Section 9.4 and 9.5, the probability of a cable failure from similar circumstances as those leading to the in-service failure of the 4kV cable in November, 1985 should be eliminated.

9.3 Replacement of 4kV Cable

The only 4kV cables the 4kVTF would have mandated replacing or repairing (based on the information known today as documented in this report) is the 'C' Transformer (X-winding) feeder cables to 4160V Bus 1C, and the 4kV cables failing the initial DC Overvoltage testing (North and South TPCW pump cables and the single feeder from the 'B' Transformer to 4160V Bus 1B); all of which have already been replaced or repaired. (Section 6.2.1)

As a precautionary measure, the Station also elected to replace the 4kV feeder cables from the 'C' Transformer (Y-winding) to Bus 2C, and from the 'A' and 'B' Transformers to Busses 1A and 1B, respectively. The 4kVTF concurs with that precautionary measure.

Reference 9.10.1 documents the engineering necessary to replace these circuits while Reference 9.10.2 documents the Maintenance Orders written to install the replacement cables. No other 4kV cables need to be replaced in the near term.

9.4 CONDUIT RELOCATION

As a result of the localized heat source walkdowns, the 4kVTF recommended relocating eight (8) specified conduit away from potentially detrimental localized heat sources. As documented in Section 6.4.2, the engineering to effect that relocation is complete. The implementation of the design changes have begun and are expected to be completed prior to return to power from the Cycle 9 refueling outage. Completion prior to return to power is not mandatory, however.

9.5 INSULATION OF PIPING

Again, as a result of the localized heat source walkdowns, it was recommended that 46 specific piping locations be insulated in accordance with design drawings following the completion of the current maintenance and construction activities dictating insulation removal. Further, other previously uninsulated piping is to be insulated to protect cable in raceways immediately adjacent to the piping. As documented in Section 6.4.2, the effort is already underway and is expected to be completed prior to return to full power operation from the Cycle 9 refueling outage. The uninsulated feedwater line and flange adjacent to the 4kV cable is included in that effort.

9.6 INSTALLATION OF HEAT AND MOISTURE REFLECTOR

While insulating the previously uninsulated feedwater line (the localized heat source associated with the in-service failure) is an adequate action to minimize the possibility of accelerated aging of the replacement cable, it is recommended that a simple heat/moisture reflector be installed between the 4kV cable tray and the three insulated feedwater lines crossing that tray. This reflector was designed and installed by the preparation and the implementation of FCN No. 1488E and PFC 1-86-008 during the Cycle 9 refueling outage.

9.7 REPAIR OF FEEDWATER FLANGE

While moisture was not a factor in the degradation of the 'C' transformer feeder cable, chronic leaks of steam onto or in the immediate vicinity of the cable could only aggravate any future marginal ambient temperature conditions. As such, is was recommended that the subject flange be refurbished in lieu of repeated treatment with Furmanite. This repair has already been effected. Additionally, the installation of the reflector should mitigate the consequences of any future leaks from the flanges.

9.8 EG&G IDAHO ECCAD TESTING

It was recommended that EG&G, Idaho ECCAD testing (Section 6.1.6 and 6.3.3) be utilized to provide additional data on the Reactor Coolant Pump 4160V circuits to aid in assessing the condition of the 4160V RCP containment penetrations. This test was conducted, the data reduced by EG&G, and documented in Section 7.1.4.

9.9 4kV CABLE TERMINATIONS

As a result of the evaluation and findings documented in Sections 6.2.3 and 6.2.5 regarding the failures of the North and South TPCW Pump (G6N and G6S) and the 'B' transformer 4kV OZ terminators, it is recommended that on all outdoor terminators used on Simplex bare armored cable with the loose fitting sleeve, the sleeves be cut or untaped from the top of the terminator. This will allow any condensation to drain from between the cable armor and the sleeve, thus minimizing the possibility of water ingress between the cable jacket and insulation (the considered cause of failure of the above mentioned cables to pass DC Overvoltage testing). Removal of any potential "standing" water will possibly allow the cable to dry over the long term. This effort should be completed prior to return to power or shortly thereafter. This action is not required for those cables/terminators replaced at this outage or at prior times, or having no loose fitting sleeve. The specific terminators requiring this modification are as follows:

Circuit	Service	Location
1FA1COSP1	Safety Injection pump G-50A	At Pump
1FA2COSP1	Safety Injection pump G-50B	At Pump
1WA1C11P1	Station Service XFMR No. 3	At XFMR
1XGA2C10P1	Station Service XFMR No. 2	At XFMR
1WA1BO1P1	Spare Exciter	At Exciter

9.10 REFERENCES FOR SECTION 9.0

9.10.1 FCN Nos. S01348E, S01349E, S-1454E, S-1455E, S-1665E, F-1666E, F-1667E

9.10.2 Maintenance Order Nos. 85122719, 85122486, 86030604, 86022180, 86023273001

TABLES

There are no tables for Section 9.0.

ATTACHMENTS

There are no attachments for Section 9.0.

SECTION 10.0

LONG-TERM RECOMMENDATIONS

10.0 LONG-TERM RECOMMENDATIONS

Based on the information contained in Sections 6.0 and 7.0, the 4kV Cable Evaluation Task Force recommends the following remedial activities to ensure continued acceptable material condition of cables at San Onofre Unit 1. These activities should be implemented within the period prescribed in each recommendation.

10.1 DC OVERVOLTAGE TESTING

It is recommended that all the 4kV cables not replaced at this outage be DC Overvoltage tested at 28kV every five years (or three refuelings) as a precautionary measure to identify cable anomalies that could cause in-service failures.

Additionally, the OZ terminations identified in Section 9.9 should be DC Overvoltage tested at 28kV every refueling until replaced. For completeness these terminations are as follows:

Circuit	Service	Location
1FA1COSP1	Safety Injection pump G-50A	At Pump
1FA2COSP1	Safety Injection pump G-50B	At Pump
1WA1C11P1	Station Service XFMR No. 3	At XFMR
1XGA2C1OP1	Station Service XFMR No. 2	At XFMR
1WA1BO1P1	Spare Exciter	At Exciter

The 4kV cables and terminations replaced this outage should be DC Overvoltage tested in accordance with standard SCE practices.

10.2 CONDITIONING MONITORING PROGRAM AREA AMBIENT TEMPERATURE SURVEYS

Based on the results of the tray/cable inspections (Section 6.4) it is recommended that the ambient temperature in certain areas of the plant be monitored and recorded. The locations selected are areas of the plant where ambient temperatures higher than the normal outside containment design basis ambients of 104°F (40°C) are suspected. The suggested locations for this monitoring are indentified in Attachment 10-1.

It is recommended that the following areas be added to the scope of the existing EQ condition monitoring programs:

a) Turbine Building Lube Oil Mezzanine Area Trays 49S1, 36P1 and 36B2.

b) Turbine Building Reheater Area Tray 49M1

c) Turbine Building Auxiliary Feedwater Pump Area Tray 49F2 (two locations)

d) 4kV Switchgear Room Motor Control Center No. 1 Top Wireway (two locations)

It is recommended that the monitoring be continued over a period of several months in order to obtain average sustained ambient temperatures for these areas during varying environmental conditions. This monitoring is recommended to ensure that the actual plant environmental conditions are accurately reflected in the Unit 1 Retrofit General Design Criteria and the Environmental Qualification Program.

10.3 CABLE REPLACEMENT

No other 4kV cable (with the exception of the North TPCW Pump cable) need be replaced unless the cable fails during future DC Overvoltage tests or requires replacement to install new OZ terminators. The North TPCW Pump cable (repaired during the Cycle 9 outage) should be replaced at the first TPCW outage of sufficient duration but no later than return from the Cycle 10 refueling outage.

As discussed in Section 7.3, the 600V Simplex cables with cracked jackets can be expected to function in existing environments despite their appearance. Therefore, the 600V Simplex cables with cracked jackets need only be replaced if future visual inspections indicate a substantial further deterioration of the cable jacket or as a practical measure when performing retrofit modifications.

Whenever cable is replaced, it is recommended that a concerted effort be made to remove both the cable being replaced and any abandoned cable found or identified as part of the retrofit activity.

10.4 4kV TERMINATION REPLACEMENT

As discussed in Section 6.2.5 and 7.1.1 , it is recommended that outdoor 4kV terminations not replaced during the Cycle 9 refueling outage be replaced when opportunities present themselves or if failing recommended future DC Overvoltage testing.

10.5 PERIODIC INSPECTIONS OF CABLE IN TRAYS

As discussed in Section 7.2, 7.3.1, and 7.3.2, periodic visual inspections of cable in tray should be conducted to verify continued acceptable material condition. Cables in trays in the turbine building mezzanine and reheater areas should be inspected once per refueling interval, especially those trays containing the 600V Simplex, No. 12 AWG cables with cracked jackets. Cables in more benign temperature environments should be inspected every other refueling until/unless jacket cracking is identified. Cable in temperature controlled, air conditioned areas (4kV, 480V rooms) need not be inspected, with one specific exception. The 4/0 AWG Simplex cable discussed in Section 7.3.2 should be inspected every refueling to monitor jacket degradation, until/unless the cable has been replaced for reasons of maintenance or design implementation activities.

10.6 EG&G, IDAHO ECCAD TESTING

Periodic testing of select cable circuits with the EG&G, Idaho ECCAD System should continue to be evaluated for its effectiveness. It is not clear to the 4kVTF that continued ECCAD monitoring of cable circuits in a normal plant environment can be of significant value after an extensive cable testing and evaluation program as that conducted on Unit 1.

This is not to say that SCE should not assist in a joint research and development effort with EG&G, Idaho; to verify system capability and effectiveness. It is to say that such testing may not be mandatory to verify the material condition of cable.

10.7 PROCEDURAL CHANGES

It is recommended that Maintenance and Project procedures be reviewed to ensure that appropriate procedures explicitly require that the insulation of any piping removed for maintenance or construction purposes be replaced upon completion of the effort, and/or prior to placing the system back into service.

It is recommended that the San Onofre Unit 1 Retrofit General Design Criteria be revised to explicitly include the established piping to cable raceway separation criteria developed for San Onofre Units 2 and 3 and adopted by Unit 1 in 1984. The 4kVTF reviewed the basis of the existing pipe/conduit separation criteria with regard to its application to cable trays and large flanges in pipes. The complexity of the calculation on which the separation criteria are based, and the established schedule for completion of 4kVTF activities, precluded an in-depth review and verification of the criteria. As such, for conservatism the 4kVTF doubled the pipe to conduit separation criteria for cable trays and performed cable tray and piping heat transfer calculations (refer to Section 6.4) as the basis for evaluating potentially acceptable heat source to cable raceway interface. The reason the 4kVTF reviewed that calculation initially was because the field configuration prompting the in-service cable failure did not appear to violate the existing criteria. It is therefore recommended that the subject calculation and criteria be reviewed to account for localized heat sources such as flanges, valves, etc.

It is further recommended that the San Onofre Unit 1 Retrofit General Design Criteria be revised to require removal of cable that is being replaced (as opposed to allowing the cable to be abandoned in place).

10.8 SIMPLEX 600V CABLE IN MOTOR CONTROL CENTERS (MCCS)

As discussed in Section 7.2, the 600V cable exhibiting cracked jackets in the immediate vicinity of the terminal blocks in the 480V MCC's should be monitored for continued jacket degradation. The 600V Simplex cable with cracked jackets can be accommodated by one of the following methods:

1. Leave the cables as is (insulation is intact);
2. Check if there is excess wire in the compartment that is usable, if so, reterminate; or
3. Cover the cracked jacket with sleeving or tape;
4. Replace the entire cable runs.

It is recommended that the cables remain as is for the following reasons:

1. The cable is electrically acceptable because the insulation is not degraded. Additionally, laboratory results have shown the insulation has acceptable dielectric strength and is expected to function for the remaining design life of San Onofre Unit 1.
2. The cables are in a protected environment (MCC cabinets) and not exposed to potential mechanical damage.
3. To preclude potential damage to the insulation that any repair process may introduce.

However, it is recommended that the Unit 1 Project evaluate providing ventilation (either forced or natural circulation, as appropriate) to minimize the ambient temperature in the upper portion of the MCC's. It is believed that the drip-shields installed earlier on the top of the MCC's, which are composed of material with apparently excellent insulating properties, may be causing higher than normal temperatures in those sections of the MCC.

This evaluation and any subsequent actions should be completed prior to the return to power from the Cycle 10 refueling outage.

10.9 MISCELLANEOUS MCRP RECOMMENDATIONS

Some recommendations were offered by the MCRP team in the report of April 9, 1986 (Reference 10.10.1). The 4kVTF has evaluated those recommendations for implementation as follows:

MCT Recommendations

10.9.1 "It is recommended that the butyl insulated 4kV cables (original installation) be overpotential tested every third refueling under a routine preventative maintenance program."

4kVTF Recommendation:

As documented in Section 10.1, the 4kVTF concurs with the recommendation.

10.9.2 "A metal splice box in Feedwater room, column H13 at 15 foot elevation was opened and the team examined the cables and splices. In this box the 3/c, 350 kcmil cables are spliced to three 1/c, 350 kcmil, 5kV shielded cables which leave from the bottom. An oil-like liquid had leaked from the vertical cable splices and had flowed over the surface of the single conductor cables and down to the floor of the box."

MCT Recommendation:

"Remove splice insulation. Inspect cables for damage. Inspect ends of armored cable to determine if the required 6" length of neoprene jacket has been removed. Remove the end 6" of neoprene jacket, if present, before reinsulating splice. Make repairs as necessary."

4kVTF Recommendation:

The 4kVTF will ensure a Maintenance Order to inspect the splices has been prepared.

10.9.3 "Splice box cover could not be opened for this circuit (South Circulating Water Pump, 1XA2C03P1) as no clearance had been obtained. The contents of this box including the cable splices could not be examined."

<u>MCT Recommendation/Action</u>:

"Open box, inspect splices. If similar conditions as found in Item I.e.1 (10.9.2) are present, proceed as recommended for Item I.e.1."

<u>4kVTF Recommendation/Action</u>:

The 4kVTF will ensure a Maintenance Order to inspect the splices has been prepared.

10.9.4 "Splice box (of item 10.9.2) is labeled 'High Voltage Duct Bank' but does not identify its contents. One cover screw is missing."

<u>MCT Recommendation</u>:

"Label terminal box cover to identify contents."

<u>4kVTF Recommendation/Action</u>:

The 4kVTF will ensure a Maintenance Order to label the box and replace the screw has been prepared.

10.9.5 "Outdoor terminal box (Spare Exciter Circuit, 1WA1B01P1) is not labeled as to contents."

<u>MCT Recommendation</u>:

"Label terminal box to identify contents."

4kVTF Recommendation/Action:

The 4kVTF will ensure a Maintenance Order to label the box has been prepared.

10.9.6 "One (Security) battery cable east of batteries is laying on the concrete floor."

MCT Recommendation:

"Raise cable off floor."

4kVTF Recommendation/Action:

The 4kVTF will request Site Project Engineering to assess this cable routing and implement appropriate action.

10.9.7 "Terminal area behind Control Room control and relay panels. Team found cables in good condition. At terminal lugs the neoprene jackets have not been cut back. Team found quantities of abandoned cable behind panels."

MCT Recommendation:

"Remove abandoned cables from behind panels and from cable trays when convenient."

4kVTF Recommendation:

The 4kVTF recommendations regarding abandoned cables, in general, is discussed in Sections 7.5.8, and 10.3.

10.9.8 MCT Recommendation

"It is recommended that during the next scheduled outage, the following preventive maintenance be performed on all outdoor bare armored cable and terminations.

1. Extend the existing cable termination cabinets 18 inches above the existing box.

2. Cut the cable at the armor terminator and re-terminate the cable.

3. Install shrinkable protective boot over the armor and terminator."

<u>4kVTF Recommendation</u>:

The 4kVTF recommendation regarding terminations is documented in Sections 9.9, and 10.4

10.10 REFERENCES FOR SECTION 10.0

10.10.1 Letter, S.C. Khamamkar to R. S. Hunter dated April 9, 1986; Subject: Material Condition Review Program, San Onofre Unit 1.

TABLES

There are no tables for Section 10.0.

ATTACHMENTS

SECTION 10.0

Task ID	System ID	Task Description
353FAA1616	FAA	Start up the auxiliary boiler feedwater system.
353FAA1617	FAA	Purge the auxiliary boiler.
353FAA1618	FAA	Start the auxiliary boiler ignitor.
353FAA1619	FAA	Prime the fuel oil pump suction header.
353FAA1620	FAA	Startup the auxiliary boiler fuel oil system.
353FAA1621	FAA	Place an oil gun in service.
353FAA1622	FAA	Warm up the auxiliary boiler and auxiliary steam system.
353FAA1623	FAA	Blowdown the auxiliary boiler water column gauge glass.
353FAA1624	FAA	Shutdown the auxiliary boiler.
353FAA1625	FAA	Add oil to the auxiliary boiler fuel oil storage tank.
353FAA1626	FAA	Charge the auxiliary boiler hydrazine tank.
353FAA1627	FAA	Charge the auxiliary boiler ammonia tank.
353FAA2342	FAA	Remove an oil gun from service.
353FAA2343	FAA	Align blowdown separator for operation.
353FAA2344	FAA	Adjust auxiliary boiler blowdown flowrate.
352FAA2345	FAA	Manually operate the auxiliary boiler.
353FAA2346	FAA	Calculate and record auxiliary boiler loading times.

Task ID	System ID	Task Description
253BMA1628	BMA	Align the blowdown processing demineralizers to clean up the condensate and feedwater system.
253BMA1629	BMA	Place two demineralizers (one in lead and one in lag) in service for condensate cleanup returning to the hotwell.
253BMA1630	BMA	Place two demineralizers (one in lead and one in lag) in service for steam generator blowdown returning to the hotwell.
253BMA1631	BMA	Place a single demineralizer in service for condensate cleanup returning to the hotwell.
253BMA1632	BMA	Place a single demineralizer in service for steam generator blowdown returning to the hotwell.
253BMA1633	BMA	Remove a lead demineralizer from service in preparation for a regeneration.
253BMA1634	BMA	Remove a lag demineralizer from service in preparation for a regeneration.
253BMA1635	BMA	Remove a lead demineralizer from service in preparation for a cleaning.
253BMA1636	BMA	Remove a lag demineralizer from service in preparation for a cleaning.
253BMA1637	BMA	Isolate a bed that has tripped out on high differential pressure or high conductivity.
253BMA1638	BMA	Isolate a lag demineralizer that has diverted to the outfall due to high conductivity.
253BMA1639	BMA	Remove a lead demineralizer from service to backwash a resin trap.
253BMA1640	BMA	Remove a lag demineralizer from service to backwash a resin trap.
253BMA1641	BMA	Exchange the position of the primary and polisher demineralizers.
253BMA1642	BMA	Remove one demineralizer from service for a prolonged outage while keeping the remaining demineralizer in service.
253BMA1643	BMA	Remove both demineralizers from service and isolate the system for a prolonged outage.

Task ID	System ID	Task Description
253BMA1644	BMA	Remove both demineralizers from service and route steam generator blowdown to the outfall.
253BMA1645	BMA	Remove both demineralizers from service and route condensate slipstream to the hotwell.
253BMA1646	BMA	Remove both demineralizers from service and route blowdown to the outfall via the "fish fry".
253BMA1647	BMA	Remove a BPS filter (F-450 or F-451) from service and isolate and drain it for a filter change out.
253BMA1648	BMA	Return a BPS filter to service after a filter change out.
253BMA1649	BMA	Manually backwash a demineralizer for resin measuring or bed separation verification.
253BMA1650	BMA	Manually air mix an isolated demineralizer.
253BMA1651	BMA	Manually drain a demineralizer for a resin change or resin addition.
253BMA1652	BMA	Manually flush radiation monitor and the effluent line.
253BMA1653	BMA	Manually perform a final rinse of a regeneration using condensate to the outfall.
253BMA2353	BMA	Align steam generator blowdown and condensate slip stream through the BPS demineralizers and return to hotwell.
253BMA2354	BMA	Manually operate pneumatically operated valves associated with the BPS demineralizers.

Task ID	System ID	Task Description
344ADM1715	ADM	Use barrier tape to retrict access to certain plant areas.
344ADM1716	ADM	Follow safety rules.
344ADM1717	ADM	Prepare and hang caution tags.
344ADM1718	ADM	Identify equipment deficiencies and prepare equipment deficiency tags.
344ADM1719	ADM	Inspect equipment identification labels.
344ADM1720	ADM	Complete on-shift required reading assignments.
344ADM1721	ADM	Use operating instructions to conduct plant manipulations.
344ADM1722	ADM	Initiate a temporary change notice.
344ADM1723	ADM	Verify component nomenclature.
344ADM1724	ADM	Act as a checker during valve alignments.
344ADM1725	ADM	Perform independent verification of valve alignments.
344ADM1726	ADM	Define clearance boundries and prepare clearance tags.
344ADM1727	ADM	Attend preshift briefings.
344ADM1728	ADM	Conduct shift turnover.
344ADM1729	ADM	Use leverage devices to operate manual valves.
344ADM1730	ADM	Perform valve alignments.
344ADM1731	ADM	Add oil to plant equipment.
343AQA0255	AQA	Receive ammonia for bulk ammonia storage tank.
344BMA0256	BMA	Inspect blowdown processing system sluice pump.
343DAA2486	DAA	Align the chlorine injection system for operation.
343DAA2487	DAA	Manually operate the chlorine injection system.
343EAA0262	EAA	Inspect service water pumps.
343EAA0263	EAA	Align the service water system for operation.

Task ID	System ID	Task Description
343EAA0285	EAA	Align the domestic water system for operation.
345GMA0264	GMA	Test operation of diesel generator building air supply fans.
343HGX0303	HGX	Inspect diesel generator building sump and sump pumps.
343HGX1698	HGX	Verify valve and breaker alignment of diesel generator sump pumps.
345HGX1706	HGX	Test operation of sump pumps.
343KBA0265	KBA	Reset service air header pressure control valve.
343KBA0266	KBA	Align valves to place service air system in service.
343KBA0267	KBA	Align valves to remove the service air system from service.
343KBA0268	KBA	Align valves to place the instrument air system in service.
343KBA0269	KBA	Monitor the operation of the service and instrument air compressors.
343KBA0270	KBA	Start-up the instrument air dryer.
343KBA0271	KBA	Remove instrument and service air compressor from service.
343KBA0272	KBA	Shutdown the instrument air dryer.
343KBA0273	KBA	Monitor the operation of the instrument air dryers.
345KBA0274	KBA	Test the automatic start on the service and instrument air compressor.
343KBA1603	KBA	Align turbine plant cooling water to the air compressors and air dryers.
343KBA1604	KBA	Return an air compressor to service with its associated air reservoir pressurized.
343KBA1605	KBA	Return an air compressor to service with its air receiver below system pressure.
343KBA1606	KBA	Blowdown an instrument air receiver.

Task ID	System ID	Task Description
343KBA2483	KBA	Align the temporary air compressors for operation.
343KBA2484	KBA	Start the temporary air compressors.
343KBA2485	KBA	Stop the temporary air compressors.
342KCX0275	KCX	Align the service water system to supply water to the fire suppression water system.
342KCX0276	KCX	Reset the carbon dioxide fire protection system following initiation.
343KCX0277	KCX	Inspect jockey pumps.
343KCX0278	KCX	Align the halon fire protection system for normal operation.
343KCX0279	KCX	Inspect diesel generator building fire protection system.
343KCX0280	KCX	Inspect fire pump diesel engine.
343KCX0281	KCX	Monitor level in diesel driven fire pump fuel oil storage tank.
343KCX0282	KCX	Inspect diesel driven fire pump.
343KCX0283	KCX	Inspect motor driven fire pumps.
345KCX0284	KCX	Test the operation of the fire suppression sytem.
345KCX1607	KCX	Perform the diesel fire pump monthly operability verification.
343KCX1615	KCX	Monitor the operation of the carbon dioxide system.
342KHA0286	KHA	Manually operate the liquid nitrogen pump.
343KHA0287	KHA	Align the high pressure nitrogen system for operation.
343KHA0288	KHA	Align the low pressure nitrogen header for operation.
343KHA0289	KHA	Add liquid nitrogen to the nitrogen storage tank.
343KHA0290	KHA	Inspect nitrogen storage system.
343KHA0291	KHA	Inspect nitrogen transfer pumps.

Task ID	System ID	Task Description
343KHA1608	KHA	Align the nitrogen pumps for service.
343KJX0293	KJX	Inspect emergency diesel generator during standby conditions.
345KJX0294	KJX	Add coolant to the diesel generator.
345KJX0295	KJX	Add lube oil to a diesel generator.
345KJX0296	KJX	Add fuel to diesel fuel storage tank.
345KJX0299	KJX	Test diesel generator local annunicator panel.
343KLA0300	KLA	Monitor the operation of the hydrogen bank system.
343KLA0301	KLA	Verify hydrogen system valve alignment.
345KLA0302	KLA	Align hydrogen bank system to fill hydrogen storage bottles.
343KLA1609	KLA	Align the hydrogen banks for normal operation.
343LFA1610	LFA	Determine the perferred waste water discharge alignment.
343LFA1611	LFA	Discharge waste water to the Unit 2 outfall.
343LFA1612	LFA	Discharge the evaporation pond to the Unit 2 or Unit 3 outfall.
343LFA1613	LFA	Discharge waste water to the Unit 1 outfall.
343LFA1614	LFA	Discharge the evaporating pond to the Unit 1 outfall.
343LFA1699	LFA	Startup the air flotation system chemical feed subsystem.
343LFA1700	LFA	Startup the air flotation subsystem.
343LFA1701	LFA	Verify valve and breaker alignment of oily waste sump pumps.
343LFA1702	LFA	Align makeup demineralizer neutralization sumps to the unit 2 outfall.
343LFA1703	LFA	Operate the oily waste flotation separator.
343LFA1704	LFA	Align waste water discharge to the evaporation pond.

Task ID	System ID	Task Description
343LFA1705	LFA	Verify valve alignment of sulphuric acid and caustic storage tanks area sumps.
343MAX0311	MAX	Monitor the operation of the main and auxiliary transformers.
343MAX0312	MAX	Align the main and auxiliary transformers for operation.
343MAX0313	MAX	Read the lightning arrester discharge counter.
345MAX0314	MAX	Clear the main and auxiliary transformers.
342MAX0315	MAX	Inspect auxiliary transformers upon receipt of trouble alarm to identify cause of alarm.
344MAX0316	MAX	Inspect transformer fault gas monitor.
343MAX0323	MAX	Monitor the operation of the reserve auxiliary transformer.
343MAX0324	MAX	Align a reserve auxiliary transformer for operation.
345MAX0325	MAX	Clear a reserve auxiliary transformer.
342MKA0317	MKA	Isolate trouble alarm on switchyard circuit breakers.
343MKA0318	MKA	Transfer relay house power supply to alternate source.
343MKA0319	MKA	Monitor the operation of equipment in the switchyard.
345MKA0320	MKA	Perform 220 kv switching operations.
345MKA0321	MKA	Test SKBU phase comparison relays.
345MKA0322	MKA	Test the Chino 220 kv line SLD phase comparison carrier relay.
343MKA1732	MKA	Prepare a clearance for a 220 kv line.
343MKA1733	MKA	Prepare a clearance for a 220 kv bus.
343MKA1734	MKA	Prepare a switching order for a 220 kv line.
343MKA1735	MKA	Prepare a switching order for a 220 kv bus.

Task ID	System ID	Task Description
343MKA1736	MKA	Perform as a checker during switching operations.
343MKA1737	MKA	Log weekly switchyard power circuit breaker readings.
342MKA1738	MKA	Inspect switchyard following a line relay.
343NKA0327	NKA	Inspect switchyard batteries.
343NKA0328	NKA	Remove a non'class 1E 125 VDC battery charger from service.
343NKA0329	NKA	Place non class 1E 125 VDC battery charger in service.
343NKA0330	NKA	Monitor the operation of non-class 1E 125 VDC system.
344OAA0331	OAA	Operate lighting panel breakers.
345OAA0332	OAA	Test emergency lighting units.
345OAA0333	OAA	Test the operation of the DC emergency lighting system.

Task ID	System ID	Task Description
263FFD1654	FFD	Align the FFCPD system for normal operation.
263FFD1655	FFD	Place the FFCPD system into normal operation from resin transfer in.
263FFD1656	FFD	Shutdown the FFCPD to resin transfer out.
263FFD1657	FFD	Place a standby cation bed in service.
263FFD1658	FFD	Place a standby mixed bed in service.
263FFD1659	FFD	Transfer a cation bed for air scrub/backwash cleanup due to high PSIGD and return to service vessel.
263FFD1660	FFD	Regenerate a cation bed in auto mode.
263FFD1661	FFD	Manually operate pneumatically operated valves associated with the FFCPD.
263FFD1662	FFD	Manually perform any step in the regeneration process.
263FFD1663	FFD	Manually restart regeneration at any step in the process.
263FFD1664	FFD	Manually adjust sulfuric acid and caustic concentrations.
263FFD1665	FFD	Manually neutralize the neutralization sump. (Low and High)
263FFD1666	FFD	Manually step the FFCPD control panel thru any step.
263FFD1667	FFD	Fill the caustic day tanks.
263FFD1668	FFD	Fill the sulfuric acid day tank.

Task ID	System ID	Task Description
363ANA1669	ANA	Align the makeup demineralizer system for normal operation.
363ANA1670	ANA	Place the makeup demineralizer into recycle operation.
363ANA1671	ANA	Place the makeup demineralizer system into normal operation from recycle operation.
363ANA1672	ANA	Shutdown the makeup demineralizer.
363ANA1673	ANA	Place a standby cation/anion train in service.
363ANA1674	ANA	Place a standby mixed bed demineralizer into service.
363ANA1675	ANA	Align the makeup demineralizer control panel for semi-automatic regeneration.
363ANA1676	ANA	Regenerate a cation/anion unit in the semi-automatic mode.
363ANA1677	ANA	Regenerate a mixed bed unit in the semi-automatic mode.
363ANA1678	ANA	Manually operate pneumatically operated valves associated with the makeup demineralizer.
363ANA1679	ANA	Manually perform any step in the regeneration process.
363ANA1680	ANA	Drain water from the vacuum pump crankcase.
363ANA1681	ANA	Change oil in the vacuum pump crankcase.
363ANA1682	ANA	Manually restart regeneration at any step in the process.
363ANA1683	ANA	Manually adjust sulphuric acid and caustic concentrations.
363ANA1684	ANA	Manually neutralize the neutralization sump.
363ANA1685	ANA	Manually step the makeup demineralizer master or individual programmers.
363ANA1686	ANA	Fill the caustic storage tank.
363ANA1687	ANA	Fill the sulphuric acid storage tank.

Task ID	System ID	Task Description
363ANA2339	ANA	Discharge the neutralization sump.
363APA1688	APA	Fill the condensate storage tank, T-120 using the makeup demineralizer.
363APA1689	APA	Fill condensate storage tank, T-121, using the makeup demineralizer.
363APA1690	APA	Place the condensate transfer pump in service.
363APA1691	APA	Fill condensate storage tank, T-121 from the opposite unit's condensate storage tank, T-120.
363APA1692	APA	Fill condensate storage tanks T-120 and T-121 from the rubber tire demineralizer.
363APA1693	APA	Fill condensate storage tank T-121 from condensate storage tank T-120 using the condensate transfer pump.
363APA1694	APA	Fill condensate storage tank T-120 from the opposite unit's condensate storage tank, T-120.
363APA1695	APA	Align the condensate storage and transfer system to fill the condensate storage tank, T-121 using semi-automatic makeup.
363APA1696	APA	Fill the demineralized water storage tanks from the makeup demineralizer.
363APA1697	APA	Fill condensate storage tanks T-120 and T-121 from the demineralized water storage tanks.
363APA2340	APA	Fill the Nuclear Service Water Tank from the makeup demineralizer or condensate storage tank T-120.
363APA2341	APA	Verify alignment of condensate drawoff system.
363APA2355	APA	Fill the Unit 1 condensate storage tank from the Unit 2/3 condensate storage tanks.

Task ID	System ID	Task Description
1332200334	220	Inspect 220 kv switchyard and associated equipment.
1332200335	220	Conduct 220 kv switching operations.
1334800336	480	Manually operate a 480 volt breaker.
1324800337	480	Inspect 480 volt circuit breaker after a relay operation.
1334800338	480	Inspect 480 volt system and associated equipment.
1334800339	480	Rack out 480 volt circuit breakers.
1354800340	480	Clear a 480 volt motor center feeder circuit.
1354800341	480	Verify the alignment of the 480 volt transfer switches.
1334800342	480	Place a 480 volt breaker in the test position.
1324800343	480	Locate 480 volt grounds under the direction of the control operator.
1354800344	480	Test fans on the station service transformers.
1334800345	480	Rack in 480 volt circut breakers.
1334KV0346	4KV	Manually operate a 4160 volt ACB.
1324KV0347	4KV	Inspect a 4 kv circuit breaker after a relay operation.
1334KV0348	4KV	Inspect 4160 volt system equipment.
1334KV0349	4KV	Place a 4160 volt circuit breaker into it's cubicle.
1334KV0350	4KV	Remove a 4160 volt circuit breaker from it's cubicle.
1334KV0351	4KV	Place a 4160 volt ACB in the test postion.
1334KV0352	4KV	Place a 4160 volt ACB in the operating position.
1354KV0353	4KV	Pull 4160 volt potential transformer primary fuses to clear a 4 kv bus.
1334KV0354	4KV	Rack out a 4160 volt ACB.

Task ID	System ID	Task Description
133ACP0355	ACP	Perform a routine inspection of the auxiliary control panel.
135ACP0356	ACP	Perform an operability test of the auxiliary control panel.
135ACP2488	ACP	Perform an auxiliary control panel check.
134ADM0357	ADM	Define clearance boundries and prepare clearance tags to remove equipment from service for maintenance.
134ADM0358	ADM	Prepare and hang information and caution tags.
134ADM0359	ADM	Use barrier tape to restrict access to certain plant areas.
134ADM0360	ADM	Conduct shift turnover.
134ADM0361	ADM	Perform independent verification of valve alignments.
134ADM0362	ADM	Attend preshift briefings.
134ADM0363	ADM	Maintain cleanliness of responsible are and equipment.
134ADM0364	ADM	Act as a checker during valve alignments.
134ADM0365	ADM	Identify equipment deficiencies and prepare an equipment deficiency tag.
134ADM0366	ADM	Enter equipment deficiency information into SOMMs.
134ADM0367	ADM	Add oil to plant equipment.
134ADM0368	ADM	Use operating instructions to conduct plant manipulations.
134ADM0369	ADM	Review control operator's log at beginning of shift.
132AFW0370	AFW	Align the auxiliary feedwater pumps to alternate suction supplies.
133AFW0371	AFW	Align the auxiliary feedwater system for operation.
133AFW0372	AFW	Inspect auxiliary feedwater system for normal operation.

Task ID	System ID	Task Description
133AFW0373	AFW	Locally start the turbine driven auxiliary feedwater pump.
135AFW0374	AFW	Test the auxiliary feedwater pump.
135AFW0375	AFW	Test the auxiliary feed pump turbine overspeed trip.
133AFW2489	AFW	Transfer water from Unit 2 to the auxiliary feedwater tank.
133ATX0376	ATX	Place the auxiliary transformer cooling fans in service.
133ATX0377	ATX	Place the main transformer fans and oil pumps in service.
133ATX0378	ATX	Place the 12kv/480v transformer in service.
133ATX0379	ATX	Remove the 12kv/480 volt transformer from service.
133ATX0380	ATX	Inspect main and auxiliary transformers and associated equipment for normal operation.
133ATX0381	ATX	Swap fan banks on main transformer.
135ATX0382	ATX	Test the automatic operation of the main transformer oil pumps and fans.
135ATX0383	ATX	Test fans on aux A and B transformer.
133CNA0384	CNA	Align the condenser air removal system to establish condenser vacuum.
133CNA0385	CNA	Operate the condenser ammonia stripper.
133CNA0386	CNA	Startup air ejectors.
133CNA0387	CNA	Inspect the condenser air removal system for normal operation.
135CNA0388	CNA	Test the automatic operation of the condenser vacuum pumps.
133CNA2497	CNA	Align the air ejector to overboard the after condenser drains.
132CND0389	CND	Monitor the condenser for air leaks.
132CND0390	CND	Isolate and overboard condenser hotwells.

Task ID	System ID	Task Description
133CND0391	CND	Manually operate the hotwell makeup/drawoff system.
133CND0392	CND	Align the condensate

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Task ID	System ID	Task Description
233ABA0617	ABA	Place the main steam isolation valves is service.
233ABA0618	ABA	Inspect the main steam isolation valves.
233ABA0619	ABA	Remove the main steam isolation valves from service.
233ABA0624	ABA	Establish a nitrogen blanket on a steam generator.
233ABA0628	ABA	Align the steam generator secondary side for direct discharge to the outfall.
233ABA1428	ABA	Place the main steam leads in service upstream of the main steam isolation valves.
233ABA1429	ABA	Blowdown the main steam leads during power operations.
235ABA1430	ABA	Perform atmospheric steam dump weekly check.
232ABA1431	ABA	Operate the atmospheric steam dump valve in local manual.
233AEA1459	AEA	Place a main feedwater isolation valve in service.
233AEA1460	AEA	Remove a main feedwater isolation valve from service.
233AEA1461	AEA	Place a main feedwater block isolation valve in service.
233AEA1462	AEA	Remove a main feedwater block isolation valve from service.
232AEA1463	AEA	Operate the main feedwater regulating valves in local manual.
232AEA1464	AEA	Operate the main feedwater bypass valves in local manual.
233AEB1714	AEB	Align the feedwater headers and feedwater control system for operation.
233ALA0620	ALA	Inspect turbine driven auxiliary feed pump.
233ALA0621	ALA	Inspect the motor driven auxiliary feedwater pump.
233ALA1432	ALA	Inspect the auxiliary feedwater system hydraulic

Task ID	System ID	Task Description
233ALA1433	ALA	Verify that the auxiliary feed pump turbine stop valve, HV-4716, is not in a tripped condition.
233ALA1434	ALA	Inspect the auxiliary feed pump discharge check valve for leakage.
233ALA1435	ALA	Inspect the auxiliary feed pump turbine steam supply line for leakage and to verify that the line is not submerged.
235ALA2468	ALA	Perform shiftly surveillance on the turbine driven auxiliary feedwater pump.
233ALA2469	ALA	Inspect the auxiliary feedwater pump's bearing oil supply tank.
233ALA2470	ALA	Verify the auxiliary feedwater system valve alignment.
233ALA2592	ALA	Reset the auxiliary feed pump turbine stop valve HV-4716.
233AQA0622	AQA	Charge the auxiliary feedwater system chemical feeder.
233AQA0623	AQA	Charge the auxiliary feedwater system ammonia tank.

Task ID	System ID	Task Description
233AQA1436	AQA	Charge the auxiliary feedwater system hydrazine tank.
233AQA2471	AQA	Monitor the operation of the auxiliary feedwater chemical addition system.
233BBA0625	BBA	Drain the reactor coolant system.
233BBA0626	BBA	Align reactor coolant system valves to fill and vent reactor coolant system.
233BBA0627	BBA	Vent the reactor coolant pumps.
233BBA1437	BBA	Verify that a reactor coolant pump is ready to start.
233BBA1438	BBA	Place the refueling level detector in service.
233BBA2472	BBA	Inspect the reactor cavity seal backup system during refueling.
233BBB1465	BBB	Add water to the quench tank.
233BGA0629	BGA	Transfer charging pump power supplies.
233BGA0630	BGA	Perform valve line ups on the chemical and volume control system.
233BGA2473	BGA	Place the nitrogen and hydrogen regulators to the volume control tank in service.
233BGA2474	BGA	Monitor the operation of the chemical and volume control system.
233BHA0631	BHA	Fill the containment emergency sump suction lines.
233BHA0633	BHA	Align high pressure safety injection system for normal operation.
233BHA0634	BHA	Inspect the safety injection system.
233BHA0636	BHA	Vent the shutdown cooling system.
233BHA0637	BHA	Drain the shutdown cooling heat exchangers.
235BHA0638	BHA	Test the high pressure safety injection system for leakage.
233BHA1439	BHA	Vent the high pressure safety injection piping high points.

Task ID	System ID	Task Description
233BHA1440	BHA	Fill and vent a shutdown cooling heat exchanger.
235BHA1441	BHA	Perform a once a shift surveillance on the safety injection system valves.
233BHA1442	BHA	Transfer the power supply of the third of a kind high pressure safety injection pump.
233BKA0639	BKA	Drain the containment spray chemical storage tank.
233BKA0640	BKA	Fill the containment spray chemical storage tank.
233BKA0641	BKA	Align the containment spray and iodine removal system for normal operation.
233BKA0642	BKA	Inspect the chemical spray tank and pumps.
235BKA0643	BKA	Flush containment spray system.
233BKA1443	BKA	Inspect the spray heat trace control panels.
233ECA0644	ECA	Makeup to the spent fuel pool via the refueling water tanks and the spent fuel pool cooling pumps.
233ECA0645	ECA	Makeup to the spent fuel pool via the spent fuel pool makeup pump.
233ECA0646	ECA	Place the spent fuel purification system in service.
233ECA0647	ECA	Place the spent fuel pool cooling system in service.
233ECA0648	ECA	Makeup to the spent fuel pool via the primary makeup water tank and spent fuel cooling pumps.
233ECA0649	ECA	Inspect the spent fuel pool pumps.
233ECA0650	ECA	Inspect the fuel pool purification pump.
233ECA0716	ECA	Clean up the refueling water tank via the spent fuel purification system.
233ECA1444	ECA	Makeup to the spent fuel pool via the refueling water storage tank and the containment spray pumps.
233ECA1445	ECA	Makeup to the spent fuel pool via the low pressure safety injections pumps and the shutdown cooling system.

Task ID	System ID	Task Description
233ECA2475	ECA	Inspect the spent fuel pool for leakage.
233ECA2476	ECA	Inspect the gate seal system for proper operation.
233ECA2477	ECA	Verify valve alignment of the spent fuel pool cooling system.
233ECA2478	ECA	Inspect the spent fuel pool.
233ECA2479	ECA	Inspect the fuel transfer canal for leakage.
232EGAØ651	EGA	Manually fill the component cooling water surge tank.
232EGAØ652	EGA	Inspect the component cooling water pumps.
233EGAØ653	EGA	Inspect the component cooling water surge tank.
233EGAØ654	EGA	Align the component cooling water system for normal operation.
233EGAØ655	EGA	Inspect the component cooling water heat exchangers.
233EGAØ656	EGA	Add chemicals to the component cooling water system.
233EGAØ657	EGA	Transfer component cooling water pump power supplies.
235EGAØ658	EGA	Return a component cooling water pump to service following maintenance.
235EGAØ659	EGA	Isolate and drain a component cooling water pump.
232EGAØ66Ø	EGA	Backwash the component cooling water heat exchangers.
233EGA1446	EGA	Read and interpret the component cooling water bearing temperature scanner.
233EGA1447	EGA	Drain the component cooling water side and salt water side of a component cooling water heat exchanger.
233EGA1448	EGA	Return a component cooling water heat exchanger to service.
233EGA1449	EGA	Transfer the component cooling water supply to the emergency chillers E-355 and/or E-336.

Task ID	System ID	Task Description
232EPA0858	EPA	Transfer salt water cooling pump power supplies.
233EPA0859	EPA	Align the salt water cooling system loops for startup.
233EPA1594	EPA	Place the salt water cooling loops in service.
232FHS0612	FHS	Startup the refueling cavity purification system.
232FHS0613	FHS	Fill the refueling cavity and the fuel transfer pool.
235FHS0614	FHS	Dewater the refueling cavity with the fuel pool purification pump.
235FHS0615	FHS	Drain the refueling cavity and the fuel transfer pool to the refueling water storage tank.
235FHS0616	FHS	Dewater the spent fuel transfer pool with the fuel pool purification pump.
233GGA0717	GGA	Align the fuel handling building normal ventilation system for normal operation.
233GGA1466	GGA	Inspect the fuel handling building ventiliation system.
233GGA1836	GGA	Align the fuel handling building isolation and emergency air cleanup system for normal operation.
233GHB0718	GHB	Inspect the charging pump and boric acid makeup pump room HVAC system.
233GLD0664	GLD	Inspect the cable spreading and electrical rooms HVAC system.
233GLD0665	GLD	Align the cable spreading and electrical rooms HVAC system for normal operation.
233GLF0666	GLF	Align the ESF switchgear and battery room normal HVAC system for normal operation.
233GLF0667	GLF	Inspect the ESF switchgear rooms HVAC system.
233GLX0230	GLX	Shutdown the condensate storage tank area HVAC system.
233GLX0231	GLX	Startup the condensate storage tank area HVAC system.

Task ID	System ID	Task Description
233GLX0686	GLX	Startup the safety equipment building elevator machine room HVAC system.
233GLX0687	GLX	Shutdown the safety equipment building elevator machine room HVAC system.
233GNX0668	GNX	Inspect the containment building dome circulators.
233GNX0669	GNX	Inspect the containment building lower level circulating fans.
233GNX0670	GNX	Inspect the containment normal cooling system air handling units.
233GNX0671	GNX	Inspect the control element drive mechanism cooling system.
233GNX1740	GNX	Inspect the containment chilled water pump following startup.
233GNX1741	GNX	Inspect a containment chiller unit following startup.
233GNX1742	GNX	Place the hydrogen purge system in service.
233GRA0672	GRA	Align the electrical and piping penetration building HVAC system for normal operation.
233GRA0673	GRA	Align the main steam and feedwater penetration rooms HVAC system for normal operation.
233GRA0674	GRA	Inspect the penetraion building HVAC system.
233GRA1450	GRA	Inspect the main steam and feedwater penetration area temperature control panel.
233GXX0675	GXX	Manually start the safety injection and CCW pump rooms emergency air conditioning systems.
233GXX0676	GXX	Align the safety injection and CCW pump rooms emergency HVAC system for operation.
233GXX0677	GXX	Align the safety injection and CCW pump rooms normal HVAC system for normal operation.
233GXX0678	GXX	Align the safety equipment building normal HVAC system for normal operation.
233GXX0679	GXX	Inspect the safety equipment building normal HVAC system.

Task ID	System ID	Task Description
233GYAØ68Ø	GYA	Inspect the safety equipment building electrical tunnels HVAC system.
233GYAØ681	GYA	Startup access building and storage tank area electrical tunnels HVAC system.
233GYAØ682	GYA	Startup the safety equipment building electrical tunnels HVAC system.
233GYAØ683	GYA	Shutdown the access building and storage area electrical tunnels HVAC system.
233GYAØ684	GYA	Inspect the access building and storage tank area electrical tunnels HVAC system.
233GYAØ685	GYA	Shutdown the safety equipment building electrical tunnels HVAC sytem.
233HGXØ688	HGX	Verify valve and breaker alignment of radwaste safety equipment building sump pumps.
233HGXØ689	HGX	Verify valve and breaker alignment of component cooling water room sump pumps.
233HGXØ69Ø	HGX	Verify valve and breaker alignment of penetration room area sump pumps.
233HGXØ691	HGX	Monitor the operation of component cooling water room sump pumps.
233HGXØ692	HGX	Verify valve and breaker alignment of containment sump pumps.
233HGXØ693	HGX	Inspect the penetration building sumps and sump pumps.
235HGX1451	HGX	Perform a functional test on the sump pumps in the PPEO's area of responsibility.
233HGX1452	HGX	Manually pump radioactive and non-radioactive sumps.
233HGX248Ø	HGX	Inspect the fuel handling building sump.
233KCX1467	KCX	Inspect the spent fuel pool heat exchanger and pumps rooms wet sprinkler system.
233KCX1468	KCX	Inspect the component cooling water heat exchanger rooms and safety equipment room wet sprinkler system.

Task ID	System ID	Task Description
233KJX0292	KJX	Align the diesel generator for automatic start operations.
235KJX0297	KJX	Isolate a diesel generator for maintenance.
235KJX0298	KJX	Test the operation of the diesel generator.
233NAX0694	NAX	Place a 6.9 kv breaker in the test position.
233NAX0695	NAX	Remove a 6.9 kv breaker from the operating position.
233NAX0696	NAX	Inspect 6.9kv switchgear.
233NAX0697	NAX	Place a 6.9kv circuit breaker in the operating position.
232NAX1456	NAX	Inspect a 6.9 kv circuit breaker after a relay operation.
233NAX2481	NAX	Clear a 6.9 kv bus.
233NBX1453	NBX	Place a 4 kv circuit breaker into the operating position.
233NBX1454	NBX	Remove a 4 kv circuit breaker from the operating position.
233NBX1455	NBX	Place a 4 kv air circuit breaker in to test position.
232NBX1457	NBX	Inspect a 4 kv circuit breaker after a relay operation.
233NBX2482	NBX	Clear a 4 kv bus.
233NGX0698	NGX	Inspect the 480 volt power center switchgear.
233NGX0699	NGX	Inspect 480 volt motor control centers.
232NGX1458	NGX	Inspect a 480 volt circuit breaker after a relay operation.
233NGX1759	NGX	Rack in a 480 volt circuit breaker.
233NGX1760	NGX	Rack out a 480 volt circuit breaker.
233NGX1761	NGX	Remove a 480 volt circuit breaker from it's cubicle.

Task ID	System ID	Task Description
233NGX1762	NGX	Replace a 480 volt circuit breaker in it's cubicle.
233QAA1804	QAA	Place the aircraft obstruction warning light system in service.
233SDA1469	SDA	Read and interpret the radiation levels on area radiation monitors.
233SDA1470	SDA	Place the containment purge area radiation monitors in service.
235SFC0251	SFC	Verify the operability of the remote shutdown panel.
233SPA1471	SPA	Place the component cooling water process radiation monitor in service.
233SPA1472	SPA	Place the fuel handling area vent airborne process radiation monitors in service.
233SPA1473	SPA	Align the containment airborne effluent radiaiton monitors for operation.
233SPA1474	SPA	Place the containment/plant vent stack wide range gas monitor in service.
233XB10700	XB1	Operate the personnel air lock.
233XB10701	XB1	Operate the emergency air lock.
235XB10702	XB1	Verify integrity of the containment airlock.
231Y091475	Y09	Carry out actions to shutdown the unit from outside the control room.
231Y091476	Y09	Carry out actions to recover from a reactor trip.
231Y091477	Y09	Carry out actions to recover from a loss of off-site electrical power.

Task ID	System ID	Task Description
333BGA0704	BGA	Add chemicals to the reactor coolant system.
333BGA0706	BGA	Remove a purification ion exchanger from service.
333BGA0707	BGA	Fill and vent a purification ion exchanger.
333BGA0708	BGA	Monitor the automatic backflush of the CVCS purification filter.
333BGA0710	BGA	Vent the operable charging pump suction line.
333BGA0711	BGA	Place a purification ion exchanger in service.
333BGA0712	BGA	Backflush the letdown strainer.
333BGA0713	BGA	Inspect charging pumps.
333BGA0714	BGA	Perform valve alignments on the chemical and volume control system.
333BGA1566	BGA	Verify the operability of the charging pump packing lubrication system prior to starting a charging pump.
333BGA2336	BGA	Vent the charging pump discharge line.
333BGA2337	BGA	Monitor the operation of the charging pump's packing cooling system.
332BGB0703	BGB	Manually dilute the reactor coolant system.
333BGB0705	BGB	Batch boric acid in the boric acid batch tank and transfer contents to the boric acid makeup tanks.
333BGB0715	BGB	Inspect the boric acid makeup pumps.
333GHA1580	GHA	Inspect the radwaste building HVAC system.
333HAA0719	HAA	Release a gas decay tank.
333HAA0720	HAA	Monitor the operation of the radwaste gas collection system.
333HAA0721	HAA	Align the radwaste gas collection system for normal operation.
333HAA1567	HAA	Drain moisture from the waste gas collection header.
333HAA1568	HAA	Drain moisture from the surge tank.

Task ID	System ID	Task Description
333HAA1569	HAA	Transfer in service gas decay tanks.
333HAA2579	HAA	Take a local sample from a waste gas decay tank.
333HAA2580	HAA	Switch the hydrogen and oxygen analyzer train from the surge tank monitors sampling the surge tank to the decay tank mon
333HAA2581	HAA	Switch the hydrogen and oxygen analyzer train from the decay tank monitors sampling the surge tank to the surge tank mon
333HBA0722	HBA	Fill the miscellaneous waste tank from the radwaste/sump.
333HBA0726	HBA	Release miscellaneous waste evaporator condensate monitoring tank.
333HBA0727	HBA	Recirculate the miscellaneous waste evaporator condensate monitor tank.
333HBA0730	HBA	Reprocess a miscellaneous waste evaporator condensate monitor tank.
333HBA0732	HBA	Transfer miscellaneous waste tank to the condensate monitor tank.
333HBA0733	HBA	Process miscellaneous waste tank to condensate monitor tank.
333HBA0734	HBA	Operate the skid mounted radwaste sump recirc filter system.
333HBA1572	HBA	Place the miscellaneous waste ion exchangers in service in lead-lag or single service.
333HBA1573	HBA	Place the miscellaneous waste condensate ion exchangers in service in lead-lag or single service.
333HBA1574	HBA	Recirculate the miscellaneous wastes evaporator condensate monitor tank for sampling using the alternate pump.
333HBA2582	HBA	Remove the miscellaneous waste system filter from service and vent and drain the filter.
333HBA2583	HBA	Place the miscellaneous waste system filter in service, vent the filter.

Task ID	System ID	Task Description
333HBA2584	HBA	Swap F001 or F002 to the opposite strainer.
333HBA2585	HBA	Remove a miscellaneous waste ion exchanger or a miscellaneous waste condensate ion exchanger from service.
333HBA2601	HBA	Process the chemical waste tank to the condensate monitor tank.,
333HBA2602	HBA	Recirculate the chemical wastes tank.
333HBA2603	HBA	Recirculate the miscellaneous waste tank.
333HBB0735	HBB	Transfer/spent resin to the spent resin tank.
333HBB0736	HBB	Transfer new resin via the eductor to selected ion exchanger or demineralizer.
333HBB0737	HBB	Sluice spent resin from the purification ion exchangers to the spent resin tank.
333HBB1575	HBB	Dewater the spent resin tank.
333HBB2586	HBB	Transfer spent resin to the portable solidification or truck disposal system via the alternate method.
333HBC0738	HBC	Monitor automatic backflush operation of backflushable filters.
333HBC0739	HBC	Manually backflush the backflushable filters.
333HBC0740	HBC	Align the crud tank for normal operation.
333HBC0741	HBC	Recirculate the crud tank through the disposable filter.
333HBC0742	HBC	Transfer crud tank contents to the miscellaneous waste tank.
333HBC1576	HBC	Remove the disposable filters from service.
333HBC2587	HBC	Manually backflush the CVCS purification filter.
333HBC2588	HBC	Manually backflush the CVCS purification filter when on shutdown cooling.
333HEB2589	HEB	Fill the primary makeup tanks via the primary makeup tank pumps.

Task ID	System ID	Task Description
333HGX0743	HGX	Monitor the operation of radwaste area sump pumps.
333HGX1577	HGX	Pump the contents of the radwaste sump to the miscellaneous waste tank.
333HGX1578	HGX	Place the radwaste sump recirculation filter system in service.
333HJA0723	HJA	Place the gas stripper in service.
333HJA0724	HJA	Shutdown the gas stripper.
333HJA0725	HJA	Recirculate a radwaste primary tank.
333HJA0728	HJA	Purge the gas stripper.
333HJA0729	HJA	Transfer radwaste primary tank water to a radwaste secondary tank.
333HJA0731	HJA	Recirculate a radwaste secondary tank.
333HJA1570	HJA	Align the gas strippers for operation.
333HJA1571	HJA	Repross a radwaste primary tank through the radwaste primary ion exchanger and the gas stripper.
333HJA2338	HJA	Release a radwaste secondary tank.
333HJA2590	HJA	Transfer RCS drain tank water to the radwaste primary tank.
333HJA2591	HJA	Reprocess a radwaste secondary tank through the radwaste primary ion exchangers, filter F-025 and gas strippers.
333SDA1581	SDA	Read and interpret radiation levels on area radiation monitors.
332SFA0744	SFA	Manually operate the reactor trip breakers.
333SFA0745	SFA	Energize the CEDM control center.
333SFA0746	SFA	Synchronize a CEDM MG set.
333SFA0747	SFA	Startup a CEDM MG set.
333SFA0748	SFA	Shutdown a CEDM MG set.
333SFA0749	SFA	Monitor the operation of the control element drive mechanism control system.

Task ID	System ID	Task Description
333SFA1579	SFA	Separate an MG set from the output bus.
333SJB0750	SJB	Monitor the post accident sampling system.
333SPA0751	SPA	Fill and vent the CVCS letdown process radiation monitor.

Task ID	System ID	Task Description
243ABA0752	ABA	Align moisture separator reheater valves for turbine startup.
243ABA0753	ABA	Align the steam bypass control system for operation.
243ABA0754	ABA	Align the main steam system to place the main steam leads in service.
244ABA0755	ABA	Inspect moisture separator reheater drain receivers.
244ABA0756	ABA	Inspect moisture separator reheater.
244ABA0757	ABA	Monitor moisture separator reheator shell temperature.
243ABA1582	ABA	Warm up the steam bypass control system header.
243ACA0758	ACA	Monitor the operation of the l.p. exhaust spray cooling system.
244ACA0759	ACA	Inspect main turbine steam seals.
245ACA0760	ACA	Rotate the turbine rotor by hand.
244ACA0761	ACA	Inspect the main turbine.
242ADA0762	ADA	Manually overboard the condenser hotwells.
242ADA0763	ADA	Manually adjust condensate pump seal water pressure and flow.
243ADA0764	ADA	Align the heater drain pump for startup.
243ADA0765	ADA	Adjust the flow control set point of the condensate pump miniflow controller (fic-3294).
243ADA1584	ADA	Align condensate system valving to fill and vent the condensate system and start the first condensate pump.
243ADA1585	ADA	Start a condensate pump with the condensate system pressurized.
243ADA1586	ADA	Monitor the operation of the condensate system during normal operation.
243ADA2466	ADA	Remove a heater drain pump from service.

Task ID	System ID	Task Description
243ADA2467	ADA	Inspect a heater drain pump for normal operation after starting.
243AEA0766	AEA	Align feedwater pump turbine lube oil system for operation.
243AEA0767	AEA	Monitor feedpump turbine lube oil temperature.
243AEA0768	AEA	Inspect main feed pump turbine control system.
243AEA0769	AEA	Inspect main feedwater pump lube oil system.
243AEA0770	AEA	Inspect main feedwater pump turbine.
243AEA0771	AEA	Inspect main feedwater pumps.
245AEA0772	AEA	Test the feed pump turbine electronic overspeed trip.
245AEA0773	AEA	Test the feed pump turbine remote manual trip.
245AEA0774	AEA	Test the feed pump turbine manual trip.
245AEA0775	AEA	Test the operation of the feed pump turbine oil pump.
245AEA0776	AEA	Test the feed pump turbine lockout and trip units.
245AEA0777	AEA	Test the operation of the feed pump turbine stop valves.
245AEA0778	AEA	Test the feed pump turbine mechanical overspeed trip.
245AEA0779	AEA	Test the feed pump turbine governor oil/discharge valve trip.
243AEA1588	AEA	Perform local operation to pre-start the feedwater pump and turbine.
243AEA1589	AEA	Perform local operations to warmup the feedwater pump and turbine.
243AEA1590	AEA	Perform local operation to roll and load the feedwater pump and turbine.
242AEA2756	AEA	Respond to Main Feed Pump Turbine "Low Oil Pressure Pretrip"alarm.
242AEA2757	AEA	Respond to Main Feed Pump Turbine "Low Vacuum Pretrip" alarm.

Task ID	System ID	Task Description
242AEA2758	AEA	Respond to Main Feed Pump Turbine "Thrust Bearing wear Pretrip" alarm.
242AEA2759	AEA	Respond to Main Feed Pump Turbine "Overspeed Pretrip" alarm.
242AEA2760	AEA	Respond to Main Feed Water Pump "High Vibration Pretrip" alarm.
242AEA2761	AEA	Respond to Main Feed Water Pump " Oil Temperture High " alarm.
242AEA2762	AEA	Respond to Main Feed Water Pump Turbine "High Casing Water Level" alarm.
242AEA2763	AEA	Respond to Main Feed Water Pump Turbine "Shaft Eccentricity High " alarm.
242AEA2764	AEA	Respond to Main Feed Water Pump Turbine "Seal Water Trouble"alarm.
242AEA2765	AEA	Respond to Main Feed Water Pump "Discharge Pressure Low" alarm.
242AEA2766	AEA	Respond to Main Feed Water Pump Turbine "Fire Detector Temperture High" alarm.
242AEA2767	AEA	Respond to Main Feed Water Pump Turbine "D.C. Lube Oil Pump Running" alarm.
242AEA2768	AEA	Respond to Main Feed Water Pump Turbine "Drain Tank Level High." alarm.
242AEA2769	AEA	Respond to Main Feed Water Pump Turbine " Lube Oil ReservoirLevel Hi/Lo " alarm.
242AEA2770	AEA	Respond to Main Feed Water Pump Turbine " Lube Oil Filter Pressure High " alarm.
243AEA2771	AEA	Perform Main Feed Water Pump Turbine Mechanical Overspeed Trip Test.
243AEB2604	AEB	Operate the main feedwater regulating valves FV-1111 or FV-1121 in remote manual.
243AEB2605	AEB	Operate the bypass feedwater valves HV-1105 or HV-1106 in remote manual.
243AEB2606	AEB	Align the main feedwater block isolation valves HV-4047 and HV-4051 for operation.

Task ID	System ID	Task Description
243AFA0780	AFA	Remove feedwater heater from service.
243AFA0781	AFA	Return feedwater heater to service.
243AFA0782	AFA	Align high and low pressure feedwater heaters for plant startup.
245AFA0783	AFA	Purge the feedwater heater shells.
245AFA0784	AFA	Test bleeder trip valve operation.
244AFA0785	AFA	Inspect feedwater heaters.
243AFA1587	AFA	Align the heater drain tank and heater drain pumps for operation.
243AQA0786	AQA	Align the feedwater hydrazine addition system for operation.
243AQA0787	AQA	Align the condensate system hydrazine tank for operation.
243AQA0788	AQA	Align the condensate system ammonia tank for operation.
243AQA0789	AQA	Align the feedwater ammonia system for operation.
243CAA0790	CAA	Start gland exhaust fans.
243CAA0791	CAA	Stop gland exhaust fans.
244CAA0792	CAA	Inspect gland sealing system control valves.
244CAA0793	CAA	Inspect gland exhaust condenser.
244CAA0794	CAA	Inspect gland exhaust fans.
243CAA1583	CAA	Align the main turbine gland steam sealing system for operation.
242CBA0795	CBA	Manually operate the main turbine lube oil temperature control.
243CBA0796	CBA	Transfer main turbine lube oil coolers.
245CBA0797	CBA	Backflush thrust bearing lube oil strainers.
244CBA0798	CBA	Inspect main turbine lube oil system.
245CBA0799	CBA	Test the main turbine thrust bearing wear trip.

Task ID	System ID	Task Description
245CBA0800	CBA	Test the main turbine low bearing oil pressure trip.
243CCA0801	CCA	Remove the generator hydrogen dryer from service.
243CCA0802	CCA	Monitor the operation of the generator gas cooling system.
243CCA0803	CCA	Place the generator hydrogen dryer in service.
243CCA0804	CCA	Align the generator hydrogen cooler for operation.
243CCA0805	CCA	Purge the generator casing.
243CCA0806	CCA	Manually control generator gas pressure.
245CCA0807	CCA	Test the generator gas cooling system for hydrogen leakage.
243CCA1591	CCA	Drain the hydrogen dryer condensation tank.
243CDA0808	CDA	Align the generator seal oil unit for normal operation with vacuum treatment.
243CDA0809	CDA	Test the automatic start of the generator seal oil pump.
243CDA0810	CDA	Remove the generator seal oil unit from service.
243CDA0811	CDA	Monitor the operation of the generator seal oil unit.
243CEA0812	CEA	Shutdown the stator cooling water system.
243CEA0813	CEA	Monitor the operation of the stator cooling water system.
243CEA0814	CEA	Align the stator cooling water system for operation.
243CEA0815	CEA	Test the stator water low flow alarm.
243CEA1592	CEA	Change over stator water strainers.
243CFA0257	CFA	Operate the lube oil centrifuge.
243CFA0816	CFA	Place the feedwater pump turbine lube oil conditioner in service.
243CFA0817	CFA	Remove the main lube oil conditioner from service.

Task ID	System ID	Task Description
243CFA0818	CFA	Transfer lube oil from the clean oil storage tank to the feedwater pump turbine lube oil conditioner.
243CFA0819	CFA	Inspect feed pump turbine lube oil conditioner.
243CFA0820	CFA	Transfer lube oil from the feedpump turbine reservoir to the dirty oil tank.
243CFA0821	CFA	Transfer lube oil from the clean lube oil storage tank to the main lube oil reservoir.
243CFA0822	CFA	Place the main lube oil conditioner in service.
243CFA0823	CFA	Transfer lube oil from the main lube oil reservoir to the dirty oil tank.
243CFA0824	CFA	Transfer lube oil from the clean lube oil storage tank to the main lube oil conditioner.
243CFA0825	CFA	Transfer lube oil from the clean lube oil storage tank to the dirty lube oil storage tank.
243CFA0826	CFA	Transfer lube oil from the dirty lube oil storage tank to the feedwater pump turbine lube oil reservoir.
243CFA0827	CFA	Transfer lube oil from the dirty oil tank to the feedwater pump turbine lube oil conditioner.
243CFA0828	CFA	Remove the feedwater pump turbine lube oil conditioner from service.
243CFA0829	CFA	Transfer lube oil from the clean oil storage tank to the feedwater pump turbine lube oil reservoir.
243CFA0830	CFA	Transfer lube oil from the lube oil conditioner to the dirty oil storage tank.
245CFA0831	CFA	Clean the lube oil centrifuge.
243CFA1601	CFA	Transfer lube oil from the main feed pump turbine lube oil conditioner to the dirty oil storage tank.
243CFA1602	CFA	Shutdown the centrifuge.
243CGA0832	CGA	Align condenser vacuum pump for startup.
243CGA0833	CGA	Inspect condenser vacuum pump.

Task ID	System ID	Task Description
243CGA0834	CGA	Inspect air ejectors.
243CGA0835	CGA	Align the bellows cooling and turbine exhaust spray system for operation.
243CGA0836	CGA	Align the steam air ejector exhaust unit for operation.
244CGA0837	CGA	Inspect vacuum breaker valves.
245CGA0838	CGA	Test condenser vacuum pump auto start.
245CGA0839	CGA	Test the condenser vacuum trip.
245CGA0840	CGA	Test the auto start of the l.p. exhaust spray pump.
243CGA2462	CGA	Inspect the water seals on the condenser skin valves.
243CGA2607	CGA	Align the condenser air ejector for startup.
244CHA0841	CHA	Inspect main turbine stop and control valves' unitized actuators.
244CHA0842	CHA	Inspect the intercept stop and control valves.
244CHA0843	CHA	Monitor turbine plant cooling water flow to unitized actuators.
244CHA0844	CHA	Inspect main turbine stop and control valves.
244CHA0845	CHA	Inspect the intercept valves unitized actuators.
245CHA0846	CHA	Place unitized actuator in service with turbine on line.
245CHA0847	CHA	Remove unitized actuator from service with turbine on line.
243DAA0258	DAA	Monitor the position of circulating water tunnel gates.
243DAA0259	DAA	Inspect circulating water tunnel gates.
245DAA0260	DAA	Operate circulating water tunnel gates.
245DAA0261	DAA	Heat treat the circulating water system.
243DAA1709	DAA	Align the circulating water system for startup.

Task ID	System ID	Task Description
243DAA1710	DAA	Align the circulating water pumps and condenser sections for operation.
243DAA1711	DAA	Perform the operations outside the control room to place a circulating water pump in service.
243DAA1713	DAA	Operate the circulating water pump bearing temperature scanner.
243DAA2463	DAA	Inspect the circulating water pumps.
243DCA0848	DCA	Align the traveling screens and bar screens for automatic operation.
243DCA0849	DCA	Operate the trash basket hoist.
243DCA0850	DCA	Align the fish handling system for automatic operation.
243DCA0851	DCA	Inspect screen wash pumps.
243DCA1707	DCA	Operate the screen wash system in the manual mode.
243DCA1708	DCA	Backflush the screen wash pump suction strainers.
243DCA1712	DCA	Operate the fish handling system in the manual mode.
243DCA2464	DCA	Flush the screen wash system spray nozzles.
243DCA2465	DCA	Operate the jib crane and dump the trash basket.
242EBA0852	EBA	Align turbine plant cooling water system valves to cross tie system to unit 3 air compressors.
242EBA0853	EBA	Align the turbine plant cooling water system for operation during heat treatment of the circulating water system.
243EBA0854	EBA	Align the turbine plant cooling water system for normal operation.
243EBA0855	EBA	Align the turbine plant cooling water system for parallel operation.
243EBA0856	EBA	Monitor the operation of the turbine plant cooling water system.
245EBA0857	EBA	Test the turbine plant cooling water pump automatic start.

Task ID	System ID	Task Description
243EBA1593	EBA	Operate the turbine plant cooling water pump bearing temperature scanner.
243EPAØ86Ø	EPA	Monitor the cepration of the salt water cooling system.
243GDAØ861	GDA	Inspect the intake structure ventilation system.
243GEAØ862	GEA	Align the turbine building ventilation system for normal operation.
243GEAØ863	GEA	Inspect the turbine building ventilation system.
243GZAØ864	GZA	Monitor the operation of the salt water cooling pump rooms ventilation system.
243HGXØ866	HGX	Verify valve and breaker alignment of intake structure sump pumps.
243HGXØ867	HGX	Verify valve and breaker alignment of turbine plant sump pumps.
243HGXØ868	HGX	Inspect intake structure sump and sump pumps.
243HGXØ869	HGX	Manually start turbine building sump pumps.
240HGXØ87Ø	HGX	Inspect turbine building sumps and sump pumps.
243HGX1596	HGX	Manually pump the intake structure sump.
243KBAØ865	KBA	Blowdown compressed air lines to remove moisture.
243KCX1595	KCX	Inspect the carbon dioxide fire protection system.
242MAAØ871	MAA	Reset alarms on the generator condition monitor.
243MAAØ872	MAA	Inspect main generator bearings.
244MAAØ873	MAA	Monitor generator condition monitor.
243MABØ3Ø4	MAB	Startup the Iso-phase bus cooling system.
243MABØ3Ø5	MAB	Transfer Iso-phase bus cooling system cooling coil units.
243MABØ3Ø6	MAB	Alternate Iso-phase bus cooling system fans.
243MABØ3Ø7	MAB	Place the generator terminal enclosure HVAC system in service.

Task ID	System ID	Task Description
243MAB0308	MAB	Shutdown the Iso-phase bus cooling system.
243MAB0309	MAB	Inspect isolated phase bus duct cooling unit.
245MAB0310	MAB	Test isolated phase bus duct annunicator pañel.
244MBA0874	MBA	Inspect the generator excitation system.
243NBX0875	NBX	Place a 4160 volt circuit breaker in the operating position.
243NBX0876	NBX	Remove a 4160 volt circuit breaker from the operating position.
243NBX0877	NBX	Place a 4160 volt circuit breaker in the test position.
243NBX0878	NBX	Inspect 4160 volt non class 1E switchgear.
242NBX1600	NBX	Inspect a 4160 volt circuit breaker after a relay operation.
243NGX0879	NGX	Inspect 480 volt class non 1E power centers.
243NGX0880	NGX	Rack in 480 volt power center breakers.
243NGX0881	NGX	Rack out 480 volt power center breakers.
243NGX1597	NGX	Remove a 480 volt circuit breaker from its cubicle.
243NGX1598	NGX	Replace a 480 volt circuit breaker in its cubicle.
242NGX1599	NGX	Inspect a 480 volt circuit breaker after a relay operation.
243NJA0326	NJA	Monitor the operation of the 250 VDC battery charger.
243NJA0882	NJA	Remove 250 VDC battery charger from service.
243NJA0883	NJA	Inspect 250 VDC switchgear.
243NJA0884	NJA	Place a 250 VDC battery charger in service.
243NNA1754	NNA	Align the non-1E 120 VAC UPS and battery charger for operation.
243NNA1755	NNA	Place the 120 VAC non-1E UPS in service.

Task ID	System ID	Task Description
243NNA1756	NNA	Remove the non-1E 120 VAC UPS or battery charger from service.
243NNA1758	NNA	Verify normal operation of the non-1E 120 VAC UPS and battery charger.
243PKA1789	PKA	Remove the critical functioning monitoring system computer power supply inverter from service.
243PKA1790	PKA	Place the critical function monitoring system power supply inverter in service.
243PKA1791	PKA	Remove the critical function monitoring system power supply static transfer switch from service.
243PKA1792	PKA	Place the critical function monitoring system power supply static transfer switch in service.
243PKA1793	PKA	Remove the critical function monitoring system power supply alternate source regulating transformer from service.
243PKA1794	PKA	Place the critical function monitoring system power supply alternate source regulating transformer in service.
243PKA1795	PKA	Perform routine monitoring of the critical function monitoring system power supply system.
243QHA0885	QHA	Inspect cathodic protection control panels.

Task ID	System ID	Task Description
313Y012007	Y01	Communicate with the switching center to receive switching orders and to provide results of switching operations.
313Y012008	Y01	Communicate with the Energy Control Center plant information concerning generation.
313Y012011	Y01	Coordinate radwaste processing and release activities.
313Y012012	Y01	Coordinate the transfer and release of waste water.
313Y012013	Y01	Review radioactive release permits.
312Y012014	Y01	Coordinate AC and DC ground fault isolation.
313Y012025	Y01	Coordinate the operation of the SCE/SDG&E system interconnection.
313Y012026	Y01	Coordinate alignment of electrical distrubution system to meet plant operations and technical specification requirements
313Y012035	Y01	Coordinate load changes and putting the unit on and taking the unit off the line with the Systems Operating Supervisor.
313Y012350	Y01	Coordinate water transfer and usage with the Unit Control Operator.
313Y012593	Y01	Transfer auxiliary electrical power during plant startups and shutdowns.
312Y092009	Y09	Coordinate response to and recovery from unexpected or unusual process or area radition levels.
312Y092010	Y09	Coordinate plant response to fire and rescue activities.
311Y092015	Y09	Assist Shift Superintendent in recognition and classification of emergency events.
311Y092016	Y09	Coordinate in plant radiation monitoring using the Control Room Airborne Monitor System during emergency conditions.
311Y092017	Y09	Coordinate non-qualified loads restoration during emergency conditions.

Task ID	System ID	Task Description
311YØ92Ø18	YØ9	Coordinate restoration of auxiliary power during a loss of off-site electrical power.
311YØ92Ø19	YØ9	Coordinate diesel generator failure follow-up actions if the diesel generator fails to start during an emergency.
311YØ92Ø2Ø	YØ9	Coordinate alignment of electrical systems in preparation to evacuate the control room.
311YØ92Ø21	YØ9	Operate ESF components from the Unit 3 ESF Switchgear Rooms during a shutdown from outside the control room.
311YØ92Ø27	YØ9	Perform accountability check of operations personnel during an emergency event.
311YØ92Ø28	YØ9	Coordinate with the unaffected unit operations support during an emergency event.
311YØ92Ø29	YØ9	Initiate a local area evacuation during an emergency event.
311YØ92Ø3Ø	YØ9	Evaluate conditions and recommend to the Emergency Coordinator precautionary evacuations.
311YØ92Ø31	YØ9	Active the emergency siren during a plant or site evacuation.
311YØ92Ø32	YØ9	Coordinate technical assistance or emergency maintenance during an emergency event.
311YØ92Ø33	YØ9	Communicate with on and off-site personnel during an emergency event to provide information concerning plant status.
311YØ92Ø34	YØ9	Make red phone notification to the NRC.

Task ID	System ID	Task Description
1133011321	301	Coordinate shift operations during a plant startup from cold shutdown to hot standby.
1133011327	301	Complete the technical specification check list during a plant startup from cold shutdown to hot standby.
1133011328	301	Calculate the startup and loading times for the main turbine during a startup from cold shutdown to hot standby.
1133012358	301	Make notifications and log entries during mode changes.
1133021322	302	Coordinate shift operations during a plant startup from hot standby to minimum load.
1133022359	302	Complete precritical checklists.
1133022360	302	Ensure requirements of fuel preconditioning are met during a startup.
1133032361	303	Coordinate shift operations from minimum load to full power.
1133041323	304	Coordinate shift operations during a plant shutdown from full power to hot standby.
1133051324	305	Coordinate shift operations during a plant shutdown from hot standby to cold shutdown.
1133052362	305	Coordinate shift operations to place the residual heat removal system in service.
1133052363	305	Control RCS pressure during solid plant operations.
1133061326	306	Coordinate shift operations during natural circuation operations.
1133081325	308	Coordinate shift operations during power operations.
1133082364	308	Determine load restrictions for various plant conditions.
114ADM0252	ADM	Receive plant status reports from other operators.
114ADM1236	ADM	Assume control room command function when directed by the Shift Superintendent or Control Room Supervisor.

Task ID	System ID	Task Description
114ADM1301	ADM	Maintain recorder charts.
114ADM1302	ADM	Interface with other site organizations.
114CSA1312	CSA	Prepare an abnormal alignment/evolution checklist.
112CSA1985	CSA	Report abnormal parameters/conditions to control room supervisor.
113CSA2366	CSA	Determine system alignment using the system alignment files.
111CSF1288	CSF	Coordinate response to unexpected nuclear power generation.
111CSF1289	CSF	Coordinate response to a potential loss of core cooling.
111CSF1290	CSF	Coordinate response to saturated core cooling conditions.
111CSF1291	CSF	Coordinate response to anticipated pressurized thermal shock.
111CSF1292	CSF	Coordinate response to a steam generator high level.
111CSF1293	CSF	Coordinate response to a steam generator low level.
111CSF1294	CSF	Coordinate response to a loss of steam dump valves.
111CSF1295	CSF	Coordinate response to a loss of secondary heat sink.
111CSF1296	CSF	Coordinate reponse to a high containment pressure.
111CSF1297	CSF	Coordinate reponse to a high containment sump level.
111CSF1298	CSF	Coordinate response to a high containment radiation level.
111CSF1299	CSF	Coordinate response to a low system inventory.
111CSF1329	CSF	Use the critical safety function status trees to determine action to take during emergency operations.

Task ID	System ID	Task Description
114DAR0253	DAR	Direct activites of other shift operators.
114DAR2367	DAR	Attend safety meetings.
114ECP0254	ECP	Review equipment control forms.
114ECP1303	ECP	Maintain abnormal equipment log.
114ECP1304	ECP	Conduct tailboard prior to removal of equipment from service.
114ECP1305	ECP	Issue a permission.
114ECP1306	ECP	Approve clearance boundries.
114ECP1307	ECP	Issue a clearance.
114ECP1308	ECP	Issue an approval.
114ECP1309	ECP	Hang test required tags.
114ECP1310	ECP	Perform monthly and annual audits of all outstanding tags and labels.
115ECP2368	ECP	Determine if maintenance items require equipment control.
115ECP2369	ECP	Coordinate retesting of equipment after maintenance.
115ECP2370	ECP	Modify an existing work authorization.
115ECP2371	ECP	Prepare and hang caution tags.
111EOI1277	EOI	Coordinate response to a loss of reactor coolant accident.
111EOI1278	EOI	Coordinate termination of safety injection following a loss of reactor coolant.
111EOI1279	EOI	Coordinate cooldown and depressurization of the reactor coolant system following a loss of coolant accident.
111EOI1280	EOI	Coordinate transfer of safety injection to cold leg injection and recirculation following a loss of coolant accident.
111EOI1281	EOI	Coordinate initiation of hot leg recirculation following a loss of coolant accident.

Task ID	System ID	Task Description
111EOI1282	EOI	Coordinate response to a loss of secondary coolant.
111EOI1283	EOI	Coordinate termination of safety injection following a loss of secondary coolant.
111EOI1284	EOI	Coordinate response to a loss of residual heat removal system due to a loss of secondary coolant.
111EOI1285	EOI	Coordinate résponse to a steam generator tube rupture.
111EOI1286	EOI	Coordinate response to an anticipated transient without scram.
111EOI1287	EOI	Coordinate response to a loss of all AC power.
111EOI1330	EOI	Coordinate shift operations during a reactor trip.
111EOI2372	EOI	Coordinate shift operations during the initiation of safety injection.
111EOI2373	EOI	Coordinate termination of safety injection following a spurious safety injection signal.
112IPO1276	IPO	Coordinate response to a complete loss of instrument air.
112IPO1315	IPO	Coordinate shift operations during recovery from a leak in the reactor coolant system.
113IPO1316	IPO	Coordinate shift operations during heat treating the circulating water system.
112IPO1317	IPO	Coordinate shift operations during recovery from a loss of containment integrity.
112IPO1318	IPO	Coordinate shift operations during recovery from a loss of condenser vacuum.
112IPO1319	IPO	Coordinate shift operations during recovery from a high air ejector radiation.
111IPO1320	IPO	Coordinate shift operations during recovery from a moderate or severe earthquake.
111IPO2374	IPO	Coordinate shift activities during a forced evacuation of the control room.
111IPO2375	IPO	Coordinate shift activities during a fire in the 4kv room or turbine lube oil reservoir area.

Task ID	System ID	Task Description
112ONT2376	ONT	Inform the Control Room Supervisor of events that may require notification to the NRC.
113ONT2377	ONT	Verify NPDES requirements are being met.
113OOA2365	OOA	Submit an operator aid for approval.
114OSH2378	OSH	Work overtime to fill a shift vacancy.
114OSI1313	OSI	Perform surveillance instructions.
114OSI1314	OSI	Determine surveillance procedures to be performed during a shift.
114OSL1300	OSL	Maintain the control operators log.
114OSR1311	OSR	Complete shift turnover..
113OTS1984	OTS	Evaluate plant status against technical specification requirements.
112OTS1986	OTS	Determine if plant/equipment deficiencies make safety related or tech spec equipment inoperable.
112OTS1987	OTS	Evaluate the impact of failed surveillances on technical specifications.
112OTS1988	OTS	Communicate results of failed surveillances to control room supervisor.
112OVO2379	OVO	Coordinate shift activities involving the manual manipulation of motor operated valves.
115OVO2380	OVO	Coordinate the return of a motor operated valve to service after maintenance.
115OVO2381	OVO	Coordinate the verification of valve positions.
112PTR2382	PTR	Evaluate/communicate plant or system conditions for a post trip/transient review.
115TMC2383	TMC	Coordinate shift activities for installation and removal of temporary modifications.
113UOP2384	UOP	Coordinate shift activities for inplementation of operating instructions.
113UOP2385	UOP	Evaluate possible invalid procedural steps when confronted by shift personnel.

Task ID	System ID	Task Description
394ADM1892	ADM	Direct activities of other shift operators.
393ADM2348	ADM	Inform the Control Room Supervisor of plant conditions and changes.
393ADM2349	ADM	Coordinate water usage and transfer with the Common Control Operator.
394ADM2409	ADM	Interface with other site organizations.
394ADM2410	ADM	Assume control room command function when directed by the shift superintendent or control room supervisor.
394ADM2411	ADM	Receive plant status reports from other operators.
394ADM2412	ADM	Coordinate shift activities as specified in special orders.
394ADM2413	ADM	Maintain recorder charts.
392DAR1990	DAR	Report abnormal parameters/conditions to control room supervisor.
394HIC1890	HIC	Maintain cleanliness in the control room.
394OCE1879	OCE	Maintain cumulative equipment hours, inoperability and design cycle logs.
394OCR1883	OCR	Control control room access.
394ODS1881	ODS	Initiate a maintenance order.
394ONT1880	ONT	Advise the Control Room Supervisor that an event may require notification to the NRC.
394OOA1882	OOA	Use operator aids.
394OOI1876	OOI	Complete required reading assignments.
394OPR1884	OPR	Use operating instructions to perform plant manipulations.
394OPR1885	OPR	Prepare a Temporary Change Notice.
394OPR1886	OPR	Prepare a procedure modification permit.
394OPR1887	OPR	Use the "In Use" binders to control procedures in use.

Task ID	System ID	Task Description
3940SA1888	OSA	Prepare an abnormal alignment/evolution document to conduct a plant evolution for which a procedure does not exist.
3930SA2347	OSA	Verify actions of other operators in the control room.
3950SA2404	OSA	Coordinate independent verification of system alignments.
3950SA2405	OSA	Coordinate system alignments according to the system alignment requirements.
3950SA2406	OSA	Report the misalignment of a system to the control room supervisor.
3950SA2407	OSA	Determine the present system alignment status.
3940SH2408	OSH	Work overtime to cover shift vacancies.
3940SI1891	OSI	Perform a surveillance instruction.
3940SI1893	OSI	Determine surveillance procedures to be performed during the shift.
3940SI1894	OSI	Review completed surveillance procedures for completeness, accuracy and acceptability of results.
3950SI1992	OSI	Evaluate the impact of failed surveillance tests on technical specifications.
3950SI1993	OSI	Communicate results of failed surveillance to control room supervisor.
3940SL1853	OSL	Maintain the control operator's log.
3940SR1850	OSR	Attend pre-shift briefings.
3940SR1851	OSR	Conduct shift turnover.
3940SR1852	OSR	Complete shift relief checklist.
3940TM1874	OTM	Review temporary facilities modifications to determine operational impact.
3940TM1875	OTM	Prepare control point caution tags to identify the boundaries of a temporary modification.
3920TR2414	OTR	Supply inputs to control room supervisor for post trip/transient review.

Task ID	System ID	Task Description
3940TS1989	OTS	Evaluate plant status against technical specification requirements.
3930TS1991	OTS	Determine if plant deficiencies make safety related or technical specification related equipment inoperable.
3950VO2415	OVO	Coordinate shift activities involving the manual manipulation of motor operated valves.
3950VO2416	OVO	Coordinate the return of a motor operated valve to service after maintenance.
3950VO2417	OVO	Coordinate the verification of valve positions.
3940WA1854	OWA	Review the work authorization letter to determine work to be done during the shift.
3940WA1855	OWA	Prepare a work authorization record sheet.
3940WA1856	OWA	Initiate a Limiting Condition for Operator Action Request.
3940WA1857	OWA	Initiate an Equipment Deficiency Mode Restraint.
3940WA1858	OWA	Verify redundant equipment operable prior to removing equipment from service.
3940WA1859	OWA	Assign personnel to perform clearance alignments and hang clearance tags.
3940WA186Ø	OWA	Issue a clearance.
3940WA1861	OWA	Transfer a clearance from one clearance holder to another authorized person.
3940WA1862	OWA	Determine the requirements for post maintenance testing.
3940WA1863	OWA	Accept the release of a clearance using the normal method.
3940WA1864	OWA	Accept the release of a clearance using the emergency method.
3940WA1865	OWA	Prepare return to service alignments to restore systems/equipment to service following maintenance.
3940WA1866	OWA	Determine if plant maintenance resulted in a modification of Plant Design.

Task ID	System ID	Task Description
3940WA1867	OWA	Assign personnel to remove men-at-work tags and reposition components following maintenance.
3940WA1868	OWA	Coordinate the performance of operability tests.
3940WA1869	OWA	Determine if work can safely be accomplished under a permission.
3940WA1870	OWA	Issue a permission.
3940WA1871	OWA	Issue an approval.
3940WA1872	OWA	Release an approval.
3940WA1873	OWA	Issue an In-Test.
3940WA1877	OWA	Prepare caution tags.
3940WA1878	OWA	Place magnetic tags on or near control room controls to identify outstanding approvals and clearances.
3940WA1889	OWA	Conduct tailboard prior to plant manipulations, removal of equipment from service or surveillance testing.
3950WA2418	OWA	Transfer a work authorization from one holder to another.
3950WA2419	OWA	Modify a work authorization.

Task ID	System ID	Task Description
213Y011905	Y01	Coordinate heat treating the circulating water system.
213Y021900	Y02	Coordinate a plant startup from cold shutdown to hot standby conditions.
213Y031899	Y03	Coordinate a reactor startup.
213Y031901	Y03	Coordinate a plant startup from hot standby to minimum load.
213Y041902	Y04	Coordinate a plant shutdown from minimum load to hot standby conditions.
213Y051903	Y05	Coordinate a plant shutdown from hot standby to cold shutdown.
213Y061904	Y06	Coordinate power operations.
211Y081898	Y08	Coordinate natural circulation operations.
211Y091895	Y09	Coordinate accident mitigation by use of the functional recovery guidelines.
211Y091896	Y09	Perform a plant shutdown from outside the control room.
211Y091897	Y09	Coordinate response to and recovery from an earthquake.
211Y091983	Y09	Coordinate response to and recovery from a loss of off-site electrical power.
211Y092022	Y09	Coordinate response to and recovery from a low system frequency.
211Y092023	Y09	Coordinate reponse to and recovery from a high system frequency.
211Y092024	Y09	Coordinate response to and recovery from a low system voltage.
211Y092386	Y09	Coordinate standard post trip actions.
211Y092387	Y09	Coordinate response to and recovery from a reactor trip.
211Y092388	Y09	Coordinate the performance of a safety function status check following an emergency situation.

Task ID	System ID	Task Description
211Y092389	Y09	Coordinate the perofmrance of a non-qualified load restoration following an emergency situation.
211Y092390	Y09	Coordinate the response to and recovery from a loss of coolant accident.
211Y092391	Y09	Coordinate the performance of a plant cooldown following a loss of coolant accident.
211Y092392	Y09	Coordinate the establishment of simultaneous hot/cold leg injection flowpaths following a loss of coolant accident.
211Y092393	Y09	Verify the proper operation of the recirculation actuation system.
211Y092394	Y09	Coordinate response to and recovery from a steam generator tube rupture.
211Y092395	Y09	Coordinate the performance of a plant cooldown following a steam generator tube rupture.
211Y092396	Y09	Coordinate draining steam generator to radwaste following a steam generator tube rupture.
211Y092397	Y09	Coordinate response to and recovery from a steam line break.
211Y092398	Y09	Coordinate the performance of a plant cooldown following a steam line break.
211Y092399	Y09	Coordinate response to and recovery from a loss of feedwater.
211Y092400	Y09	Coordinate response to and recovery from an anticipated transient without scram.
211Y092401	Y09	Coordinate response to and recovery from a loss of forced circulation.
211Y092402	Y09	Cordinate the peroformance of a plant cooldown following a loss of forced circulation.
211Y092403	Y09	Coordinate the response to and recovery from a loss of instrument air.

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Task ID	System ID	Task Description
ZZZ2598	ZZZ	End of file

Task ID	System ID	Task Description
1232200001	220	Write switching orders.
1252200002	220	Check/verify switching done by PEO.
1252201141	220	Demonstrate the operability of the electrical distribution system.
1222201195	220	Respond to a low system frequency.
1222201196	220	Respond to a high system frequency.
1222201197	220	Respond to a low system voltage.
1233010086	301	Perform a plant startup from cold shutdown to minimum load.
1233021165	302	Perform a plant startup from miminum load to hot standby.
1233031166	303	Conduct plant operations from minimum load to full power.
1233041167	304	Perform a plant shutdown from mimimum load to hot standby.
1233051168	305	Perform a plant shutdown from hot standby to cold shutdown.
1233061169	306	Perform a natural circulation cooldown of the reactor coolant system.
1233081170	308	Reduce unit load.
1233081171	308	Increase unit load.
1223081172	308	Recover from a unit load runback.
1224800003	480	Perform 480 volt AC ground isolation.
1234800004	480	Remove a station service transformer from service.
1234800005	480	Place a station service transformer in service.
1234800006	480	Transfer 480 volt bus power supplies.
1234800007	480	Monitor the operation of the 480 volt system.
1234801145	480	Prepare a clearance for a 480 volt bus.
1224802522	480	Respond to an overcurrent relay of a 480 volt feeder circuit.

Task ID	System ID	Task Description
1234KV0008	4KV	Monitor the operation of the 4 kv system.
1234KV1142	4KV	Transfer 4160 volt buses by parallelling.
1234KV1143	4KV	Transfer 4160 volt buses by drop and pickup.
1234KV1144	4KV	Prepare a clearance for a 4160 volt bus.
1224KV2523	4KV	Respond to an overcurrent relay of a 4 kv feeder circuit.
1224KV2524	4KV	Respond to a 4kv feeder ground alarm.
1224KV2525	4KV	Respond to a 4kv bus relay.
123ACP2569	ACP	Perform an auxiliary control panel check.
123ACP2570	ACP	Perform an auxiliary control panel operability test.
124ADM1235	ADM	Maintain the control operators log.
124ADM1237	ADM	Use operating instructions to carry out plant manipulations.
124ADM1238	ADM	Prepare a temporary change notice to make an on the spot change to an operating instruction.
124ADM1239	ADM	Advise the Control Room Supervisor that events may require notification to the NRC.
124ADM1240	ADM	Make entries to the abnormal equipment log.
124ADM1241	ADM	Test redundant equipment prior to removing equipment from service.
124ADM1242	ADM	Issue a clearance.
124ADM1243	ADM	Release a clearance.
124ADM1244	ADM	Issue a permission.
124ADM1245	ADM	Issue an approval.
124ADM1246	ADM	Add additional tags to an existing clearance or permission.
124ADM1247	ADM	Modify a clearance or permission.
124ADM1248	ADM	Prepare an abnormal alignment/evolution checklist to perform an evolution not covered by a procedure.

Task ID	System ID	Task Description
124ADM1249	ADM	Complete the administrative requirements for the installation of a temporary modification.
124ADM1250	ADM	Conduct a shift turnover.
121AFW0009	AFW	Manually initiate the auxiliary feedwater system.
121AFW0010	AFW	Shutdown the auxiliary feedwater system following automatic actuation.
123AFW0011	AFW	Startup the electric auxiliary feedwater pump.
121AFW0012	AFW	Monitor the operation of the auxiliary feedwater system following automatic actuation.
123AFW0013	AFW	Startup the steam driven auxiliary feedwater pump.
123AFW0014	AFW	Feed steam generators with auxiliary feedwater system.
125AFW0015	AFW	Perform auxiliary feedwater pump operability test.
125AFW0016	AFW	Perform auxiliary feedwater system operability test.
125AFW0017	AFW	Perform auxiliary feedwater system flow test.
123AFW1104	AFW	Shift to feeding the steam generators with the steam driven auxiliary feedwater pump during a Unit shutdown.
123AFW1105	AFW	Shift to feeding the steam generators with the motor driven auxiliary feedwater pump during a Unit shutdown.
123AFW1106	AFW	Feed the steam generators using the normal flow path during modes 5 or 6.
123AFW1107	AFW	Feed the steam generators using the emergency auxiliary feedwater flow path during modes 5 or 6.
123ATX0018	ATX	Place the main and unit auxiliary transformers in service.
123ATX0019	ATX	Place auxiliary transformer C in service.
122BAS0021	BAS	Emergency borate the reactor coolant system.
123BAS0022	BAS	Manually borate the reactor coolant system.

Task ID	System ID	Task Description
123BAS0023	BAS	Place the RCS makeup controls in automatic.
123BAS0024	BAS	Transfer the contents of the batch tank to the boric acid storage tank.
123BAS0025	BAS	Prepare a boric acid solution in the batch tank.
123BAS0026	BAS	Manually dilute the reactor coolant system.
123BAS0027	BAS	Monitor the operation of the boric acid system.
123BAS0028	BAS	Recirculate boric acid storage tank from the control room.
123BAS0029	BAS	Perform boron concentration change calculations.
122BAS1187	BAS	Respond to an unplanned boration of the reactor coolant system.
123BAS2526	BAS	Recirculate the boric acid storage tank from the radwaste building.
125BAS2527	BAS	Perform boric acid from path verification test from the control room.
125BAS2528	BAS	Perform a boric acid flow path verification test from the radwaste building.
122BAS2529	BAS	Respond to a malfunction of the makeup control system.
123CCW0030	CCW	Align the component cooling water system for normal operation.
123CCW0031	CCW	Monitor the operation of the component cooling water system.
123CCW0032	CCW	Shutdown a component cooling water pump.
123CCW0033	CCW	Startup a component cooling water pump.
123CCW0034	CCW	Add chemicals to the component cooling water system.
125CCW0035	CCW	Clear and drain component cooling water system components.
125CCW0036	CCW	Test the automatic start of the component cooling water pump and the thermal barrier pump.

Task ID	System ID	Task Description
125CCW1108	CCW	Test the component cooling water low flow alarm.
122CCW1224	CCW	Respond to a loss of component cooling water flow.
122CCW1225	CCW	Respond to a component cooling water system high radiation.
123CNA0037	CNA	Startup a vacuum pump.
123CNA0038	CNA	Monitor the operation of the condenser air removal system.
123CNA0039	CNA	Operate condenser air removal transfer valve.
122CNA1192	CNA	Respond to a loss of condenser vacuum.
122CNA1230	CNA	Respond to a main condenser air ejector high radiation alarm.
123CND0040	CND	Startup a heater drain pump.
123CND0041	CND	Start up a condensate pump.
123CND0042	CND	Shutdown a heater drain pump.
123CND0043	CND	Monitor the operation of the condensate system.
123CND2530	CND	Shutdown a condensate pump.
123CRD0143	CRD	Operate the reactor trip breakers.
125CRD0147	CRD	Perform control rod position verification.
123CRD1152	CRD	Start up the control rod drive system.
123CRD1153	CRD	Inspect the control rod drive system prior to startup.
122CRD1154	CRD	Inspect the control rod drive system following a control rod malfunction.
125CRD1155	CRD	Perform a monthly control rod exercise test.
122CRD1201	CRD	Respond to a control rod bank or group failure.
122CRD1202	CRD	Respond to a continuous control rod insertion.
122CRD1203	CRD	Respond to a continuous control rod withdrawal.
122CRD1204	CRD	Respond to a dropped control rod.

Task ID	System ID	Task Description
122CRD1205	CRD	Respond to a stuck or misaligned control rod.
122CRD1206	CRD	Respond to a rod position indicating system failure.
122CRD1207	CRD	Respond to a control rod drive cooling system failure.
121CVS0049	CVS	Operate the hydrogen recombiner.
123CVS0050	CVS	Purge the containment sphere.
125CVS0051	CVS	Test the hydrogen recombiner.
121CVS1110	CVS	Vent hydrogen from the containment .
123CVS2531	CVS	Fill and vent the sphere cooling filtering air handling fans.
123CVS2532	CVS	Fill and vent the reactor coolant pump heat removal air handling fans.
123CVS2533	CVS	Fill and vent the control rod drive mechanism cooling air handling fans.
123CVS2534	CVS	Perform a reactor containment fan damper test.
122CWS0052	CWS	Evaluate condenser salt leakage.
123CWS0053	CWS	Startup a circulating water pump.
123CWS0054	CWS	Shutdown a circulating water pump.
123CWS1111	CWS	Bump a circulating water pump.
122CWS1223	CWS	Respond to condenser bay flooding.
123DCB0055	DCB	Perform DC bus ground isolation.
122DCB1199	DCB	Respond to a loss of DC bus #1.
122DCB1200	DCB	Respond to a loss of DC bus #2.
125DGX0056	DGX	Parallel and load the diesel generator to an energized 4kv bus.
122DGX0057	DGX	Monitor the operation of the diesel generator and associated equipment.
121DGX0058	DGX	Manually initiate loss of bus or loss of power sequence.

Task ID	System ID	Task Description
125DGX0061	DGX	Perform diesel generator operability test.
125DGX0062	DGX	Perform diesel generator load test.
123DGX1112	DGX	Start the diesel generator from the control room.
123DSD2772	DSD	Start the DSD Diesel Generator
123DSD2773	DSD	Energize the DSD buses with the DSD Diesel Generator
123DSD2774	DSD	Shutdown the DSD Diesel Generator
123DSD2775	DSD	Start the West Auxiliary Feedwater Pump from the DSD switchgear
123DSD2776	DSD	Operate the West Auxiliary Feedwater Pump on recirculation
123DSD2777	DSD	Shutdown the West Auxiliary Feedwater Pump
123DSD2778	DSD	Align the North Charging Pump for RWST operation
123DSD2779	DSD	Start the North Charging Pump from the DSD switchgear
123DSD2780	DSD	Shutdown the North Charging Pump from the DSD switchgear
123DSD2781	DSD	Operate the Pressurizer Heaters from the DSD switchgear
125DSD2790	DSD	Perform an operability and a load test of the DSD Diesel Generator
122DSD2797	DSD	Manually trip the turbine from the turbine front standard
122DSD2798	DSD	Operate the North Charging Pump power supply transfer switch
122DSD2799	DSD	Operate the North Charging Pump oil cooler fan power supply transfer switch
122DSD2800	DSD	Operate the Pressurizer Heaters power supply transfer switch
122DSD2801	DSD	Fail open seal injection flow control valves FCV-1115A, B and C

Task ID	System ID	Task Description
122DSD2802	DSD	Fail closed seal injection flow control valves FCV-1115D, E and F
122DSD2803	DSD	Manually control pressurizer pressure from the Remote Shutdown Panel
122DSD2804	DSD	Manually control charging flow from the remote shutdown panel
122DSD2805	DSD	Manually control atmospheric steam dump control valve operations from the Remote Shutdown Panel
122DSD2806	DSD	Verify Hot Standby Natural Circulation conditions during a plant shutdown using the Dedicated Safe Shutdown System
122DSD2807	DSD	Perform a natural circulation cooldown using the Dedicated Safe Shutdown System
121EOI1251	EOI	Respond to a reactor trip.
121EOI1252	EOI	Respond to a automatic acutation of the safety injection system.
121EOI1253	EOI	Terminate safety injection following a spurious safety injection initiation.
121EOI1254	EOI	Respond to a loss of reactor coolant accident.
121EOI1255	EOI	Terminate safety injection following a loss of reactor coolant.
121EOI1256	EOI	Cooldown and depressurize the reactor coolant system following a loss of coolant accident.
121EOI1257	EOI	Transfer safety injection to cold leg injection and recirculation following a loss of coolant accident.
121EOI1258	EOI	Initiate hot leg recirculation following a loss of coolant accident.
121EOI1259	EOI	Respond to a loss of secondary coolant.
121EOI1260	EOI	Terminate safety injection following a loss of secondary coolant.
121EOI1261	EOI	Respond to a loss of residual heat removal system due to a loss of secondary coolant.

Task ID	System ID	Task Description
121EOI1262	EOI	Respond to a steam generator tube rupture.
121EOI1263	EOI	Respond to a loss of all AC power.
121EOI1264	EOI	Respond to unexpected nuclear power generation.
121EOI1265	EOI	Respond to a potential loss of core cooling.
121EOI1266	EOI	Respond to saturated core cooling conditions.
121EOI1267	EOI	Respond to anticipated pressurized thermal shock.
121EOI1268	EOI	Respond to a steam generator high level.
121EOI1269	EOI	Respond to a steam generator low level.
121EOI1270	EOI	Respond to a loss of steam dump valves.
121EOI1271	EOI	Respond to a loss of secondary heat sink.
121EOI1272	EOI	Repond to a high containment pressure.
121EOI1273	EOI	Repond to a high containment sump level.
121EOI1274	EOI	Respond to a high containment radiation level.
121EOI1275	EOI	Respond to a low system inventory.
123FSY0064	FSY	Start fire pump.
123FSY0065	FSY	Monitor the operation of the fire pumps.
125FSY2535	FSY	Perform the fire water pump operability test.
123FSY2536	FSY	Monitor the fire alarm panel and the fire annunciator.
123FWH0066	FWH	Monitor the operation of the feedwater heaters.
123FWS0067	FWS	Shutdown a main feedwater pump.
123FWS0068	FWS	Start up a main feedwater pump.
123FWS0069	FWS	Monitor the operation of the feedwater control system.
123FWS0070	FWS	Monitor the operation of the feedwater system.
122FWS1190	FWS	Respond to a high steam generator level.

Task ID	System ID	Task Description
122FWS1191	FWS	Respond to a steam generator low level.
123FWS2537	FWS	Transfer feedwater from the auxiliary to the main feedwater regulators.
123FWS2538	FWS	Control feedwater flow in manual during a unit startup.
123FWS2539	FWS	Transfer steam generator level control from automatic to manual.
123FWS2540	FWS	Transfer steam generator level control from manual to automatic.
123FWS2541	FWS	Place the main feedwater system in service.
122GEN0072	GEN	Manually control main generator excitation.
123GEN0073	GEN	Place the generator voltage regulator in service.
123GEN0074	GEN	Remove the voltage regulator from service.
123GEN0075	GEN	Monitor the operation of the main generator and exciter.
123GEN1113	GEN	Place the exciter motor and generator mag-a-stat motor generator in service.
123GEN1114	GEN	Evaluate generator resistance temperature detector readings.
122GEN1193	GEN	Respond to a loss of generator excitation.
122GEN1194	GEN	Respond to a generator out of step condition.
123GNI0076	GNI	Align the nitrogen system for operation.
123GNI2542	GNI	Monitor the operation of the gaseous nitrogen system.
125IPO1159	IPO	Perform the monthly sphere isolation channel test.
125IPO1160	IPO	Perform in service valve testing.
125IPO1161	IPO	Perform a leakage test of radioactive systems outside of containment.
125IPO1162	IPO	Perform a status check of equipment during refueling.

Task ID	System ID	Task Description
125IPO1163	IPO	Perform an inspection of the containment and reactor coolant system.
125IPO1164	IPO	Perform a sphere isolation valve test.
122IPO1232	IPO	Respond to a moderate or severe earthquake.
121IPO1233	IPO	Respond to a forced evacuation of the control room.
121IPO1234	IPO	Respond to a fire in the 4kv room or in the turbine lube oil reservoir area.
122ISA1229	ISA	Respond to a low instrument or service air system pressure.
123LTGØØ87	LTG	Transfer station lighting transformers.
123LTG2543	LTG	Test the control room emergency lighting.
123MSSØØ9Ø	MSS	Shutdown the turbine reheaters.
123MSSØØ91	MSS	Startup the turbine reheaters.
123MSSØØ92	MSS	Monitor the operation of the main and reheat steam systems.
125MSSØØ97	MSS	Test the operation of the main steam safety valves.
123MVS2566	MVS	Monitor the operation of the technical support center ventilation control panel.
123MVS2567	MVS	Perform a monthly operability check of the control room emergency air treatment system.
123MVS2568	MVS	Test the exhaust fan (A-22 or A-24) failure alarm.
123NISØØ98	NIS	Monitor the operation of the nuclear instrumentation system.
123NISØØ99	NIS	Operate source range alarm panel.
125NISØ1ØØ	NIS	Calculate excore axial offset.
125NISØ1Ø1	NIS	Test the operation of the nuclear instrumentation intermediate range.
125NISØ1Ø2	NIS	Test the operation of the nuclear instrumentation source range.

Task ID	System ID	Task Description
125NIS0103	NIS	Test the nuclear instrumentation system power range.
125NIS0104	NIS	Calculate NIS/CAOMS deviation.
125NIS1116	NIS	Perform a reactor thermal power calibration.
122NIS1208	NIS	Respond to a nuclear flux tilt.
122NIS1209	NIS	Respond to a source range channel failure.
122NIS1210	NIS	Respond to a source range shutdown high flux level.
122NIS1211	NIS	Respond to an intermediate range channel failure.
122NIS1212	NIS	Respond to a power range channel failure.
122NIS1213	NIS	Respond to a NIS neutron detector high temperature indication.
123PAS2356	PAS	Perform valve alignments on the Post Accident Sample System.
123PAS2357	PAS	Inspect the PASS.
123PMU0105	PMU	Align primary makeup water system for normal operation.
123PZR0106	PZR	Establish a nitrogen blanket on the pressurizer relief tank.
123PZR0107	PZR	Control reactor coolant system pressure during solid plant operations.
123PZR0109	PZR	Transfer from manual to automatic pressurizer control.
123PZR0110	PZR	Fill the pressurizer relief tank.
123PZR0111	PZR	Place the overpressure mitigation system in service.
123PZR0112	PZR	Transfer pressurizer level control from automatic to manual.
125PZR0113	PZR	Test the backup nitrogen supply to the PORV's and block valves.
125PZR0114	PZR	Add nitrogen to the pressurizer.

Task ID	System ID	Task Description
125PZR1117	PZR	Test the operability of the power operated relief valve block valves.
122PZR1177	PZR	Respond to a leaking pressurizer power operated relief valve or safety valve.
122PZR1178	PZR	Respond to an actuation of the overpressure mitigation system.
122PZR1179	PZR	Respond to a high pressurizer pressure.
122PZR1180	PZR	Respond to a low pressurizer pressure.
122PZR1181	PZR	Respond to a high pressurizer level.
122PZR1182	PZR	Respond to a low pressurizer level.
123PZR2544	PZR	Transfer pressurizer level control channels.
123PZR2545	PZR	Transfer pressurizer pressure control channels.
123RCP0115	RCP	Place reactor coolant pump seal water in service.
123RCP0116	RCP	Verify alignment of RCP seal injection system.
123RCP0117	RCP	Remove the RCP seal water system from service.
123RCP0118	RCP	Manually control reactor coolant pump seal injection flow.
122RCP1183	RCP	Respond to a complete loss of reactor coolant seal water supply.
122RCP1184	RCP	Respond to a partial loss of reactor coolant seal water supply.
122RCP1185	RCP	Respond to a reactor coolant pump seal failure.
123RCS0119	RCS	Place the refueling water level detector inservice.
123RCS0120	RCS	Fill the reactor coolant system.
123RCS0121	RCS	Place the reactor flange leak detector in service.
123RCS0122	RCS	Remove the refueling level detector from service.
123RCS0123	RCS	Vent the reactor coolant pumps.
123RCS0124	RCS	Degass the reactor coolant system.

Task ID	System ID	Task Description
123RCS0126	RCS	Inspect a reactor coolant pump prior to startup.
123RCS0127	RCS	Shutdown a reactor coolant pump.
123RCS0128	RCS	Drain the reactor coolant system.
123RCS0129	RCS	Startup a reactor coolant pump.
123RCS0130	RCS	Evaluate the containment for leakage from systems inside the containment.
123RCS1118	RCS	Depressurize the reactor coolant system to atmospheric pressure.
123RCS1119	RCS	Drain the reactor coolant system to mid loop.
123RCS1120	RCS	Install and place the eductor in service.
125RCS1121	RCS	Perform a hot leak rate test of the reactor coolant system.
122RCS1173	RCS	Respond to a partial loss of reactor coolant system flow.
122RCS1174	RCS	Respond to leakage from the reactor coolant system.
122RCS1175	RCS	Respond to a loss of reactor coolant pump motor cooling.
122RCS1176	RCS	Respond to a high activity in the reactor coolant system.
123RHR0132	RHR	Align the residual heat removal loop for operation.
123RHR0133	RHR	Place the residual heat removal loop in service.
123RHR0134	RHR	Control RHR loop flow.
123RHR0135	RHR	Transfer operating residual heat removal pumps.
122RHR1188	RHR	Respond to a loss of the residual heat removal system.
123RHR2546	RHR	Monitor the operation of the residual heat removal system from inside the control room.
123RHR2547	RHR	Perform a routine inspection of the residual heat removal system inside containment.

Task ID	System ID	Task Description
123RHR2548	RHR	Manually operate the residual heat exchanger temperature control valve.
123RLC0136	RLC	Align the radwaste liquid collection system for normal operation.
123RLC2549	RLC	Flush a radwaste liquid collection sump.
123RMS0137	RMS	Monitor the operation of the operational radiation monitoring system.
123RMS0138	RMS	Monitor the operation of the emergency radiation monitoring system.
123RMS0139	RMS	Monitor the operation of the area radiation monitoring system.
125RMS0140	RMS	Test the operation of the area radiation monitoring system.
122RMS1214	RMS	Respond to a containment sphere high particulate or gaseous radiation.
122RMS1215	RMS	Respond to a high vent stack radiation level.
122RMS1216	RMS	Respond to a control room high area radiation alarm.
122RMS1217	RMS	Respond to a containment sphere high area radiation alarm.
122RMS1218	RMS	Respond to a high radio-chem lab area radiation alarm.
122RMS1219	RMS	Respond to a reactor auxiliary building high area radiation alarm.
122RMS1220	RMS	Respond to a sampling room high area radiation alarm.
122RMS1221	RMS	Respond to a cyrogenic system building high area radiation alarm.
122RMS1222	RMS	Respond to a spent fuel building high area radiation alarm.
123RMS2550	RMS	Test the operation radiation monitoring system.
122RMS2551	RMS	Respond to an emergency radiation monitoring system high radiation alarm.

Task ID	System ID	Task Description
123RPI1157	RPI	Manually determine RCS subcooling margin using thermocouple indication and pressurizer pressure.
125RPI1158	RPI	Perform the accident monitoring instrumentation channel check.
122RPS0141	RPS	Remove a reactor control and protection system delta T or Tave channel from service.
123RPS0145	RPS	Verify proper alignment of reactor control and protection system.
125RPS0148	RPS	Place a delta T or Tave channel in the operate position.
123RSD0088	RSD	Place the reheater steam dump system in service.
123RSD0089	RSD	Remove the reheater steam dump system from service.
125RSD0095	RSD	Isolate a reheater steam dump valve.
125RSD0096	RSD	Test the reheater steam dump system.
123RWC2571	RWC	Cooldown the cyrogenic unit.
123RWC2572	RWC	Process waste gas through the radwaste cyrogenic unit.
123RWC2573	RWC	Terminate a gas release through the cyrogenic unit.
123RWC2574	RWC	Desorb the cyrogenic unit and transfer the waste gas to the waste gas storage bottles.
123RWC2575	RWC	Regenerate the cyrogenic unit dryer.
123RWC2576	RWC	Release the waste gas high pressure storage bottles.
123RWC2577	RWC	Start the cyrogenic waste gas composite sample system.
123RWC2578	RWC	Start and prime the cyrogenic unit waste gas compressor.
123RWG0149	RWG	Terminate a continuous gas release.
123RWG0150	RWG	Remove the radwaste gas system from service.

Task ID	System ID	Task Description
123RWG0151	RWG	Align the radwaste gas system for normal operations.
123RWG0152	RWG	Release a gas decay tank directly to the vent stack.
123RWG0153	RWG	Terminate a release of a gas decay tank.
123RWG0154	RWG	Align radwaste gas system for a continuous release.
123RWG0155	RWG	Monitor the operation of the waste gas system.
123RWG1122	RWG	Transfer in service gas decay tanks.
123RWL0156	RWL	Pump the decontamination drain tank to a hold up tank.
123RWL0157	RWL	Transfer the contents of a monitor tank to a hold up tank.
123RWL0158	RWL	Sluice spent resin from radwaste ion exchangers.
123RWL0159	RWL	Process a radwaste holdup tank.
123RWL0160	RWL	Process the flash tank pump discharge.
123RWL0161	RWL	Release a hold up tank.
123RWL0162	RWL	Release a monitor tank.
123RWL0163	RWL	Add new resins to a radwaste ion exchanger.
123RWL0164	RWL	Align the mixed bed demineralizer for backflushing.
123RWL0165	RWL	Sluice resins from a mixed bed demineralizer to the spent resin tank.
123RWL0166	RWL	Transfer new resins to the mixed bed demineralizer.
123RWL0167	RWL	Backflush a radwaste ion exchanger.
123RWL0168	RWL	Monitor the operation of the radwaste liquid processing and release system.
123RWL1123	RWL	Transfer a holdup tank on another holdup tank.
123RWL1124	RWL	Backwash the RCS filter.

Task ID	System ID	Task Description
122RWL1189	RWL	Respond to a liquid radwaste effluent high radiation.
123RWL2552	RWL	Transfer the contents of the sphere sump to the decon drain tank.
123RWL2553	RWL	Transfer the contents of the sphere sump to the monitor tanks.
123RWL2554	RWL	Transfer the contents of the auxiliary building sump to the hold-up tanks.
123RWL2555	RWL	Transfer the contents of the rad-chem lab drain tank to a monitor tank.
123RWL2556	RWL	Transfer the contents of the decon drain tank to the monitor tanks.
123RWL2557	RWL	Release a hold-up tank dedicated as a monitor tank.
123RWL2558	RWL	Release the oily waste separator.
123RWSØ169	RWS	Place the refueling water storage tank filter in service.
123RWSØ170	RWS	Fill the refueling water storage tank.
123RWSØ171	RWS	Process the refueling water storage tank through an ion exchanger.
123RWSØ172	RWS	Drain the reactor refueling cavity.
123RWSØ173	RWS	Calculate the required quantity of boric acid and water to fill the refueling water storage tank.
125RWSØ174	RWS	Align valves to clean the refueling cavity via the radwaste ion exchangers.
125RWSØ175	RWS	Fill the reactor refueling cavity.
125RWSØ176	RWS	Align valves to clean the refueling cavity via the refueling water filter.
123RWS1125	RWS	Recirculate the refueling water storage tank using the refueling water pumps.
123SBSØØ93	SBS	Operate the steam generator blowdown valves.
123SBSØØ94	SBS	Monitor steam generator blowdown.

Task ID	System ID	Task Description
122SBS1231	SBS	Respond to a steam generator blowdown high radiation.
123SCF0177	SCF	Relate chemical lab recorder trends to plant conditions.
123SFP0046	SFP	Monitor spent fuel pool and spent fuel pool cooling system.
123SFP0178	SFP	Align valving to purify the spent fuel pool through the radwaste ion exchangers.
123SFP0179	SFP	Place the spent fuel pool cooling loop in service.
123SFP0180	SFP	Remove the spent fuel pool filter from service.
122SFP1227	SFP	Respond to a loss of spent fuel pool cooling.
123SFP2559	SFP	Place the spent fuel pool filter loop in service.
123SFP2560	SFP	Fill the spent fuel pool with primary water from the primary water system and boric acid from the boric acid storage tan
123SFP2561	SFP	Fill the spent fuel pool from the refueling water storage tank.
121SHA0044	SHA	Monitor the operation of the containment spray system following automatic actuation.
121SHA0045	SHA	Manually initiate containment spray.
123SHA0047	SHA	Monitor the operation of the containment spray and hydrazine injection systems during normal operation.
125SHA0048	SHA	Test the operation on the containment spray system.
121SHA1109	SHA	Reset the containment spray system following automatic or manual actuation.
121SIS0181	SIS	Monitor the operation of the safety injection system following automatic actuation.
121SIS0182	SIS	Manually initiate safety injection.
123SIS0183	SIS	Monitor the safety injection during normal operation.

Task ID	System ID	Task Description
125SIS0184	SIS	Test the operation of the sequencer.
125SIS1126	SIS	Test the safety injection system check valves.
125SIS1127	SIS	Perform a recirculation system leakage test.
125SIS1128	SIS	Perform a hot operational test of the safety injection system.
125SIS1129	SIS	Perform a cold safety injection and loss of offsite power test.
123SIS2562	SIS	Deenergize the sequencer.
123SIS2563	SIS	Energize the sequencer.
123SWC0185	SWC	Monitor the operation of the salt water cooling system.
123SWC0186	SWC	Startup the auxiliary saltwater cooling pump.
123SWC1130	SWC	Align the salt water cooling system for heat treatment of the circulating water system.
123SWC1131	SWC	Transfer operating salt water cooling pumps.
122SWC1226	SWC	Respond to a loss of salt water cooling.
123TBN0187	TBN	Place the main turbine on the turning gear.
123TBN0188	TBN	Monitor the operation of the main turbine and associated equipment.
125TBN0189	TBN	Test the turbine backup overspeed trip.
125TBN0190	TBN	Test the thrust bearing failure trip.
125TBN0191	TBN	Test turbine control valve leakage.
125TBN0192	TBN	Test main turbine mechanical overspeed trip.
125TBN0193	TBN	Read the turbine rotor position.
125TBN0194	TBN	Test the low condenser vacuum trip.
125TBN0195	TBN	Test the main turbine governor oil trip.
125TBN0196	TBN	Test the turbine stop valves.
125TBN1132	TBN	Perform a governor range test.

Task ID	System ID	Task Description
125TBN1133	TBN	Test the main turbine auxiliary governor.
125TBN1134	TBN	Perform a solenoid trip test.
125TBN1135	TBN	Perform a no load, generator antomotoring test.
125TBN1136	TBN	Perform a low hydraulic oil header pressure trip test.
123TCW0197	TCW	Monitor the operation of the turbine plant cooling water pumps.
123TFX0142	TFX	Place the thermocouple monitoring system in service.
123TFX0144	TFX	Execute a thermocouple map.
123TFX0146	TFX	Monitor core thermocouples.
123TFX1156	TFX	Obtain a digital readout of incore thermocouples.
125TLO1137	TLO	Test the turbine generator oil pumps.
123VCC0077	VCC	Place excess letdown in service.
123VCC0078	VCC	Remove excess letdown from service.
123VCC0079	VCC	Backflush the lithium demineralizer.
123VCC0080	VCC	Place a mixed bed demineralizer in service.
123VCC0081	VCC	Shift mixed bed demineralizers.
123VCC0082	VCC	Remove the lithium demineralizer from service.
123VCC0083	VCC	Place the lithum demineralizer in service.
123VCC0084	VCC	Remove a mixed bed demineralizer from service.
123VCC0085	VCC	Backflush a mixed bed demineralizer.
123VCC0125	VCC	Add lithium or hydrazine to the reactor coolant system.
123VCC0198	VCC	Monitor the operation of the charging and letdown systems.
123VCC0199	VCC	Startup a charging pump.
123VCC0200	VCC	Shutdown a charging pump.

Task ID	System ID	Task Description
123VCC0201	VCC	Establish a nitrogen atmosphere on the volume control tank.
123VCC0202	VCC	Establish a hydrogen atmosphere on the volume control tank.
125VCC0203	VCC	Manually adjust charging flowrate.
123VCC1115	VCC	Place a new mixed bed demineralizer in service without containment integrity.
122VCC1138	VCC	Establish a charging flow path to the RCS through the alternate cold leg injection path during mode 5 or 6.
123VCC1139	VCC	Degas the reactor coolant system.
125VCC1140	VCC	Vent the charging pump suction from the RWST.
122VCC1186	VCC	Respond to a loss of letdown flow.
123VCC2564	VCC	Establish charging and letdown in modes 1-4.
123VCC2565	VCC	Establish charging and letdown in Modes 5 & 6.
123VTB0063	VTB	Monitor the operation of the vital, utility and regulated buses.
123VTB1146	VTB	Place inverter No. 4 in service.
123VTB1147	VTB	Remove inverter No. 4 from service.
123VTB1148	VTB	Place vital bus No. 4 voltage regulator in service.
123VTB1149	VTB	Remove vital bus No.4 voltage regulator from service.
123VTB1150	VTB	Place the CSAS logic panel power supply inverters in service.
123VTB1151	VTB	Remove the CSAS logic panel power supply inverters from service.
122VTB1198	VTB	Respond to a loss of a vital or a utility bus.

Task ID	System ID	Task Description
323BHA0632	BHA	Place the shutdown cooling system suction isolation valve power supply system in service.
323BHA0635	BHA	Remove the shutdown cooling system suction isolation valve power supply system from service.
322GBA0204	GBA	Monitor the aux building normal HVAC chiller for abnormal operation, take corrective action.
323GBA0205	GBA	Startup aux building normal HVAC chiller unit.
323GBA0206	GBA	Align aux building normal HVAC chilled water system valves to place system in service.
323GBA1832	GBA	Inspect a chilled water pump after starting.
323GBA1833	GBA	Inspect a chiller unit after starting.
323GBA1834	GBA	Add chemicals to the normal chilled water system.
323GHA0210	GHA	Monitor the radwaste ventilation system for normal operation.
323GHA0211	GHA	Inspect auxiliary building HVAC fans for readiness to start.
323GHA0212	GHA	Align the radwaste normal HVAC system air wash system for operation.
323GHA0213	GHA	Align the radwaste normal HVAC system for normal operation.
323GHA1839	GHA	Align the center air wash pump to supply either radwaste HVAC unit.
323GHA1840	GHA	Perform radwaste ventilation one-a-shift surveillance.
323GHA1841	GHA	Place the continuous plant exhaust system in service.
321GJA0214	GJA	Monitor the operation of the emergency chilled water system during an automatic start(emergency operation).
322GJA0215	GJA	Transfer the emergency chilled water system chiller unit power supply breakers.
323GJA0216	GJA	Align emergency chilled water system valves to place system in service.

Task ID	System ID	Task Description
323GJA0217	GJA	Startup emergency chilled water pump.
323GJA0218	GJA	Startup emergency chilled water system chiller unit.
323GJA1845	GJA	Shutdown the emergency chilled water system.
323GJA1846	GJA	Add chemicals to the emergency chilled water system.
321GKA0219	GKA	Perform the CRIS/TGIS reset alignment checklist.
321GKA0220	GKA	Verify the proper actuation of the control room isolation system and the toxic gas isolation system.
323GKA0221	GKA	Manually actuate the control room isolation and emergency ventilation system.
323GKA0222	GKA	Align the control room isolation and emergency ventilation system for normal operation.
325GKA0223	GKA	Test the operation of the control room emergency air cleanup system.
323GKA1811	GKA	Align the control room emergency air condition units power supply to unit 2 (or Unit 3).
323GKA1812	GKA	Perform a routine inspection of the toxic gas analyzer.
323GKB0224	GKB	Inspect the control room HVAC system.
323GKB0225	GKB	Align the control room smoke exhaust control system for automatic operation.
323GKB0226	GKB	Align the control room normal HVAC system for normal operation.
323GKB1842	GKB	Manually actuate the smoke exhaust system.
323GKB1843	GKB	Override the automatic start of the smoke exhaust system.
323GKB1844	GKB	Stroke the control room normal HVAC system three way temperature control valves.
323GLA0227	GLA	Align the public address and communication room hvac system for normal operation.

Task ID	System ID	Task Description
321GLB0661	GLB	Manually start the ESF switchgear room emergency air conditioning system.
323GLB0662	GLB	Align the ESF switchgear room emergency air condition system for automatic operation.
323GLC0663	GLC	Align the health physics and locker room HVAC system for normal operation.
323GLC1813	GLC	Place the health physics and locker room HVAC system in service.
323GLD1814	GLD	Place the cable spreading and electrical rooms HVAC system in service.
323GLE1815	GLE	Align the ESF battery room emergency exhaust fans for automatic operation.
323GLE1816	GLE	Manually start the ESF battery room emergency exhaust fan.
323GLF1817	GLF	Align the ESF switchgear room and non-ESF battery room HVAC for normal operation.
323GLG1818	GLG	Place the ESF battery room normal HVAC system in service.
323GLH0228	GLH	Manually start the chiller room emergency HVAC system.
323GLH0229	GLH	Align the chiller room HVAC normal system for operation.
323GLH1847	GLH	Align the emergency chiller room emergency supply and exhaust fans for automatic operation.
323GLX1848	GLX	Align the non-ESF switchgear exhaust fans for automatic operation.
323KBA0232	KBA	Startup an instrument and service air compressor.
323KCX0233	KCX	Operate fire water pumps.
322KCX1048	KCX	Monitor the automatic actuation of the fire suppression water system.
323KCX1049	KCX	Monitor the operation of the fire suppression water system during normal operation.
323KCX1050	KCX	Monitor the normal operation of the carbon dioxide fire protection system.

Task ID	System ID	Task Description
323KCX1051	KCX	Disarm automatic initiation of the halon fire protection system.
323KCX1052	KCX	Monitor fire control valve status.
323KCX1058	KCX	Operate the fire monitoring system computer.
323KCX1824	KCX	Inspect the halon fire protection panel (zone panel and power supply panel) to verify normal alignment.
323KCX1825	KCX	Restore the halon fire protection system to normal following automatic or manual initiation.
323KCX2599	KCX	Test the fire monitoring system computer from the keyboard.
323KDA1018	KDA	Operate service water pumps.
323KJX0234	KJX	Startup a diesel generator.
323KJX0235	KJX	Shutdown a diesel generator.
323KJX0236	KJX	Operate diesel generator fuel system.
323KJX1826	KJX	Synchronize the diesel generator to the 4kv bus.
323KJX1827	KJX	Parallel the diesel generator with the Unit reserve auxiliary transformer while operating isolated on the 4kv bus.
325KJX2460	KJX	Test the operation of the emergency diesel generator.
323MAX1743	MAX	Complete a switching order to clear the main and unit auxiliary transformers.
323MAX1744	MAX	From the control room monitor the operation of the main and unit auxiliary transformers.
323MAX1745	MAX	Align the main and unit auxiliary transformer relay protection for normal operation.
323MAX1746	MAX	Complete a switching order to clear a reserve auxiliary transformer.
323MAX1747	MAX	From the control room monitor the operation of the reserve auxiliary transformers.
323MKA1748	MKA	Prepare a switching order to remove a 220 kv line from service.

Task ID	System ID	Task Description
323MKA1749	MKA	Prepare a switching order to clear a 220 kv bus.
323MKA1750	MKA	Give a switching order to the switching operator and checker.
323NAX1751	NAX	Manually transfer a 6.9 kv bus from the unit auxiliary transformer to the reserve auxiliary transformer.
323NAX1752	NAX	Manually transfer a 6.9 kv bus from the unit aux transformer to the alternate unit reserve auxiliary transformer.
323NAX1753	NAX	Manually transfer a 6.9 kv bus from the reserve auxiliary transformer to the unit auxiliary transformer.
323NBX0237	NBX	Manually transfer non-1E 4.16kv bus from reserve auxiliary transformer to the unit auxiliary transformer.
323NBX0238	NBX	Manually transfer non-1E 4.16 kv bus from the unit auxiliary transformer to the reserve auxiliary transformer.
323NBX0240	NBX	Manually transfer 1E 4.16 kv bus from the bus tie postion to the unit auxiliary transformer.
323NBX0241	NBX	Manually transfer 1E 4.16 kv bus from the unit auxiliary transformer to the bus tie position.
323NBX0242	NBX	Manually transfer 1E 4.16 kv bus from the bus tie position to the unit auxiliary transformer.
323NBX0243	NBX	Perform a dead bus transfer of 1E 4.16 kv bus to the reserve auxiliary transformer.
323NBX0244	NBX	Manually transfer 1E 4.16 kv bus from the bus tie position to the reserve auxiliary transformer.
323NBX0245	NBX	Manually transfer 1E 4.16 kv bus from the reserve aux transformer to the bus tie position.
323NBX0246	NBX	Inspect the 4.16 kv class 1E switchgear.
325NBX0247	NBX	Test the 4 kv bus emergency transfer.
323NBX1828	NBX	Transfer 4 kv bus power supplies by the drop and pickup method.

Task ID	System ID	Task Description
323NBX1829	NBX	Remove a 4 kv air circuit breaker from the operating position.
323NBX1830	NBX	Place a 4 kv air circuit breaker in the test position.
323NBX1831	NBX	Inspect a 4 kv and 480 volt circuit breaker after a relay operation.
323NBX2600	NBX	Place a 4 kv circuit breaker into the operating position.
323NGX1763	NGX	Deenergize a 480 volt load center and it's associated motor control centers.
323NGX1764	NGX	Inspect the 480 volt switchgear for normal operation.
323NGX1765	NGX	Transfer 480 volt load center B10 power supplies.
323NGX1766	NGX	Transfer 480 volt motor control center BQ or BS power supplies.
323NGX1767	NGX	Transfer 480 volt motor control center BT or BG power supplies.
323NGX1768	NGX	Transfer 480 volt motor control center BU power supplies.
323NGX1769	NGX	Locate a 480 volt system ground.
323NKA1821	NKA	Perform routine inspection of non-1E 125 VDC system.
323NKA1822	NKA	Remove a 125 VDC battery charger from service.
323NKA1823	NKA	Place a 125 VDC battery charger in service.
323NNA0239	NNA	Monitor the operation of the non 1E 120 vac instrument and control power system.
323NNA1757	NNA	Transfer non-1E instrument buses to and from their emergency sources.
321NNA2461	NNA	Restore power to the non-1E instrument AC power system following an ESFAS actuation.
323PKA1770	PKA	Perform routine monitoring of the 1E 125 VDC switchgear.

Task ID	System ID	Task Description
323PKA1771	PKA	Place a 1E 125 VDC battery charger in service.
323PKA1772	PKA	Remove a 1E 125 VDC battery charger from service.
323PKA1773	PKA	Remove the plant computer power supply inverter from service.
323PKA1774	PKA	Place the plant computer power supply inverter in service.
323PKA1775	PKA	Remove the plant computer power supply static transfer switch from service.
323PKA1776	PKA	Place the plant computer power supply static transfer switch in service.
323PKA1777	PKA	Remove the plant computer power supply alternate source regulating transformer from service.
323PKA1778	PKA	Place the plant computer power supply alternate source regulating transformer in service.
323PKA1779	PKA	Perform routine monitoring of the plant computer power supply system.
323PKA1780	PKA	Place the shutdown cooling system suction isolation valve power supply inverter in service.
323PKA1781	PKA	Remove the shutdown cooling system suction isolation valve power supply system inverter from service.
323PKA1782	PKA	Remove the health physics computer power supply inverter from service.
323PKA1783	PKA	Place the health physics computer power supply inverter in service.
323PKA1784	PKA	Remove the health physics computer power supply static transfer switch from service.
323PKA1785	PKA	Place the health physics computer power supply static transfer switch in service.
323PKA1786	PKA	Remove the health physics computer power supply alternate source regulating transformer from service.
323PKA1787	PKA	Place the health physics computer power supply alternate source regulating transformer in service.

Task ID	System ID	Task Description
323PKA1788	PKA	Perform routine monitoring of the health physics computer power supply system.
323PKA1796	PKA	Transfer an energized vital bus from the inverter to it's alternate source.
323PKA1797	PKA	Remove a 1E 120 VAC inverter from service.
323PKA1798	PKA	Place a 1E 120 VAC inverter in service.
323PKA1799	PKA	Transfer an energized 1E 120 VAC vital bus from the alternate supply to the inverter.
323PKA1800	PKA	Perform routine monitoring of the 1E 120 VAC power supply system.
323QAA1801	QAA	Transfer a lighting bus from it's normal to standby station lighting transformer.
323QAA1802	QAA	Remove from service the lighting transformers supplying normal lighting to outlying areas.
323QAA1803	QAA	Place in service the transformer that supplies the switchyard lighting.
323QAA1805	QAA	Install a station lighting transformer low side breaker in it's cubicle.
323QAA1806	QAA	Rack in a station lighting transformer low side breaker.
323QAA1807	QAA	Remove a station lighting transformer low side breaker from service.
323QAA1808	QAA	Test the DC emergency lighting for the central areas of each unit.
323QAA1809	QAA	Test the outlying areas individual lighting units emergency lighting.
323SDA0248	SDA	Read and interpret area radiation monitoring instruments.
323SDA0249	SDA	Operate the area radiation monitor control room module controls.
325SDA0250	SDA	Test the operation of the area radiation monitoring system.
323SDA1849	SDA	Place the area radiation monitoring system in service.

Task ID	System ID	Task Description
223ABA0901	ABA	Monitor moisture separator reheater operation.
223ABA0902	ABA	Manually operate steam bypass control valves.
223ABA0903	ABA	Operate the atmospheric steam dump control valves.
223ABA0904	ABA	Operate the main steam bypass system during plant shutdown.
223ABA0905	ABA	Operate the main steam bypass system during plant startup.
225ABA0906	ABA	Test the operation of the atmospheric steam dump valves.
225ABA0907	ABA	Test the operation of the steam bypass control system.
225ABA0908	ABA	Test the operation of the main steam isolation valves.
223ABA1331	ABA	Place the moisture separator reheaters in service.
223ABA2420	ABA	Warm the main steam leads using the MSIV bypass valves with vacuum established.
223ABA2421	ABA	Warm the main steam leads using the MSIC bypass valves without vacuum established.
223ABA2422	ABA	Open the main steam isolation valves.
223ACA0909	ACA	Monitor main turbine vibration.
223ACA0910	ACA	Startup the turbine generator.
223ACA0911	ACA	Place turbine turning gear in service.
223ACA0912	ACA	Shutdown the main turbine.
223ACA0913	ACA	Monitor the operation of the turbine generator.
223ACA1332	ACA	Calculate the minimum time to increase turbine speed to 1800 rpm.
223ACA1333	ACA	Calcuate the maximum loading rates for the main turbine given the initial turbine temperatures and load.
225ACA2423	ACA	Test the main turbine stop valves.

Task ID	System ID	Task Description
222ADA0914	ADA	Monitor automatic overboarding of the condenser hotwells.
222ADA0915	ADA	Manually operate the hotwell overboard system.
223ADA0916	ADA	Startup a condensate pump.
223ADA0917	ADA	Startup a heater drain pump.
223ADA0918	ADA	Shutdown a heater drain pump.
223ADA0919	ADA	Shutdown a condensate pump.
223ADA0920	ADA	Operate feedwater and condensate systems to establish chemical conditions.
223ADA0921	ADA	Monitor condensate system chemical conditions.
223ADA0922	ADA	Monitor the operation of the condensate system.
222ADA2424	ADA	Respond to a loss of a heater drain pump.
222ADA2425	ADA	Respond to a loss of a condensate pump.
224ADM1372	ADM	Use operating instructions to carry out plant manipulations.
224ADM1373	ADM	Prepare a temporary change notice to make an on the spot change to an operating instruction.
224ADM1374	ADM	Identify procedural deficiencies.
224ADM1375	ADM	Prepare a procedure modification permit.
224ADM1376	ADM	Prepare an abnormal alignments and evolutions document to perform an plant manipulation not covered by a procedure.
224ADM1377	ADM	Issue and release a clearance.
224ADM1378	ADM	Issue and release a permission.
224ADM1379	ADM	Issue and release an approval.
224ADM1380	ADM	Modify a clearance or permission.
224ADM1381	ADM	Conduct a shift turnover.
224ADM1382	ADM	Complete the Unit ACO's shift relief checklist.

Task ID	System ID	Task Description
224ADM1383	ADM	Control access to the control room.
223AEA0923	AEA	Warm-up feedwater pump and turbine.
223AEA0924	AEA	Startup a main feedwater pump.
223AEA0925	AEA	Shutdown a main feedwater pump.
223AEA0926	AEA	Monitor main feed pump turbine vibration.
223AEA0927	AEA	Monitor feedwater system chemical conditions.
223AEA0928	AEA	Manually control main feed pump turbine speed.
223AEA0929	AEA	Start main feed pump turbine turning gear.
223AEB0930	AEB	Manually operate the main feedwater valves.
223AEB0931	AEB	Operate the feedwater regulating system during a unit startup.
223AEB0932	AEB	Manually operate the bypass feedwater valves.
223AEB0933	AEB	Manually operate the feedwater pump turbine speed control.
223AEB0934	AEB	Operate the feedwater regulating system during a unit shutdown.
223AFA0935	AFA	Operate fifth point heater high level dump.
223AFA2426	AFA	Monitor the operation of the feedwater heater.
223AFA2427	AFA	Remove a feedwater heater from service.
225AFA2428	AFA	Clear a feedwater heater for maintenance.
223ALA0936	ALA	Shutdown the auxiliary feedwater system.
223ALA0937	ALA	Establish flow to the steam generators with the auxiliary feedwater system using 4705,4706,4712,4713.
223ALA0938	ALA	Startup a motor driven auxiliary feedwater pump.
223ALA0939	ALA	Startup a turbine driven auxiliary feed pump.
225ALA0940	ALA	Test the operation of the auxiliary feedwater system.

Task ID	System ID	Task Description
222ALA1334	ALA	Verify the proper operation of the auxiliary feedwater system following automatic actuation.
223ALA2429	ALA	Manually inititate the auxiliary feedwater system.
223ALA2445	ALA	Establish flow to the steam generators with the auxiliary feedwater system using 4762 and 4763.
223BBA0941	BBA	Shutdown a reactor coolant pump.
223BBA0942	BBA	Monitor the operation of the reactor coolant pumps.
223BBA0943	BBA	Startup a reactor coolant pump.
223BBA0944	BBA	Control reactor coolant system cold leg temperature.
225BBA0945	BBA	Monitor the reactor coolant system for leakage.
225BBA0946	BBA	Calculate reactor coolant system flow rate.
225BBA0947	BBA	Calculate the reactor coolant system leak rate.
225BBA0948	BBA	Test the leakage across the RCS pressure isolation valves.
225BBA0949	BBA	Calculate reactor power.
221BBA0950	BBA	Operate the reactor coolant gas vent system during emergency operation.
223BBA0960	BBA	Operate the reactor coolant gas vent system for draining and filling the reactor coolant system.
223BBA1335	BBA	Fill and vent the reactor coolant system with air in the steam generator tubes.
223BBA1336	BBA	Fill and vent the reactor coolant system with no air in the steam generator tubes.
223BBA1337	BBA	Drain the reactor coolant system.
225BBA1338	BBA	Calculate the available shutdown margin with the reactor critical.
225BBA1339	BBA	Calculate the actual shutdown margin with the reactor subcritical.
222BBA1413	BBA	Respond to a reactor coolant pump seal failure.

Task ID	System ID	Task Description
222BBA1421	BBA	Respond to a reactor coolant system leak.
222BBB0951	BBB	Control pressurizer level using local setpoint control of LIC-0110.
222BBB0952	BBB	Operate the auxiliary spray valve.
222BBB0953	BBB	Control pressurizer level using HIC-0110.
222BBB0954	BBB	Transfer pressurizer pressure control from automatic to manual.
222BBB0955	BBB	Control pressurizer pressure in manual.
222BBB0956	BBB	Transfer pressurizer pressure control from manual to automatic.
222BBB0957	BBB	Transfer pressurizer level control from manual to automatic.
222BBB0958	BBB	Transfer pressurizer level control from automatic to manual.
223BBB0959	BBB	Purge the quench tank.
223BBB0961	BBB	Control reactor coolant system pressure during heatup and cooldown.
223BBB0962	BBB	Vent the quench tank.
223BBB0963	BBB	Operate the pressurizer heaters.
223BBB0964	BBB	Drain the quench tank.
223BBB0965	BBB	Manually operate spray valves.
222BBB1340	BBB	Transfer pressurizer level setpoint control from manual to automatic.
223BBB1341	BBB	Place the quench tank into service.
222BBB2439	BBB	Respond to off-normal level, temperature or pressure conditions in the quench tank.
222BBB2440	BBB	Respond to a pressurizer pressure control system malfunction.
222BBB2441	BBB	Respond to a loss of pressurizer level control.
222BGA0967	BGA	Reduce RCS boron concentration using a purification ion exchanger.

Task ID	System ID	Task Description
223BGA0969	BGA	Align valves to establish a letdown flow path for filling the reactor coolant system.
223BGA0973	BGA	Secure charging and letdown.
223BGA0974	BGA	Monitor the operation of the boronometer.
223BGA0975	BGA	Shift operating charging pumps.
223BGA0976	BGA	Initiate charging and letdown.
223BGA0978	BGA	Control pressurizer pressure during solid plant operation.
223BGA0979	BGA	Monitor the operation of the chemical and volume control system.
223BGA1346	BGA	Purge the volume control tank to reduce oxygen level.
223BGA1347	BGA	Align the RWST to the charging pump suction in preparation for filling the RCS.
222BGA2442	BGA	Respond to a manfunction of the letdown/purification system.
222BGB0966	BGB	Reset the makeup control system following a loss of control power.
222BGB0968	BGB	Emergency borate the reactor coolant system.
223BGB0970	BGB	Operate the makeup control system in the manual mode.
223BGB0971	BGB	Operate the makeup control system in the borate mode.
223BGB0972	BGB	Operate the makeup control system in automatic.
223BGB0977	BGB	Operate the makeup control system in the dilution mode.
225BGB0980	BGB	Verify operability of boron injection flow paths.
223BGB1342	BGB	Align the boric acid makeup control for normal operation.
223BGB1343	BGB	Monitor automatic makeup operation.
223BGB1344	BGB	Fill the refueling water storage tank with a given volume of boric acid to a given boric acid concentration.

Task ID	System ID	Task Description
225BGB1345	BGB	Perform a boric acid flow test.
222BGB1419	BGB	Respond to a loss of boron concentration or inadvertent dilution.
222BGB2443	BGB	Respond to a loss of reactor coolant makeup.
221BGB2444	BGB	Respond to a CVCS loss of coolant accident.
221BHA0981	BHA	Return containment isolation valves to normal following automatic actuation.
221BHA0982	BHA	Verify alignment of containment isolation valves following automatic actuation.
221BHA0983	BHA	Verify alignment of safety injection system following automatic actuation.
221BHA0984	BHA	Return safety injection system to normal alignment following automatic actuation.
223BHA0985	BHA	Fill the reactor coolant system using the low pressure safety injection pump method.
223BHA0986	BHA	Pressurize the safety injection tank.
223BHA0987	BHA	Remove shutdown cooling from service.
223BHA0988	BHA	Place the shutdown cooling system in service.
223BHA0989	BHA	Warm the shutdown cooling system.
223BHA0990	BHA	Vent the safety injection tank.
223BHA0991	BHA	Align the shutdown cooling system for purification operation.
223BHA0992	BHA	Drain the safety injection tank.
223BHA0993	BHA	Fill the safety injection tank.
222BHA1422	BHA	Respond to a loss of shutdown cooling.
223BHA2430	BHA	Align the swing high pressure safety injection pump for operation.
221BKA0994	BKA	Verify the alignment of the containment spray system after automatic actuation.
221BKA0995	BKA	Manually control containment spray flow.

Task ID	System ID	Task Description
221BKA0996	BKA	Manually initiate the containment spray system.
223BKA0997	BKA	Fill the reactor coolant system using the containment spray pump method.
225BKA0998	BKA	Test the operation of the containment spray and iodine removal systems.
223BKA1348	BKA	Recirculate the spray chemical addition tank.
221BKA1349	BKA	Realign the containment spray system for normal operation following automatic actuation.
223BMA2431	BMA	Initiate steam generator blowdown.
223BMA2432	BMA	Secure steam generator blowdown.
223CAA0999	CAA	Operate emergency spray valves.
223CAA1000	CAA	Control gland steam supply pressure.
223CAA1001	CAA	Place the steam seal and exhaust system in service.
223CAA1002	CAA	Operate the emergency spray water pump.
223CAA1003	CAA	Monitor the operation of the steam seal system.
223CBA1004	CBA	Startup the jacking oil system.
223CBA1005	CBA	Startup the main turbine lube oil system.
223CBA1006	CBA	Shutdown the turbine lube oil system.
223CDA1007	CDA	Startup the generator seal oil system.
223CDA2433	CDA	Monitor the operation of the seal oil system.
223CEA1008	CEA	Shutdown a stator cooling water pump.
223CEA1009	CEA	Startup a stator cooling water pump.
223CEA2434	CEA	Monitor the operation of the stator cooling system.
223CGA1350	CGA	Establish condenser vacuum.
222CGA1418	CGA	Respond to a loss of condenser vacuum.
223CHA1010	CHA	Monitor the operation of the turbine control system.

Task ID	System ID	Task Description
223CHA1Ø11	CHA	Place the turbine protection system in service.
225CHA1Ø12	CHA	Test main turbine overspeed trip.
223CHA1351	CHA	Remove a unitized actuator from service during on load operation.
223CHA1352	CHA	Place a unitized actuator in service during on load operation.
222CHA1353	CHA	Reset a tripped computing channel.
225CHA1354	CHA	Test the turbine overspeed governor with the turbine off line.
225CHA1355	CHA	Test the main turbine turning gear motor start function.
225CHA1356	CHA	Test the main turbine control valves for leakage.
222DAA1Ø13	DAA	Align the circulating water system for degraded intake/outfall capacity.
222DAA1Ø14	DAA	Back flush the circulating water system.
223DAA1Ø15	DAA	Shutdown a circulating water pump and associated condenser section.
223DAA1Ø16	DAA	Startup a circulating water pump.
223DAA1Ø17	DAA	Monitor the operation of the circulating water system.
222DAA1417	DAA	Respond to a condenser salt leak.
223EBA1Ø19	EBA	Startup a turbine plant cooling water pump.
223EBA1Ø2Ø	EBA	Shutdown a turbine plant cooling water pump.
223EBA1Ø21	EBA	Monitor the operation of the turbine plant cooling water system.
223ECA1Ø22	ECA	Operate the spent fuel pool cooling pumps.
223ECA1Ø23	ECA	Monitor the operation of the spent fuel pool cooling and purification loop.
222EGA1Ø24	EGA	Remove a component cooling water critical loop from service.

Task ID	System ID	Task Description
223EGA1025	EGA	Transfer the component cooling water non-critical loops.
223EGA1026	EGA	Startup a component cooling water pump.
223EGA1027	EGA	Monitor the operation of the component cooling water system.
223EGA1028	EGA	Shutdown a component cooling water pump.
223EGA1029	EGA	Align component cooling water to the shutdown heat exchanger.
223EGA1030	EGA	Align third of a kind component cooling water pump for operation.
225EGA1031	EGA	Test the operation of the component cooling water system.
222EGA1414	EGA	Respond to a loss of component cooling water.
223EPA1032	EPA	Startup a saltwater cooling pump.
223EPA1033	EPA	Monitor the operation of the salt water cooling system.
222EPA1415	EPA	Respond to a loss of saltwater cooling.
222EPA2435	EPA	Backwash the salt water side of a component cooling water heat exchanger.
222EPA2436	EPA	Bump salt water cooling pump to clean the salt water side of the component cooling water heat exchangers.
221GGA0207	GGA	Reset the FHIS after actuation.
223GGA0208	GGA	Verify proper operation of the fuel handling building isolation and emergency air cleanup system upon actuation.
225GGA0209	GGA	Test the operation of the fuel handling building post accident air clean up system.
223GGA1835	GGA	Place the fuel handling building normal ventilation system in service.
223GGA1837	GGA	Manually initiate the fuel handling building isolation and emergency air cleanup system.

Task ID	System ID	Task Description
223GGA1838	GGA	Test the manual actuation of the fuel handling building emergency ventilation system.
223GHB1810	GHB	Manually start the charging pump room and BAMU pump room emergency A.C. units.
221GNX1034	GNX	Verify alignment of containment cooling after automatic actuation.
221GNX1035	GNX	Reset the containment combustible gas control system.
222GNX1036	GNX	Manually actuate the containment gas control system.
222GNX1037	GNX	Realign the containment emergency cooling system for standby operation after automatic or manual actuation.
223GNX1038	GNX	Vent the containment.
223GNX1039	GNX	Startup the containment mini-purge system.
223GNX1040	GNX	Determine the containment average ambient temperature.
223GNX1041	GNX	Align the containment recirculation filtration and mini-purge system for unit startup.
223GNX1042	GNX	Startup the containment recirculation filtration system.
225GNX1043	GNX	Test the operation of the hydrogen recombiner.
221GNX1044	GNX	Operate the hydrogen purge system.
225GNX1045	GNX	Test the containment purge isolation system.
221GNX1357	GNX	Place the hydrogen recombiner in service.
221GNX1358	GNX	Place the hydrogen purge system in service.
223GNX1739	GNX	Manually place the containment emergency cooling system in service and verify proper operation.
223GXX1819	GXX	Place the safety equipment building normal HVAC system in operation.
223GXX1820	GXX	Place safety injection and CCW pump rooms normal HVAC system in service.

Task ID	System ID	Task Description
223HGX1Ø46	HGX	Operate the containment sump pumps.
223HGX1Ø47	HGX	Monitor containment sump level.
223HJA1359	HJA	Purge the reactor coolant drain tank to reduce oxygen concentration.
223MAA1Ø53	MAA	Monitor the operation of the main generator.
223MAA1Ø54	MAA	Synchronize main generator to the line.
223MAA1Ø55	MAA	Operate generator field ground detector.
223MAA136Ø	MAA	Place the automatic voltage regulator in service.
223MAA1361	MAA	Remove the automatic voltage regulator from service.
222MAA141Ø	MAA	Respond to a low system voltage.
222MAA1411	MAA	Respond to a generator out-of-step condition.
223MBA1Ø56	MBA	Monitor the operation of the main generator voltage regulator.
223MBA1Ø57	MBA	Manually control generator voltage.
221RJA1Ø59	RJA	Operate the critical function monitoring system.
223RJA1Ø6Ø	RJA	Operate the core operating limits supervisor system.
223RJA1Ø61	RJA	Operate the plant computer system.
223RJA2437	RJA	Operate the qualified safety parameter display system.
221SAAØ9ØØ	SAA	Reset a main steam isolation signal.
221SAA1Ø62	SAA	Reset containment purge isolation system.
221SAA1Ø63	SAA	Monitor automatic or manually initiated containment purge isolation actuation.
221SAA1Ø64	SAA	Monitor actuation of main steam isolation.
222SAA1Ø65	SAA	Respond to ESFAS alarm conditions.
223SAA1Ø66	SAA	Place an ESFAS auxiliary relay cabinet in service.

Task ID	System ID	Task Description
223SAA1067	SAA	Operate the ESF bypass status panel.
223SAA1068	SAA	Deenergize an ESFAS auxiliary relay cabinet.
225SAA1069	SAA	Test the operation of the engineered safety features subgroup relays.
221SAA1362	SAA	Verify the proper operation of the containment isolation actuation system following a system actuation.
221SAA1363	SAA	Realign containment isolation valves and systems to normal following an actuation of the containment isolation system.
222SBA1070	SBA	Manually trip the reactor.
223SBA1071	SBA	Close the reactor trip breakers.
223SBA1072	SBA	Bypass a reactor protective system trip channel.
223SBA1073	SBA	Reset the steam generator pressure variable setpoint.
223SBA1074	SBA	Operate the core protection calculator.
223SBA1075	SBA	Operate the control element assembly calculator.
223SBA1076	SBA	Reset the pressurizer pressure variable setpoint.
223SBA1077	SBA	Monitor reactor trip status panel.
225SBA1078	SBA	Calculate core protection calculator flow coefficients.
223SBA1370	SBA	Change the value of a CPC addressable constant.
225SBA1371	SBA	Determine the operability of the reed switch position transmitter.
222SBA1425	SBA	Respond to a failure of the reactor protection system.
222SDA1079	SDA	Respond to area radiation monitoring system alarms.
223SDA1080	SDA	Monitor the operation of the area radiation monitoring system.
225SDA2608	SDA	Test an area radiation monitoring channel.

Task ID	System ID	Task Description
225SDA2609	SDA	Check the calibration of the containment area radiation monitoring system fail and alarm circuits.
223SEA1081	SEA	Monitor the operation of the nuclear instrumentation system during a reactor startup.
223SEA1082	SEA	Monitor the operation of the excore instrumentation startup channels during shutdown modes.
223SEA1083	SEA	Monitor the operation of the excore instrumentation startup channels during modes 1 and 2.
223SEA1084	SEA	Monitor the operation of the excore instrumentation control channel during shutdown.
223SEA1085	SEA	Monitor the operation of the excore instrumentation safety channel.
223SEA1086	SEA	Monitor the operation of the excore instrumentation control channel during power operation.
225SEA1087	SEA	Calibrate the excore nuclear instrumentation system.
222SEA2447	SEA	Respond to a loss of a linear power safety channel.
222SEA2448	SEA	Respond to a loss of a linear power control channel.
222SEA2449	SEA	Respond to a loss of a low power channel.
222SEA2450	SEA	Respond to a loss of a startup channel.
222SFA1088	SFA	Realign a part length CEA.
222SFA1089	SFA	Align a misaligned CEA with its group.
223SFA1090	SFA	Operate the CEA's in the manual group mode.
223SFA1091	SFA	Operate the CEA's in the manual individual mode.
223SFA1092	SFA	Operate the CEA's in the automatic sequential mode.
223SFA1093	SFA	Operate the CEA's in the manual sequential mode.

Task ID	System ID	Task Description
223SFA1094	SFA	Monitor CEA position on display CRT.
223SFA1095	SFA	Operate control rods to shape axial power.
225SFA1096	SFA	Test the operation of the CEA's.
225SFA1097	SFA	Verify position of CEA's.
222SFA1420	SFA	Respond to a misaligned control element assembly.
222SFA2451	SFA	Respond to a slipped or dropped control element assembly.
222SFA2452	SFA	Respond to an inoperable full or part length control element assembly.
223SFC1098	SFC	Switch reactor regulating system units.
223SFC1099	SFC	Verify normal operation of the reactor regulating system.
222SFC2446	SFC	Respond to a failure of the reactor regulating system.
225SPA1100	SPA	Perform a channel check on the non-ESF area radiation monitoring system.
225SPA1101	SPA	Test the operation of the radiation monitoring system.
222SQA1102	SQA	Analyze alarms on the vibration and loose parts monitoring system.
223SQA1103	SQA	Monitor the operation of the vibration and loose parts monitoring system.
225SQA2438	SQA	Test the operation of the vibration and loose parts monitoring system.
221Y010889	Y01	Perform a localized DNB evaluation.
225Y010896	Y01	Verify linear heat rate within limits.
225Y010897	Y01	Calculate azimuthal power tilt.
225Y010899	Y01	Verify DNBR margin within limits.
223Y011364	Y01	Calculate the minimum boron concentration to maintain shutdown margin during heatup or cooldown.

Task ID	System ID	Task Description
223Y011365	Y01	Calculate the shutdown margin during refueling.
222Y011366	Y01	Calculate the available shutdown margin with the reactor critical and a slipped or dropped control rod.
222Y011416	Y01	Respond to a mismatch between the outputs of the reactor and the turbine-generator.
222Y011427	Y01	Respond to a refueling accident.
223Y022453	Y02	Perform a plant startup from cold shutdown to hot standby.
223Y030892	Y03	Calculate an inverse count rate ratio.
223Y030893	Y03	Perform an estimated critical position calculation.
223Y030894	Y03	Perform a reactor precritical check-off.
223Y030895	Y03	Perform a reactor startup.
223Y032454	Y03	Perform a plant startup from hot standby to minimum load.
225Y040898	Y04	Perform a reactor shutdown.
223Y042455	Y04	Perform a plant shutdown from minimum load to hot standby.
223Y052456	Y05	Perform a plant shutdown from hot standby to cold shutdown.
223Y061367	Y06	Determine the maximum loading rates for power increases.
223Y061368	Y06	Calculate the dilution rate and volume necessary to achieve a given power.
223Y061369	Y06	Determine the maximum rate for reducing load.
223Y062457	Y06	Increase unit load from mimimum load to full power.
223Y062458	Y06	Monitor and control ASI during steady state operation.
223Y062459	Y06	Decrease unit load from full power to minimum load.

Task ID	System ID	Task Description
222Y080887	Y08	Cooldown the reactor coolant system using natural circulation.
222Y080888	Y08	Verify natural circulation is occuring.
222Y080891	Y08	Establish and maintain hot standby conditions using natural circulation.
221Y090886	Y09	Evaluate reactor coolant system performance for inadequate core cooling.
221Y090890	Y09	Perform an evaluation of secondary heat sink performance.
221Y091384	Y09	Respond to a reactor trip by taking the standard post trip actions.
221Y091385	Y09	Recover from a reactor trip.
221Y091386	Y09	Respond to a loss of coolant accident.
221Y091387	Y09	Perform safety function status check following a loss of coolant accident.
221Y091388	Y09	Cooldown the reactor coolant system following a loss of coolant accident.
221Y091389	Y09	Perform simultaneous hot and cold leg injection following a loss of coolant accident.
221Y091390	Y09	Respond to a steam generator tube rupture.
221Y091391	Y09	Perform a safety function status check following a steam generator tube rupture.
221Y091392	Y09	Cooldown the reactor coolant system following a steam generator tube rupture.
221Y091393	Y09	Align steam generator drains to radwaste following a steam generator tube rupture.
221Y091394	Y09	Respond to a steam line break accident.
221Y091395	Y09	Perform a safety function status check following a steam line break.
221Y091396	Y09	Cooldown the reactor coolant system following a steam line break.
221Y091397	Y09	Respond to a loss of feedwater accident.

Task ID	System ID	Task Description
221Y091398	Y09	Perform a safety function status check following a loss of feedwater accident.
221Y091399	Y09	Respond to a loss of forced circulation.
221Y091400	Y09	Perform a safety function status check following a loss of forced circulation.
221Y091401	Y09	Cooldown the reactor coolant system following a loss of forced circulation.
221Y091402	Y09	Perform safety function status check for functional recovery accident mitigation.
221Y091403	Y09	Evaluate safety function resources.
221Y091404	Y09	Perform safety function restoration.
221Y091405	Y09	Respond to a loss of offsite electrical power.
221Y091406	Y09	Perform a plant shutdown from outside the control room.
221Y091407	Y09	Respond to an earthquake.
222Y091408	Y09	Respond to a low system frequency.
222Y091409	Y09	Respond to a high system frequency.
221Y091412	Y09	Respond to a loss of instrument air.
222Y091423	Y09	Respond to a loss of containment integrity.
221Y091424	Y09	Recover from an inadvertent safety injection/containment isolation.
222Y091426	Y09	Respond to a Loss of a Non-1E Instrument Bus

Task ID	System ID	Task Description
194ADM2696	ADM	Provide technical information on safety related events to assist the compliance staff in the preparation of LER's.
194ADM2737	ADM	Perform investigation and prepare station incident reports, unusual operation reports and LER's.
194ADM2738	ADM	Review significant operating experience reports after ISEG review.
194ADM2739	ADM	Prepare special reports requested by STA supervisor.
194ADM2743	ADM	Review night orders.
194ADM2744	ADM	Review special orders, operating memos and instructions.
193CSA2750	CSA	Independently review manipulations of safety related systems which effect the basic plant configuration.
193CSA2753	CSA	Integrate available information to ensure the overall plant configuration is acceptable.
191EOI2698	EOI	Verify the adequate core cooling exists.
191EOI2699	EOI	Recommend actions to ensure that core cooling and the subcooling margin are maintained.
191EOI2700	EOI	Independently verify the operating shift's identification of an event.
191EOI2701	EOI	Observe the operating shift's response to an emergency event to verify proper corrective actions are taking place.
191EOI2702	EOI	Analyze indications to determine the cause of an emergency event.
191EOI2709	EOI	Perform a qualitative assissment of safety parameters during emergency conditions to ascertain acceptable plant status.
191EOI2713	EOI	Use the critical function status trees to analyze an emergency event.
191EOI2726	EOI	Make a qualitative assessment of plant parameters during and following an accident to determine corrective actions.

Task ID	System ID	Task Description
191EPI2720	EPI	Provide recommendations of classification of an emergency event.
191EPI2721	EPI	Recommend the shift superintendent contact appropriate personnel for assistance.
194EPI2722	EPI	Assist the plant evaluation team in evaluating plant conditions.
192EPI2723	EPI	Provide recommendations to the shift superintendent on personnel safety.
193IPO2704	IPO	Assist in evaluating core operations (e.g., reactivity, safety parameters and power distributions).
193IPO2708	IPO	Evaluate primary and secondary thermodynamics.
193IPO2712	IPO	Perform calcuations to determine plant status, if critical parameter become unavailable.
191IPO2725	IPO	During transients or accidents, compare existing safety parameter with analyzed values to determine proper response.
193IPO2731	IPO	Report and discuss system/plant abnormalities with shift personnel.
193IPO2749	IPO	Independently observe significant planned operational evolutions (e.g, approach to criticality, mode changes, etc.).
193IPO2751	IPO	Review planned activities and determine special conditions, precautions and tech spec requirements are warrented.
193IPO2754	IPO	Evaluate the current shift activities and plant conditions to provide technical recommendation to the SS.
194OOI2742	OOI	Complete required reading assignments.
194OSL2694	OSL	Make entries on abnormalities, significant operational events and importand shift activities into the STA log.
194OSL2741	OSL	Review shift superintent's log for significant operational activities.
194OSR2693	OSR	Conduct STA relief turnover and administer STA shift turnover check-off's.

Task ID	System ID	Task Description
1940SR2740	OSR	Attend pre-shift briefings
1940SR2745	OSR	Review plant status and important activities for the preceeding shift.
1940SR2746	OSR	Discuss plant conditions and scheduled shift activities with the shift superintendent.
1940SR2747	OSR	Inspect the plant each shift for abnormal conditions and potential problems.
1940SR2748	OSR	Review the shift's logs, turnover sheets, chemical data for plant status and trends.
1930TS2703	OTS	Identify limiting conditions for operations affecting safety related equipment.
1930TS2705	OTS	Evaluate reactivity related parameters are within tech spec limits.
1930TS2706	OTS	Evaluate sufficient shutdown margin per tech spec requirements.
1920TS2711	OTS	Clarify tech specs and application of action statements requirements for an incident.
1930TS2728	OTS	Check systems governed by technical specification to ensure operability requirements are met.
1930TS2729	OTS	Assist operations personnel in interpreting and applying the requirements of the technical specification.
1930TS2732	OTS	Provide recommendations to the shift superintendent on tech spec requirements for the operability of system/equip.
1930TS2733	OTS	Provide assistance in developing a plant for corrective action for a LCOAR.
1930TS2734	OTS	Review LCOAR's and EDMR's for operating limitations or mode restraints.
1930TS2735	OTS	Verify the implementation of technical specification action requirements.
1930TS2736	OTS	Verify mode changes, power ascension and plant activities are permissible according to tech spec requirements.

Task ID	System ID	Task Description
193OWA2695	OWA	Review manipulation of safety related equipment or systems under work authorizations or realignment of system.
194OWA2697	OWA	Maintain knowledge of modifications to plant safety related systems and equipment and evaluate the system performance.
193OWA2707	OWA	Assist in evaluating the operability of safety related equipment.
192PTR2717	PTR	Perform a post-trip transient review.
193PTR2724	PTR	Analyze safety related data following post-trip reviews.
193UOP2715	UOP	Make recommendations to revise operating procedures for correctness and to ensure safe operation.
192UOP2716	UOP	Review deviation from operating instructions through SIR process if the evolution led to a significant event.

Task ID	System ID	Task Description
294ADM2633	ADM	Provide technical information on safety related events to assist the compliance staff in the preparation of LER's.
294ADM2674	ADM	Perform investigation and prepare station incident reports, unusual operation reports and LER's.
294ADM2675	ADM	Review significant operating experience reports after ISEG review.
294ADM2676	ADM	Prepare special reports requested by STA supervisor.
294ADM2680	ADM	Review night orders.
294ADM2681	ADM	Review special orders, operating memos and instructions.
293CSA2687	CSA	Independently review manipulations of safety related systems which effect the basic plant configuration.
293CSA2690	CSA	Integrate available information to ensure the overall plant configuration is acceptable.
291EOI2635	EOI	Verify the adequate core cooling exists.
291EOI2636	EOI	Recommend actions to ensure that core cooling and the subcooling margin are maintained.
291EOI2637	EOI	Independently verify the operating shift's identification of an event.
291EOI2638	EOI	Observe the operating shift's response to an emergency event to verify proper corrective actions are taking place.
291EOI2639	EOI	Analyze indications to determine the cause of an emergency event.
291EOI2646	EOI	Perform a qualitative assissment of safety parameters during emergency conditions to ascertain acceptable plant status.
291EOI2650	EOI	Use the critical function status trees to analyze an emergency event.
291EOI2663	EOI	Make a qualitative assessment of plant parameters during and following an accident to determine corrective actions.

Task ID	System ID	Task Description
291EPI2657	EPI	Provide recommendations of classification of an emergency event.
291EPI2658	EPI	Recommend the shift superintendent contact appropriate personnel for assistance.
294EPI2659	EPI	Assist the plant evaluation team in evaluating plant conditions.
292EPI2660	EPI	Provide recommendations to the shift superintendent on personnel safety.
293IPO2641	IPO	Assist in evaluating core operations (e.g., reactivity, safety parameters and power distributions).
293IPO2645	IPO	Evaluate primary and secondary thermodynamics.
293IPO2649	IPO	Perform calcuations to determine plant status, if critical parameter become unavailable.
291IPO2662	IPO	During transients or accidents, compare existing safety parameter with analyzed values to determine proper response.
293IPO2668	IPO	Report and discuss system/plant abnormalities with shift personnel.
293IPO2686	IPO	Independently observe significant planned operational evolutions (e.g, approach to criticality, mode changes, etc.).
293IPO2688	IPO	Review planned activities and determine special conditions, precautions and tech spec requirements are warrented.
293IPO2691	IPO	Evaluate the current shift activities and plant conditions to provide technical recommendation to the SS.
294OOI2679	OOI	Complete required reading assignments.
294OSL2631	OSL	Make entries on abnormalities, significant operational events and importand shift activities into the STA log.
294OSL2678	OSL	Review shift superintent's log for significant operational activities.
294OSR2630	OSR	Conduct STA relief turnover and administer STA shift turnover check-off's.

Task ID	System ID	Task Description
2940SR2677	OSR	Attend pre-shift briefings
2940SR2682	OSR	Review plant status and important activities for the preceeding shift.
2940SR2683	OSR	Discuss plant conditions and scheduled shift activities with the shift superintendent.
2940SR2684	OSR	Inspect the plant each shift for abnormal conditions and potential problems.
2940SR2685	OSR	Review the shift's logs, turnover sheets, chemical data for plant status and trends.
2930TS2640	OTS	Identify limiting conditions for operations affecting safety related equipment.
2930TS2642	OTS	Evaluate reactivity related parameters are within tech spec limits.
2930TS2643	OTS	Evaluate sufficient shutdown margin per tech spec requirements.
2920TS2648	OTS	Clarify tech specs and application of action statements requirements for an incident.
2930TS2666	OTS	Assist operations personnel in interpreting and applying the requirements of the technical specification.
2930TS2670	OTS	Provide assistance in developing a plant for corrective action for a LCOAR.
2930TS2671	OTS	Review LCOAR's and EDMR's for operating limitations or mode restraints.
2930TS2672	OTS	Verify the implementation of technical specification action requirements.
2930TS2673	OTS	Verify mode changes, power ascension and plant activities are permissible according to tech spec requirements.
2930WA2632	OWA	Review manipulation of safety related equipment or systems under work authorizations or realignment of system.
2940WA2634	OWA	Maintain knowledge of modifications to plant safety related systems and equipment and evaluate the system performance.

Task ID	System ID	Task Description
293OWA2644	OWA	Assist in evaluating the operability of safety related equipment.
292PTR2654	PTR	Perform a post-trip transient review.
293PTR2661	PTR	Analyze safety related data following post-trip reviews.
293UOP2652	UOP	Make recommendations to revise operating procedures for correctness and to ensure safe operation.
292UOP2653	UOP	Review deviation from operating instructions through SIR process if the evolution led to a significant event.

Task ID	System ID	Task Description
183ADM1556	ADM	Coordinate plant operation to support maintenance activities.
183ADM1557	ADM	Apply union contract.
183ADM1559	ADM	Conduct training of shift personnel.
183ADM1560	ADM	Establish priority for shift activities.
185ADM1564	ADM	Request performance of emergency maintenance.
181ADM2006	ADM	Coordinate plant activities and operations personnel assignments during a fire or rescue activities.
184COA1510	COA	Review and approve operator aids.
184CSA1506	CSA	Evaluate system misalignments.
184CSA1507	CSA	Determine the method to accomplish an activity for which no procedure exists.
184CSA1508	CSA	Prepare an abnormal alignment/evolution checklist to accomplish an activity for which no procedure exists.
184CSA1509	CSA	Determine system alignment requirements during plant mode changes and integrated plant operations.
182DSD2816	DSD	Coordinate plant operations during a plant shutdown using the Dedicate Safe Shutdown System
184ECP1482	ECP	Direct shift operators to remove equipment from service for maintenance.
184ECP1483	ECP	Conduct tailboard meetings to preplan plant evolutions.
184ECP1485	ECP	Review and approve boundaries of a work authorization.
184ECP1486	ECP	Approve the modification of a clearance or a permission.
184ECP1487	ECP	Determine the desired position of valves and breakers prior to returning equipment to service following maintenance.
184ECP1488	ECP	Approve the installation and removal of caution tags.

Task ID	System ID	Task Description
184ECP1489	ECP	Review and approve information tags.
184ECP1490	ECP	Direct shift operators to hang test required tags.
184ECP1491	ECP	Perform a monthly and annual check of all outstanding tags and labels.
184ECP1492	ECP	Initiate a safety related systems and component control form to control the position of safety related components.
184ECP1493	ECP	Initiate a safety related systems and component control form to control the position of a locked valve or/breaker.
185ECP1565	ECP	Review and approve equipment control forms.
184EDS1494	EDS	Assign priority to equipment deficiency tags.
182EOI1518	EOI	Direct response to a complete loss of instrument air.
181EOI1519	EOI	Direct response to a loss of reactor coolant accident.
181EOI1520	EOI	Direct termination of safety injection following a loss of reactor coolant.
181EOI1521	EOI	Direct cooldown and depressurization of the reactor coolant system following a loss of coolant accident.
181EOI1522	EOI	Direct transfer of safety injection to cold leg injection and recirculation following a loss of coolant accident.
181EOI1523	EOI	Direct initiation of hot leg recirculation following a loss of coolant accident.
181EOI1524	EOI	Direct response to a loss of secondary coolant.
181EOI1525	EOI	Direct termination of safety injection following a loss of secondary coolant.
181EOI1526	EOI	Direct response to a loss of residual heat removal system due to a loss of secondary coolant.
181EOI1527	EOI	Direct response to a steam generator tube rupture.
181EOI1528	EOI	Direct response to an anticipated transient without scram.

Task ID	System ID	Task Description
181EOI1529	EOI	Direct response to a loss of all AC power.
181EOI1530	EOI	Direct response to unexpected nuclear power generation.
181EOI1531	EOI	Direct response to a potential loss of core cooling.
181EOI1532	EOI	Direct response to saturated core cooling conditions.
181EOI1533	EOI	Direct response to anticipated pressurized thermal shock.
181EOI1534	EOI	Direct response to a steam generator high level.
181EOI1535	EOI	Direct response to a steam generator low level.
181EOI1536	EOI	Direct response to a loss of steam dump valves.
181EOI1537	EOI	Direct response to a loss of secondary heat sink.
181EOI1538	EOI	Direct reponse to a high containment pressure.
181EOI1539	EOI	Direct reponse to a high containment sump level.
181EOI1540	EOI	Direct response to a high containment radiation level.
181EOI1541	EOI	Direct response to a low system inventory.
181EOI1550	EOI	Use the critical safety function status trees to determine action to take during emergency operations.
181EOI1551	EOI	Direct shift operations during a reactor trip.
181EOI1552	EOI	Classify emergency events requiring emergency plan implementation.
182EOI1553	EOI	Notify shift technical advisor of plant abnormal conditions.
181EOI1554	EOI	Analyze indications to determine that an emergency/abnormal plant event is in progress.
181EOI1555	EOI	Direct shift personnel actions to ensure plant safety during an emergency/abnormal event.
183IPO1542	IPO	Coordinate shift operations during heat treating the circulating water system.

Task ID	System ID	Task Description
183IP01543	IPO	Coordinate shift operations during a plant startup from cold shutdown to hot standby.
183IP01544	IPO	Coordinate shift operations during a plant startup from hot standby to minimum load.
183IP01545	IPO	Coordinate shift operations during a plant shutdown from full power to hot standby.
183IP01546	IPO	Coordinate shift operations during a plant shutdown from hot standby to cold shutdown.
183IP01547	IPO	Coordinate shift operations during power operations.
183IP01548	IPO	Coordinate shift operations during natural circulation operations.
183IP01549	IPO	Complete the technical specification check list during a plant startup from cold shutdown to hot standby.
183IP01561	IPO	Evaluate plant chemistry conditions.
183IP01562	IPO	Acknowledge chemical analysis results.
183IP01563	IPO	Evaluate plant conditions in relationship to technical specification requirements.
182IP02284	IPO	Direct response to a loss of reactor coolant flow.
182IP02285	IPO	Direct response to a loss of letdown flow.
182IP02286	IPO	Direct response to a malfunction of the reactor makeup control system.
182IP02287	IPO	Direct an emergency boration of the reactor coolant system.
182IP02288	IPO	Direct response to trouble with a pressurizer relief valve or safety valve.
182IP02289	IPO	Direct response to an unplanned boration of the reactor coolant system.
182IP02290	IPO	Direct response to reactor coolant system leakage.
182IP02291	IPO	Direct response to a loss of containment integrity.

Task ID	System ID	Task Description
182IP02292	IPO	Direct response to a loss of reactor coolant pump motor cooling.
182IP02293	IPO	Direct response to to reactor coolant pump seal trouble.
182IP02294	IPO	Direct response to a loss of the residual heat removal system.
182IP02295	IPO	Direct reponse to a loss of component cooling water.
182IP02296	IPO	Direct reponse to an actuation of the overpressure mitigation system.
182IP02297	IPO	Direct reponse to spent fuel pit cooling system trouble.
182IP02298	IPO	Direct response to a nuclear flux tilt.
182IP02299	IPO	Direct reponse to a high activity in the reactor coolant system.
182IP02300	IPO	Direct response to operational radiation monitoring system high radiation.
182IP02301	IPO	Direct response to an area radiation monitoring system high activity.
182IP02302	IPO	Direct response to a control rod bank or group failure.
182IP02303	IPO	Direct response to a continuous control rod insertion.
182IP02304	IPO	Direct response to a continuous control rod withdrawal.
182IP02305	IPO	Direct reponse to a dropped control rod.
182IP02306	IPO	Direct response to a stuck or misaligned control rod.
182IP02307	IPO	Direct response to a failure of the rod position indicating system.
182IP02308	IPO	Direct reponse to a failure of the control rod drive cooling system.
182IP02309	IPO	Direct response to a source range channel failure.

Task ID	System ID	Task Description
182IP02310	IPO	Direct reponse to a source range shutdown high flux level.
182IP02311	IPO	Direct response to an intermediate range channel failure.
182IP02312	IPO	Direct response to a power range channel failure.
182IP02313	IPO	Direct reponse to a NIS neutron detector high temperature indication.
182IP02314	IPO	Direct response to an abnormal pressurizer pressure.
182IP02315	IPO	Direct response to an abnormal pressurizer level.
182IP02316	IPO	Direct response to an abnormal steam generator level.
182IP02317	IPO	Direct response to a loss of saltwater cooling.
182IP02318	IPO	Direct response to a low service or instrument air system pressure.
182IP02319	IPO	Direct response to an instrument air dryer malfunction.
182IP02320	IPO	Direct response to a restricted instrument air filter.
182IP02321	IPO	Direct response to a loss of condenser vacuum.
182IP02322	IPO	Direct reponse to a loss of 480 or 4 KV room HVAC system.
182IP02323	IPO	Direct response to an earthquake.
182IP02324	IPO	Direct response to a fire in the 4 KV room or in the turbine lube oil reservoir area.
182IP02325	IPO	Direct a plant shutdown from outside the control room.
182IP02326	IPO	Direct response to a loss of generator excitation.
182IP02327	IPO	Direct reponse to a low system frequency.
182IP02328	IPO	Direct response to a high system frequency.
182IP02329	IPO	Direct response to a low system voltage.

Task ID	System ID	Task Description
182IPO2330	IPO	Direct response to a loss of vital or utility bus.
182IPO2331	IPO	Direct response to a loss of a DC bus.
183IPO2332	IPO	Evaluate plant conditions in relation to NPDES requirements.
182IPO2333	IPO	Notify the Shift Superintendent or Enviornmental Engineering upon failure of enviornmental monitoring insturmentation.
183IPO2334	IPO	Coordinate refueling activities.
184ONT1479	ONT	Advise shift superintendent on events that require notification to the NRC.
184OSI1511	OSI	Determine priority of surveillance test assigned to shift.
184OSI1512	OSI	Supervise the performance of surveillance tests.
184OSI1513	OSI	Review completed surveillance tests for completeness, accuracy and acceptability of results.
184OSI1514	OSI	Authorize the performance of surveillance tests.
184OSI1515	OSI	Verify the completion of required surveillance tests prior to Operational Mode changes.
184OSI1516	OSI	Direct testing of redundant equipment when called for by a failed surveillance test.
184OSI1517	OSI	Initiate a Deficiency tag and maintenance order to repair failed equipment.
184OSO1480	OSO	Use special orders to administer shift activities.
184OSR1478	OSR	Conduct a shift turnover.
184OSR1481	OSR	Prepare the Control Room Supervisor's shift relief status log.
184OTS1498	OTS	Initiate and complete a Limiting Condition for Operation Action Requirement.
184OTS1499	OTS	Close out a Limiting Condition for Operation Action Requirement.
184OTS1500	OTS	Initiate and complete an Equipment Deficiency Mode Restraint

Task ID	System ID	Task Description
184OTS1501	OTS	Terminate an Equipment Deficiency Mode Restraint.
184OVO1495	OVO	Authorize the checking of valve position by moving the valve in the open direction.
184OVO1496	OVO	Approve the closing and reopening of a throttled valve to determine valve position.
184PTR1497	PTR	Coordinate a post trip/transient review.
184TMC1484	TMC	Insure temporary modification control forms are completed prior to installing or removing a temporary modification.
184UOP1502	UOP	Preview operating instructions prior to their use.
184UOP1503	UOP	Coordinate the implementation of operating instructions.
184UOP1504	UOP	Review operating instructions for completness and to ensure the procedure accomplished the desired objectives.
184UOP1505	UOP	Approve data transfer between field copies and final copies of in use procedures.
183UOP1558	UOP	Initiate temporary change notices.

Task ID	System ID	Task Description
284ADM1911	ADM	Use special orders to administer shift activities.
283ADM1944	ADM	Direct plant operation to support maintenance activities.
283ADM1945	ADM	Direct ordering and delivery of plant consumables (gases and chemicals).
283ADM1948	ADM	Conduct training of shift personnel.
283ADM1949	ADM	Establish priority for shift activities.
284ADM1951	ADM	Direct shift personnel assignments.
284ADM1952	ADM	Handle shift personnel problems.
284ADM1953	ADM	Prepare personnel accident reports.
283ADM1954	ADM	Approve radioactive waste discharge/release permits.
285ADM1955	ADM	Request performance of emergency maintenance.
284ADM1998	ADM	Notify the ESO shift captain of any fire protection/detection system outages.
284ADM1999	ADM	Notify shift superintendent of any unanticipated changes in plant conditions.
284ADM2000	ADM	Provide plant status information to plant/operations management.
282ADM2352	ADM	Perform local accident investigations.
284HIC1916	HIC	Coordinate shift housekeeping activities.
284OCN1910	OCN	Resolve questions concerning meal payment, travel time and other compensations issues associated with overtime.
283OCN1946	OCN	Apply union contract.
284OCR2001	OCR	Control access to the control room.
284OCT2597	OCT	Approve the issuance of caution tags.
284ODS1921	ODS	Assign priority to equipment deficiency tags.
285ODS1956	ODS	Approve equipment deficiency forms.

Task ID	System ID	Task Description
2850DS1994	ODS	Direct the preparation of maintenance orders for known plant deficiencies.
2820DS2004	ODS	Evaluate the impact of equipment deficiencies against technical specification requirements.
2840KC2005	OKC	Report the loss of a security key.
2840KC2594	OKC	Control the issuance of security and non-security keys.
2840LV1920	OLV	Determine the desired position of valves and breakers prior to returning equipment to service following maintenance.
2830LV1996	OLV	Authorize changes to locked valve and breaker position.
2840NT1908	ONT	Advise shift superintendent on events that require notification to the NRC.
28400A1937	OOA	Review and approve operator aids.
28400I1922	OOI	Complete required on-shift reading assignments.
28400R2595	OOR	Maintain the important to safety and not important to safety alignment files.
28400V1909	OOV	Schedule operators for overtime to fill shift vacancies and other requirements for extra personnel.
28400V1923	OOV	Evaluate overtime to determine if NRC or station guidelines have been exceeded.
28400V1950	OOV	Call in additional shift personnel as necessary.
2840PR1929	OPR	Preview operating instructions prior to their use.
2840PR1930	OPR	Coordinate the implementation of operating instructions.
2840PR1931	OPR	Review operating instructions for completness and to ensure the procedure accomplished the desired objectives.
2840PR1932	OPR	Approve data transfer between field copies and final copies of in use procedures.
2840PR1934	OPR	Determine the method to accomplish an activity for which no procedure exists.

Task ID	System ID	Task Description
2830PR1947	OPR	Initiate temporary change notices.
2840SA1933	OSA	Evaluate system misalignments.
2840SA1935	OSA	Prepare an abnormal alignment/evolution document to accomplish an activity for which no procedure exists.
2840SA1936	OSA	Determine system alignment requirements during plant mode changes and integrated plant operations.
2850SA1995	OSA	Approve abnormal evolutions and alignments.
2840SA2596	OSA	Prepare a System Alignment Requirement for a plant mode change.
2840SI1938	OSI	Determine priority of surveillance test assigned to shift.
2840SI1939	OSI	Supervise the performance of surveillance tests.
2840SI1940	OSI	Review completed surveillance tests for completeness, accuracy and acceptability of results.
2840SI1941	OSI	Authorize the performance of surveillance tests.
2840SI1942	OSI	Verify the completion of required surveillance tests prior to Operational Mode changes.
2840SI1943	OSI	Direct testing of redundant equipment when called for by a failed surveillance test.
2840SR1907	OSR	Conduct a shift turnover.
2840SR1912	OSR	Prepare the Control Room Supervisor's shift relief checklist.
2840SR2002	OSR	Evaluate the shift turnover process.
2840SR2003	OSR	Conduct a shift relief for a short term absence from the control room.
2840TM1915	OTM	Insure temporary modification control forms are completed prior to installing or removing a temporary modification.
2840TM1997	OTM	Review and approve temporary facilities modifications.

Task ID	System ID	Task Description
2840TR1924	OTR	Conduct a post trip/transient review.
2840TS1925	OTS	Initiate and complete a Limiting Condition for Operation Action Requirement.
2840TS1926	OTS	Close out a Limiting Condition for Operation Action Requirement.
2840TS1927	OTS	Initiate and complete an Equipment Deficiency Mode Restraint
2840TS1928	OTS	Terminate an Equipment Deficiency Mode Restraint.
2840WA1913	OWA	Direct shift operators to remove equipment from service for maintenance.
2840WA1914	OWA	Conduct tailboard meetings to preplan plant evolutions.
2840WA1917	OWA	Review and approve boundaries of a work authorization.
2840WA1918	OWA	Approve the modification of a clearance or a permission.
2840WA1919	OWA	Direct removal of clearance tags.
2850WA1957	OWA	Perform operational impact eveluation of work authorization requests.
283Y011962	Y01	Direct shift operations during heat treating the circulating water system.
283Y011963	Y01	Evaluate plant chemistry conditions.
283Y011964	Y01	Approve chemical analysis results.
283Y011965	Y01	Evaluate plant conditions in relationship to technical specification requriements.
283Y011966	Y01	Review operating logs for trends and out of specification conditions.
281Y011976	Y01	Direct natural circulation operations.
282Y011977	Y01	Direct response to and recovery from a loss of instrument air.
283Y011978	Y01	Direct a plant startup from cold shutdown to hot standby conditions.

Task ID	System ID	Task Description
283Y011979	Y01	Direct a plant startup from hot standby to minimum load.
283Y011980	Y01	Direct a plant shutdown from minimum load to hot standby conditions.
283Y011981	Y01	Direct a plant shutdown from hot standby to cold shutdown.
283Y011982	Y01	Direct power operations.
281Y091958	Y09	Classify emergency events requiring emergency plan implementation.
282Y091959	Y09	Notify shift technical advisor of plant abnormal conditions.
281Y091960	Y09	Analyze indications to determine that an emergency/abnormal plant event is in progress.
281Y091961	Y09	Direct shift personnel actions to ensure plant safety during an emergency/abnormal event.
281Y091967	Y09	Direct response to and recovery from a reactor trip.
281Y091968	Y09	Direct response to and recovery from a loss of coolant accident.
281Y091969	Y09	Direct response to and recovery from a steam generator tube rupture.
281Y091970	Y09	Direct response to and recovery from a steam line break accident.
281Y091971	Y09	Direct response to and recovery from a loss of feedwater accident.
281Y091972	Y09	Direct response to and recovery from a loss of forced circulation.
281Y091973	Y09	Direct accident mitigation by use of the functional recovery guidelines.
281Y091974	Y09	Direct a plant shutdown from outside the control room.
281Y091975	Y09	Direct response to and recovery from an earthquake.

Task ID	System ID	Task Description
282Y092610	Y09	Direct operator response to a reactor coolant pump seal failure.
282Y092611	Y09	Direct operator response to a reactor coolant system leak.
282Y092612	Y09	Direct operator action to emergency borate the reactor coolant system.
282Y092613	Y09	Direct operator response to a loss of boron concentration or inadvertent dilution.
282Y092614	Y09	Direct operator response to a loss of shutdown cooling.
282Y092615	Y09	Direct operator response to a loss of condenser vacuum.
282Y092616	Y09	Direct operator response to a condenser salt leak.
282Y092617	Y09	Direct operator response to a loss of component cooling water.
282Y092618	Y09	Direct operator response to a loss of saltwater cooling.
282Y092619	Y09	Direct operator response to a low system voltage.
282Y092620	Y09	Direct operator response to a failure of the reactor protection system.
282Y092621	Y09	Direct operator response to a misaligned control element assembly.
282Y092622	Y09	Direct operator response to a mismatch between the outputs of the reactor and the turbine-generator.
282Y092623	Y09	Direct operator response to a low system frequency.
282Y092624	Y09	Direct operator response to a loss of instrument air.
282Y092625	Y09	Direct operator response to a loss of containment integrity.
282Y092626	Y09	Direct operator actions during recovery from an inadvertent safety injection/containment isolation.

Task ID	System ID	Task Description
282Y092627	Y09	Direct operator response to a loss of offsite electrical power.
282Y092628	Y09	Direct operator response to a Loss of a Non-1E Instrument Bus

Task ID	System ID	Task Description
103ADM2148	ADM	Approve chemical analysis sample request.
104ADM2149	ADM	Review and approve waste discharge/release permits.
104ADM2150	ADM	Estimate completion times of shift evolutions.
104ADM2151	ADM	Evaluate potential industrial hazards for operations work assignments.
104ADM2152	ADM	Act as senior company representative on-site during backshift, weekends and holidays.
104ADM2153	ADM	Authorize or effect process radition monitor setpoint changes.
105ADM2154	ADM	Direct minor repairs by the operating shift.
103ADM2155	ADM	Coordinate support from operations department and other departments for required testing.
104ADM2156	ADM	Maintain knowledge of modifications to plant safety-related equipment.
104ADM2157	ADM	Approve interim control/alarm setpoint changes.
106ADM2158	ADM	Coordinate plant operation to support maintenance activities.
103ADM2159	ADM	Coordinate ordering and delivery of plant consumables (gases and chemicals).
103ADM2160	ADM	Direct operating shift to carry out actions required by operations orders/memos.
103ADM2161	ADM	Inspect plant each shift.
103ADM2162	ADM	Establish priority for shift activities.
104ADM2163	ADM	Direct shift personnel assignments.
105ADM2164	ADM	Approve use of other than normal shear pin in the traveling bars and traveling screens.
105ADM2165	ADM	Approve testing of 480 volt feeders after a relay operation.
103ADM2166	ADM	Approve containment entry outside secondary shield.

Task ID	System ID	Task Description
105ADM2167	ADM	Approve operation of CT or PT secondary switches.
105ADM2168	ADM	Request performance of emergency maintenance.
105ADM2169	ADM	Evaluate work for alara requirements.
105ADM2170	ADM	Approve use of 4 kv or 480 v grounding device.
102ADM2171	ADM	Assume the duties of Supervisor of Security as required.
104ADM2267	ADM	Conduct shift briefings on industrial safety.
104ADM2270	ADM	Respond to questions from on-site and off-site personnel.
104ADM2271	ADM	Read and respond to operations department orders and memos (special orders and night letter).
104ADM2272	ADM	Review plant status and planned shift activities with plant management.
104AOI2176	AOI	Complete required reading assignments.
104AOI2177	AOI	Ensure shift personnel review requried operational information.
104AOI2248	AOI	Evaluate information for inclusion in acknowledgement of information.
104COA2249	COA	Authorize operator aids for use by operators in plant operation.
103CSA2183	CSA	Review completed checkoff lists following plant evolutions involving mode changes.
103CSA2184	CSA	Approve an abnormal alignment/evolution checklist.
103CSA2185	CSA	Direct operators to realign a misaligned component to its proper position.
103CSA2250	CSA	Verify safety related system valve and component alignment procedures are completed.
102DAR2251	DAR	Determine the actions required for unusual conditions or activities affecting security.
104DAR2252	DAR	Direct actions for delivery of materials on-site.
104DAR2253	DAR	Maintain security key, lock and locking device log.

Task ID	System ID	Task Description
104DAR2254	DAR	Issue security keys to on-shift personnel.
105ECP2173	ECP	Approve changing of locked valve or breaker position.
103ECP2208	ECP	Determine if a system and/or equipment is inoperable.
105ECP2210	ECP	Determine retest requirements following Shift Superintendent Accelerated Maintenance.
105ECP2211	ECP	Review retest results following maintenance.
105ECP2212	ECP	Verify post-maintenance operability of safety related equipment.
104ECP2213	ECP	Ensure periodic auditing of tag outs.
105ECP2214	ECP	Review and approve equipment control forms.
103ECP2215	ECP	Verify operational impact evaluation when equipment control is not available.
103ECP2216	ECP	Determine or verify equipment testing requirements.
103ECP2217	ECP	Review and approve work authorization records.
105ECP2218	ECP	Authorize release from/return to service of important to safety systems for maintenance or testing.
103ECP2255	ECP	Approve the clearance isolation boundaries for components important to safety.
105ECP2256	ECP	Approve work done on any relay, control wiring or other auxiliary equipment which affect the ability to generate power.
104ECP2257	ECP	Direct the installation of out of commission labels, control room info tags, out of calibration tags and caution tags.
104ECP2258	ECP	Conduct an audit of information tags inside the control room.
105ECP2259	ECP	Approve/review safety related system and component control form.
101EOI2232	EOI	Classify emergency events requiring emergency plan implementation.

Task ID	System ID	Task Description
101EOI2233	EOI	Direct emergency response as site emergency coordinator.
101EOI2234	EOI	Provide technical assistance to plant management during an emergency event.
101EOI2235	EOI	Access the need for additional personnel for responding to an emergency event.
102EOI2236	EOI	Direct actions to ensure that core cooling and the sub-cooling margin are maintained during an off-normal event.
101EOI2237	EOI	Authorize deviations from technical specifications/procedures during emergency conditions.
101EOI2238	EOI	Direct shift personnel actions to ensure plant safety during an emergency/abnormal event.
101EOI2239	EOI	Make notifications to state and local agencies in regard to emergency classification.
101EOI2240	EOI	Determine if a local area evacution is required.
101EOI2241	EOI	Determine if a site evacuation of personnel is required.
101EOI2242	EOI	Determine if a plant evacuation of personnel is required.
101EOI2243	EOI	Determine if plant conditions allow reclassification of an emergency event.
101EOI2244	EOI	Determine if plant conditions allow closeout of an emergency event.
101EOI2245	EOI	Authorize overexposure of an emergency worker.
101EOI2246	EOI	Perform emergency coordinator command turnover.
102EOI2247	EOI	Approve actions not defined in the Emergency Operating Instruction during an abnormal or emergency event.
104HIC2172	HIC	Conduct housekeeping inspections.
104HIC2260	HIC	Implement housekeeping requirements for assigned areas.

Task ID	System ID	Task Description
103IPO2219	IPO	Monitor plant chemistry to ensure conformance to specifications.
105IPO2220	IPO	Authorize placement of a reactor protection channel in test, or in a trip condition.
103IPO2221	IPO	Authorize and direct de-energizing or energizing of electrical buses.
102IPO2222	IPO	Analyze indications to determine the cause of an off normal event.
102IPO2223	IPO	Direct corrective actions to mitigate the consequences of an off normal event.
102IPO2224	IPO	Evaluate the off-normal event to determine that conditions are following the expected sequence.
101IPO2225	IPO	Analyze indications to determine that an emergency/abnormal plant event is in progress.
102IPO2226	IPO	Notify unit superintendent of abnormal plant conditions.
103IPO2227	IPO	Approve chemical analysis results.
103IPO2228	IPO	Evaluate plant conditions in relationship to technical specification requriements.
102IPO2229	IPO	Analyze plant condition to determine the cause of a trip or unscheduled power reduction.
102IPO2230	IPO	Authorize return to power after a trip of unscheduled power reduction.
102IPO2266	IPO	Direct actions of the fire brigade pertaining to reactor and personnel safety.
103IPO2273	IPO	Coordinate load changes with the energy control supervisor.
104NCR2276	NCR	Prepare nonconforming material, parts or components report.
103ONT2174	ONT	Report significant events to the nuclear regulatory commission.
102ONT2175	ONT	Ensure notification of Energy Control Center Senior Operations Supervisor of any requried one hour reports to the NRC.

Task ID	System ID	Task Description
1040NT2268	ONT	Supply input for reports to the NRC and other special reports.
1040SH2186	OSH	Authorize overtime for operations personnel.
1040SH2187	OSH	Call in additional personnel as necessary.
1030SH2193	OSH	Maintain minimum shift manning.
1050SI2188	OSI	Authorize performance of surveillance test on shift.
1050SI2189	OSI	Monitor the conduct of shift surveillance test.
1050SI2190	OSI	Review results of surveillance tests.
1050SI2191	OSI	Review technical specification surveillance control sheets.
1050SI2261	OSI	Review and verify satisfactory completion of routine surveillance procedures.
1030SL2192	OSL	Review station logs and shift relief status logs.
1040SL2202	OSL	Maintain required logs, records and status boards.
1040SP2194	OSP	Assess personnel behavior patterns.
1040SP2195	OSP	Review personnel accident reports.
1040SP2196	OSP	Make verbal reports to immediate supervisor and other supervisors.
1040SP2197	OSP	Conduct on the job training of operations.
1030SP2198	OSP	Apply union contract.
1030SP2199	OSP	Write periodic personnel performance evaluation.
1040SP2200	OSP	Handle shift personnel problems and grievances.
1040SP2274	OSP	Maintain operations personnel time sheets.
1040SP2275	OSP	Approve vacations of shift personnel.
1040SR2201	OSR	Conduct shift and relief turnover.
1040SR2203	OSR	Conduct the pre-shift briefing.
1030SR2204	OSR	Evaluate the effectiveness of the shift turnover process.

Task ID	System ID	Task Description
103OTS2207	OTS	Generate a limiting condition for operation action request.
102PTR2262	PTR	Determine if a trip or transient requires a post trip/transient review.
102PTR2263	PTR	Conduct a personnel debriefing following a trip or unscheduled or unexplained power reduction.
105TMC2205	TMC	Approve placement of temporary modifications.
103TMC2206	TMC	Review temporary facility modification package.
103TMC2209	TMC	Review temporary modifications for impact on Limiting Conditions for Operation.
105TMC2264	TMC	Approve restoration of temporary modifications..
101UOP2178	UOP	Evaluate the adequuacy of abnormal and emergency procedures for mitigation capabilities during off normal conditions.
103UOP2179	UOP	Initiate temporary change notices.
103UOP2180	UOP	Approve temporary change notices.
102UOP2181	UOP	Resolve questions from operators performing a procedure on the intent of the procedure.
102UOP2182	UOP	Direct shift personnel during abnormal situations not covered by procedure.
104UOP2265	UOP	Prepare and submit an instruction resolution request.
104UOP2269	UOP	Evaluate the adequacy of procedures to ensure safe operations.

Task ID	System ID	Task Description
203ADM2038	ADM	Approve chemical analysis sample request.
204ADM2040	ADM	Review radioactive waste discharge/release permits.
204ADM2041	ADM	Estimate completion times of shift evolutions.
204ADM2042	ADM	Direct operating shift to carry out actions required by operations orders/memos.
204ADM2046	ADM	Evaluate potential industrial hazards for operations work assignments.
204ADM2049	ADM	Act as senior company representative on-site during backshift, weekends and holidays.
204ADM2050	ADM	Interpret and ensure compliance with plant administrative procedures during normal and off normal plant operations.
204ADM2054	ADM	Approve radiation work permit.
205ADM2058	ADM	Direct minor repairs by the operating shift.
203ADM2061	ADM	Coordinate support from operations department and other departments for required testing.
204ADM2068	ADM	Maintain knowledge of modifications to plant safety-related equipment.
204ADM2073	ADM	Approve interim control/alarm setpoint changes.
205ADM2088	ADM	Coordinate plant operation to support maintenance activities.
203ADM2089	ADM	Coordinate ordering and delivery of plant consumables (gases and chemicals).
203ADM2092	ADM	Inspect plant each shift.
203ADM2095	ADM	Establish priority for shift activities.
204ADM2098	ADM	Direct shift personnel assignments.
205ADM2101	ADM	Approve use of other than normal shear pin in the traveling bars and traveling screens.
205ADM2103	ADM	Approve testing of 480 volt feeders after a relay operation.

Task ID	System ID	Task Description
203ADM2104	ADM	Approve containment entry outside secondary shield.
205ADM2105	ADM	Approve operation of CT or PT secondary switches.
205ADM2106	ADM	Request performance of emergency maintenance.
205ADM2107	ADM	Evaluate work for ALARA requirements.
205ADM2108	ADM	Approve use of 4 kv or 480 v grounding device.
202ADM2139	ADM	Assume the duties of Supervisor of Security as required.
204ADM2277	ADM	Supervise the rescue team leaders handling of the rescue of injured personnel.
202ADM2278	ADM	Assist shift personnel in reporting injuries.
204ADM2279	ADM	Perform duties of SRO control room command function.
202ADM2351	ADM	Perform local accident investigations.
204HIC2047	HIC	Conduct housekeeping inspections.
202OCR2094	OCR	Control control room access.
204OKC2067	OKC	Issue non-security controlled keys.
205OLV2102	OLV	Approve changing of locked valve or breaker position.
203ONT2097	ONT	Report significant events to the nuclear regulatory commission.
202ONT2135	ONT	Ensure notification of Energy Control Center Senior Operations Supervisor of any requried one hour reports to the NRC.
204OOI2070	OOI	Complete required reading assignments.
203OOI2133	OOI	Review priority 1 and 2 operational information.
204OOI2134	OOI	Ensure shift personnel review requried operational information.
204OPR2065	OPR	Approve temporary change notices.
201OPR2078	OPR	Evaluate the adequacy of abnormal and emergency procedures for mitigation capabilities during off normal conditions.

Task ID	System ID	Task Description
2030PR2091	OPR	Initiate temporary change notices.
2030PR2120	OPR	Resolve questions from operators performing a procedure on the intent of the procedure.
2030PR2122	OPR	Approve a procedure modification permit.
2020PR2141	OPR	Direct shift personnel during abnormal situations not covered by procedure.
2030PT2145	OPT	Review the post trip/transient review package.
2030SA2043	OSA	Review completed checkoff lists following plant evolutions involving mode changes.
2030SA2123	OSA	Approve an abnormal alignment/evolution document.
2030SA2124	OSA	Determine non-safety system alignment requirements after abnormal alignment evolution or release from work authorization
2030SA2125	OSA	Direct operators to realign a misaligned component to its proper position.
2050SI2059	OSI	Authorize performance of surveillance test on shift.
2050SI2060	OSI	Monitor the conduct of shift surveillance test.
2050SI2110	OSI	Review results of surveillance tests.
2050SI2140	OSI	Review technical specification surveillance control sheets.
2030SL2039	OSL	Review operating logs for trends and out of specification conditions.
2030SM2093	OSM	Maintain minimum shift manning.
2040SM2096	OSM	Call in additional shift personnel as necessary.
2040SM2099	OSM	Authorize overtime for shift personnel.
2040SP2062	OSP	Write periodic personnel performance evaluations.
2040SP2063	OSP	Assess personnel behavior patterns.
2040SP2064	OSP	Handle shift personnel problems and grievances.
2040SP2066	OSP	Make verbal reports to immediate supervisor and other supervisors.

Shift Superintendent-Unit 2/3

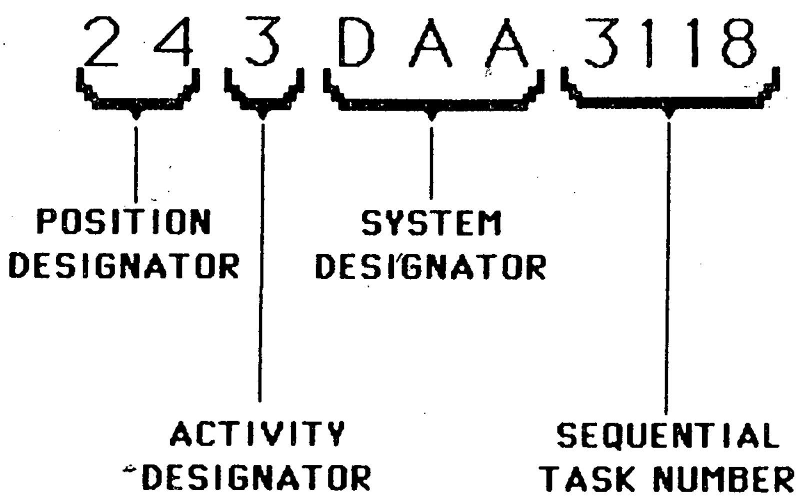
Task ID	System ID	Task Description
204OSP2069	OSP	Conduct on the job training of operations.
203OSP2090	OSP	Apply union contract.
204OSR2036	OSR	Conduct shift and relief turnover.
204OSR2037	OSR	Maintain required logs, records and status boards.
204OSR2045	OSR	Conduct the pre-shift briefing.
203OSR2142	OSR	Evaluate the effectiveness of the shift turnover process.
205OTM2111	OTM	Approve placement of temporary modifications.
203OTM2130	OTM	Review temporary facility modification package.
203OTM2132	OTM	Determine if a system and/or equipment is inoperable.
203OTM2137	OTM	Review temporary modifications for impact on Limiting Conditions for Operation.
205OTM2146	OTM	Authorize work authorization to install a temporary facility modification.
203OTS2131	OTS	Generate a limiting condition for operation action request.
202OTS2280	OTS	Evaluate plant system performance and coordinate actions per tech specs in the event an LCO is entered.
202OTS2281	OTS	Evaluate plant conditions in relationship to tech spec requirements.
205OWA2055	OWA	Determine retest requirements following Shift Superintendent Accelerated Maintenance.
205OWA2056	OWA	Review retest results following maintenance.
205OWA2057	OWA	Verify post-maintenance operability of safety related equipment.
204OWA2071	OWA	Ensure periodic auditing of tag outs and labels.
205OWA2109	OWA	Approve clearance boundries.
203OWA2126	OWA	Verify operational impact evaluation when equipment control is not available.

Task ID	System ID	Task Description
2030WA2127	OWA	Determine or verify equipment testing requirements.
2030WA2128	OWA	Review and approve work authorization records.
2030WA2129	OWA	Approve work on unit controls and relays within the station which could affect the ability to generate power.
2050WA2147	OWA	Authorize release from/return to service of important to safety systems for maintenance or testing.
2050WA2282	OWA	Determine if a LCOAR/EDMR is required from a review of a maintenance order.
2050WA2283	OWA	Authorize the modification of a clearance or permission for a system/equipment important to safety.
203Y012044	Y01	Monitor plant chemistry to ensure conformance to specifications.
203Y012048	Y01	Direct actions to ensure compliance with local, state and federal environmental regulations.
205Y012052	Y01	Authorize placement of a reactor protection channel in test, or in a trip condition.
203Y012053	Y01	Authorize and direct de-energizing or energizing of electrical buses.
202Y012079	Y01	Analyze indications to determine the cause of an off normal event.
202Y012080	Y01	Direct corrective actions to mitigate the consequences of an off normal event.
202Y012081	Y01	Evaluate the off-normal event to determine that conditions are following the expected sequence.
201Y012084	Y01	Notify shift technical advisor of plant abnormal conditions.
201Y012085	Y01	Analyze indications to determine that an emergency/abnormal plant event is in progress.
202Y012086	Y01	Direct operating shift actions for off-normal and alarm conditions.

Task ID	System ID	Task Description
202Y012087	Y01	Notify unit superintendent of abnormal plant conditions.
203Y012100	Y01	Approve chemical analysis results.
202Y012136	Y01	Direct actions to remove fire protection system impairments.
202Y012143	Y01	Analyze plant condition to determine the cause of a trip or unscheduled power reduction.
202Y012144	Y01	Authorize return to power after a trip of unscheduled power reduction.
201Y092051	Y09	Authorize termination of engineered safety features functions.
201Y092072	Y09	Check with other units to determine if an emergency event is interrelated.
201Y092074	Y09	Classify emergency events requiring emergency plan implementation.
201Y092075	Y09	Direct emergency response as site emergency coordinator.
201Y092076	Y09	Access the need for additional personnel for responding to an emergency event.
201Y092077	Y09	Evaluate plant personnel safety hazards associated with the emergency event.
202Y092082	Y09	Direct actions to ensure that core cooling and the sub-cooling margin are maintained during an off-normal event.
201Y092083	Y09	Authorize deviations from technical specifications/procedures during emergency conditions.
201Y092112	Y09	Make notifications to state and local agencies in regard to emergency classification.
201Y092113	Y09	Determine if a local area evacution is required.
201Y092114	Y09	Determine if a site evacuation of personnel is required.
201Y092115	Y09	Determine if a plant evacuation of personnel is required.

Task ID	System ID	Task Description
201Y092116	Y09	Determine if plant conditions allow reclassification of an emergency event.
201Y092117	Y09	Determine if plant conditions allow closeout of an emergency event.
201Y092118	Y09	Authorize overexposure of an emergency worker.
201Y092119	Y09	Perform emergency coordinator command turnover.
202Y092121	Y09	Approve actions not defined in the Emergency Operating Instruction during an abnormal or emergency event.
201Y092138	Y09	Evaluate the safety of the reactor during an emergency event.

TASK NUMBERING SYSTEM



TASK: "ALIGN THE CIRCULATING WATER SYSTEM FOR START-UP"

SECONDARY PEO , NORMAL OPERATIONS , CIRCULATING WATER SYSTEM

Operator Training Program Development
Position List

Position Identifier	Position Name	Position Number
ABO	Auxiliary Boiler Operator	35
ACAD	ACO Admin Requirements-Unit 2/3	38
ACO	Assistant Control Operator	12
APEO	NPEO Admin Requirements-Unit 2/3	37
BPS	Blowdown Processing Demin Operator	25
CACO	Common Assistant Control Operator	32
CCO	Common Control Operator	31
CO	Control Operator	11
COAD	CO Admin Requirements-Unit 2/3	39
CPEO	Common Plant Equipment Operator	34
FFPO	Full Flow Demineralizer Operator	26
MUD	Makeup Demineralizer Operator	36
PEO	Plant Equipment Operator	13
PPEO	Primary Plant Equipment Operator	23
RWOP	Radwaste Operator	33
SPEO	Secondary Plant Equipment Operator	24
SS1	Shift Superintendent-Unit 1	1Ø
SS2	Shift Superintendent-Unit 2/3	2Ø
STA1	Shift Technical Advisor-Unit 1	19
STA2	Shift Technical Advisor-Unit 2/3	29
SUP1	Control Room Supervisor-Unit 1	18
SUP2	Control Room Supervisor-Unit 2/3	28
UACO	Unit Assistant Control Operator	22
UCO	Unit Control Operator	21

Operator Training Program Development
Systems List

System ID	System Name
220	220 KV Switchyard System and 18 KV System
301	Plant Startup from Cold Shutdown to Hot Standby S01-3-1
302	Plant Startup From Hot Standby to Minimum Load S01-3-2
303	Plant Operation From Minimum Load To Full Power S01-3-3
304	Plant Shutdown From Full Power To Hot Standby S01-3-4
305	Plant Shutdown From Hot Standby To Cold Shutdown
306	Natural Circulation Operations
308	Power Operations
480	480 Volt Electrical Distribution
4KV	4.16 KV Electrical Distribution
4VS	4 KV and 480 V Rooms Ventilation Systems
ABA	Main and Reheat Steam System
ACA	Main Turbine
ACP	Auxiliary Control Panel
ADA	Condensate System
ADM	General Administrative Requirements
AEA	Feedwater System
AEB	Feedwater Regulation
AFA	Feedwater Heaters, Drains and Vents
AFW	Auxiliary Feedwater System
ALA	Auxiliary Feedwater System
ANA	Makeup Demineralizer
ANN	Annunciator Systems
AOI	Acknowledgement of Information S01-14-16
APA	Condensate Storage and Transfer System
APM	Accident Prevention Manual
AQA	Condensate And Feedwater Chemical Control
ATX	Main and Auxiliary Transformers
BAS	Boric Acid System
BBA	Reactor Coolant System
BBB	Pressurizer Systems
BGA	Chemical And Volume Control System
BGB	CVCS Boric Acid Mix And Storage
BHA	Safety Injection System
BKA	Containment Spray System
BMA	Steam Generator Blowdown Processing System
CAA	Main Turbine Gland/Valve Steam Sealing
CBA	Main Turbine And Generator Lube Oil System
CCA	Generator Gas Cooling System
CCW	Component Cooling Water System
CDA	Generator Seal Oil System
CEA	Generator Stator Cooling System
CFA	Lube Oil Storage Transfer And Purification
CGA	Condenser Air Removal System
CHA	Main Turbine Controls
CNA	Condenser Air Removal
CND	Condensate System
COA	Control of Operator Aids S01-14-44

Operator Training Program Development
Systems List

System ID	System Name
CRD	Control Rods and Rod Control System
CSA	Control of System Alignments S01-14-43
CSF	Critical Safety Function Status Trees
CSI	Containment Sphere Integrity and Access S0123-VII-7.8
CVS	Containment Ventilation System
CWS	Circulating Water System
DAA	Circulating Water System
DAR	Duties and Responsibilities
DCA	Traveling Screens And Fish Handling System
DCB	125 VDC System and Protection
DGX	Emergency Diesel Generator
DSD	Dedicated Safe Shutdown System
EBA	Turbine Plant Cooling Water System
ECA	Spent Fuel Pool Cooling And Clean Up
ECP	Equipment Control Implementation S0123-0-21
EDS	Equipment Deficiency Status S01-14-15
EFA	Nuclear Service Water System
EGA	Component Cooling Water System
EOI	Emergency Operating Instructions
EPA	Salt Water Cooling System
EPI	Emergency Plan Implementing Procedures
FAA	Auxiliary Boiler
FBA	Auxiliary Steam System
FFD	Full Flow Condensate Polishing Demineralizer System
FHS	Refueling and Fuel Handling Systems
FPP	Fire Protection and Rescue Procedures
FRG	Functional Recovery Guidelines
FSY	Fire Protection Systems
FWH	Feedwater Heaters, Vents and Drains System
FWS	Feedwater System
GBA	Chilled Water (Normal)
GDA	Intake Structure Ventilation
GEA	Turbine Building HVAC
GEN	Main Generator, Excitation and Protection Systems
GGA	Fuel Handling Building HVAC
GGS	Generator Gas System
GHA	Auxiliary Building Radwaste Area HVAC
GHB	Charging Pump And Boric Acid Makeup Pump Room HVAC
GJA	Chilled Water (Emergency)
GKA	Control Room Area HVAC (Emergency)
GKB	Control Room Area HVAC (Normal)
GLA	PA Communication And Battery Rooms HVAC
GLB	ESF Switchgear Rooms HVAC (Emergency)
GLC	Health Physics And Locker Rooms HVAC
GLD	Cable Spreading And Electrical Rooms HVAC
GLE	Battery Rooms HVAC (Emergency)
GLF	ESF Switchgear Rooms HVAC (Normal)
GLG	Battery Rooms HVAC (Normal)
GLH	Emergency Chiller Rooms HVAC (Emergency and Normal)

Operator Training Program Development
Systems List

System ID	System Name
GLX	Miscellaneous Ventilation Systems
GMA	Diesel Generator Building HVAC (Normal)
GNI	Gaseous Nitrogen System
GNX	Containment Bldg HVAC
GRA	Penetration Building HVAC
GRD	Cathodic Protection System
GSE	Turbine Gland Seal and Exhaust Systems
GSO	Generator Hydrogen Seal Oil System
GXX	Safety Equipment Building HVAC
GYA	Cable Tunnel HVAC
HAA	Gaseous Radwaste
HBA	Miscellaneous Radwaste Systems
HBB	New And Spent Resin Handling System
HBC	Filter Precoat And Filter Crud Tank System
HEB	Boric Acid Recycle System
HGX	Radioactive and Non-Radioactive Sumps And Drains
HIC	Housekeeping Implementation and Compliance S0123-VI-23.0
HJA	Coolant Radwaste System
IPO	Integrated Plant Operations
ISA	Instrument And Service Air System
KBA	Instrument And Service Air System
KCX	Fire Protection Systems
KDA	Domestic Water and Service Water Systems
KHA	Service Gas - Nitrogen
KJX	Emergency Diesel Generator
KLA	Service Gas-Hydrogen
LEA	Secondary Sumps and Drains
LFA	Waste Water System
LNI	Liquid Nitrogen System
LTG	Plant Lighting System
LUB	Routine Lubrication
MAA	Main Generator and 22 KV Systems
MAB	Generator Iso Phase Bus Cooling System
MAX	Main, Auxiliary And Reserve Auxiliary Transformers
MBA	Main Generator Excitation and Voltage Regulation Systems
MET	Meterological Monitoring System
MIS	Miscellaneous Systems
MKA	220KV Electrical Distribution
MSS	Main Steam and Steam Dump Systems
MVS	Miscellaneous Ventilation Systems
NAX	6.9KV Electrical Systems
NBX	4.16KV Electrical Systems (1E and non-1E)
NCR	Nonconforming Material, Parts or Components S0123-XV-5.0
NGX	480V Electrical Systems (1E and non-1E)
NIS	Nuclear Instrumentation System
NJA	Non-1E 250V DC System

Operator Training Program Development
Systems List

System ID	System Name
NKA	Non-1E 125V DC System
NNA	Non-1E Instrument AC Power Supply Sys
NOC	Noise Control S0123-XVI-18.Ø
OCE	Cummulative Equipment Hours and Design Cycles SØ23-Ø-2Ø
OCL	Operation Charts and Data Logs Control SØ1-14-25
OCN	Union Contract Agreement
OCR	Control Room Access and Conduct SØ123-Ø-15
OCT	Use of Caution Tags and Magnetic Tags SØ23-Ø-19
ODS	Equipment Deficiency Status SØ23-Ø-26
OKC	Key Control SØ23-Ø-27
OLV	Locking of Safety Related Valves and Breakers SØ2(3)-Ø-17
ONT	Notification and Reporting of Significant Events SØ123-Ø-14
ONV	Locking of Non-Safety Related Critical Valves SØ23-Ø-17.1
OOA	Administrative Control of Operator Aids SØ23-Ø-32
OOI	Operational Information SØ23-Ø-18
OOR	Operations Department Organization
OOV	Assignment of Overtime SØ23-Ø-3Ø
OPM	Personnel Management
OPR	Use of Procedures SØ23-Ø-35
OPS	Station Operations
ORG	Station Organization
OSA	Control of System Alignments SØ23-Ø-36
OSH	Scheduling
OSI	Operating Surveillance Implementation SØ23-XV-3.Ø
OSL	Station Logs SØ123-Ø-11
OSM	Shift Manning SØ123-Ø-3Ø
OSO	Special Orders SØ1-14-2Ø
OSP	Supervisory Skills
OSR	Operations Shift Relief SØ123-Ø-1Ø
OTM	Temporary Facility Modification Control SØ23-Ø-16
OTR	Trip/Transient Review SØ123-Ø-25
OTS	Technical Specifications
OVO	Administrative Control of Valve Operation SØ23-Ø-15
OWA	Work Authorizations SØ23-Ø-13
PAP	Performance Appraisals
PAS	Post Accident Sampling System
PKA	IE 12Ø VAC and 125 VDC Systems
PMU	Primary Plant Makeup System
PTR	Post Trip/Transient Review SØ123-Ø-25
PZR	Pressurizer And Pressurizer Relief Tank
QAA	Plant Lighting Systems
QHA	Cathodic Protection System
RCP	Reactor Coolant Pump Seal Water System
RCS	Reactor Coolant System
REF	Refueling
RHR	Residual Heat Removal System

Operator Training Program Development
Systems List

System ID	System Name
RJA	Plant Monitoring System
RKA	Station Annunciators
RLC	Radwaste Liquid Collection System
RMS	Radiation Monitoring System
ROP	Routine Operations and Inspection S023-0-38
RPI	Reactor Plant Instrumentation
RPS	Reactor Control And Protection System
RSD	Reheater Steam Dump System
RSS	Reactor Cycle Sampling System
RVD	Reheater Steam, Vents and Drains
RWC	Radwaste Cryogenic Gas Treatment System
RWG	Radwaste Gas System
RWL	Radwaste Liquid Processing And Release System
RWS	Refueling Water System
SAA	Engineering Safety Features Actuation System
SAM	Seismic Activity Monitoring System
SBA	Plant Protection System
SBS	Steam Generator Blowdown System
SCA	In-Core Reactor Instrumentation
SCF	Secondary Chemical Feed System
SDA	Area Radiation Monitoring System
SDB	Health Physics Computer
SDW	Service And Domestic Water System
SEA	Ex-Core Neutron Monitoring System
SEQ	Sequencer System
SEV	Sphere Enclosure Building Ventilation System
SFA	CEDM Control System and Control Rods
SFC	Reactor Regulation
SFP	Spent Fuel Pit and Cooling Water System
SGL	Steam Generator Level Control System
SHA	Containment Spray And Hydrazine Injection System
SIS	Safety Injection System
SJB	Post Accident Sampling System
SOR	Special Orders & Night Letters S01-14-20
SPA	Process And Airborne Radiation Monitoring System
SQA	Vibration and Loose Parts Monitoring System
SSD	Secondary Station Sumps And Drains
STD	Performance Standards for Completion of On-the-Job Training
SUR	Operating Surveillance Implementation S01-12.0-2
SWC	Salt Water Cooling System
SWS	Screen Wash Sysem
TBN	Main Turbine
TCO	Turbine Control and Bearing Oil Systems
TCW	Turbine Plant Cooling Water System
TEL	Plant Communications
TFX	Incore Instrumentation System
TLO	Turbine Lube Oil System
TMC	Temporary Facilities Modification Control S0123-0-22

Operator Training Program Development
Systems List

System ID	System Name
TSS	Turbine Cycle Sampling System
UOP	Use of Procedures SØ1-14-42
VCC	Chemical and Volume Control System
VOP	Valve Operation SØ1-14-17
VTB	Vital Buses, Utility Buses And Regulated Buses
XB1	Containment
YØ1	Integrated Plant Operations
YØ2	Plant Startup from Cold Shutdown to Hot Standby SØ23-5-1.3
YØ3	Plant Startup from Hot Standby to Minimum Load SØ23-5-1.3.1
YØ4	Plant Shutdown from Minimum Load to Hot Standby SØ23-5-1.4
YØ5	Plant Shutdown from Hot Standby to Cold Shutdown SØ23-5-1.5
YØ6	Power Operations SØ23-5-1.7
YØ7	Shutdown Operations SØ23-5-1.8
YØ8	Natural Circualtion Operations SØ2(3)-3-2.31
YØ9	Emergency Operations