DEC 20 1990

Mrs. Betty Geismar
P. O. Box 2000-302
Mission Viejo, CA 92690

Dear Mrs. Geismar:

I am responding to your letter of December 8, 1990, regarding the U. S. Nuclear Regulatory Commission (NRC) Confirmatory Order dated January 2, 1990, pertaining to the full-term operating license for the San Onofre Nuclear Generating Station, Unit No. 1. In particular, you requested specific information regarding the implementation of the reactor vessel level monitoring system (RVLMS) and the upgrades of the core-exit thermocouples.

The Southern California Edison (SCE) Company responded to this aspect of the Order by letter dated November 29, 1990, which I have enclosed for your information. In its correspondence, SCE stated that, after assessing the applicability and reliability of various RVLMS designs, it has chosen the one most suitable for San Onofre Unit No. 1. The RVLMS and core-exit thermocouple upgrades will be included as part of the Cycle 12 refueling outage, which is tentatively scheduled to occur on or about September 1992. Approximately six months before this outage, SCE will submit a change to the San Onofre Unit No. 1 Technical Specifications for NRC review and approval.

The NRC staff believes that SCE has taken the appropriate steps to ensure that the RVLMS is installed such that inadequate core cooling can be detected and handled in a safe manner.

I trust this reply responds to your concern. If I may be of further assistance to you, please feel free to contact me.

Sincerely,

Original signed by
Thomas E. Murley

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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ENCLOSURE

Southern California Edison Company

23 PARKER STREET

IRVINE, CALIFORNIA 92718

F. R. NANDY
MANAGER, NUCLEAR LICENSING

TELEPHONE
(714) 454-4504

November 29, 1990

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

Gentlemen:

Subject: **Docket No. 50-206**
TMI Action Plan Item II.F.2,
Inadequate Core Cooling Instrumentation
San Onofre Nuclear Generating Station, Unit 1

By Order issued January 2, 1990 the NRC required SCE to install modifications to meet the requirements of NUREG 0737 Item II.F.2, "Inadequate Core Cooling Instrumentation". The Order required that by December 1, 1990 we submit specific plans for implementing these requirements during the Cycle 12 refueling outage. This submittal provides the specific plans for implementation of the SONGS 1 Inadequate Core Cooling Monitoring System (ICCMS).

We have assessed the applicability and reliability of both the Westinghouse and the Combustion Engineering Reactor Vessel Level Monitoring System (RVLMS) designs. We have determined that the standard Combustion Engineering RVLMS design is more suitable for San Onofre Unit 1 application. The RVLMS and the core-exit thermocouple upgrades will be included as part of the Cycle 12 refueling outage.

If you have any questions, please contact me.

Very truly yours,

Enclosure

cc: J. B. Martin, Regional Administrator, NRC Region V
C. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2 and 3
C. D. Townsend, NRC Resident Inspector, San Onofre Unit 1

A002
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SAN ONOFRE NUCLEAR GENERATING STATION

UNIT 1 CYCLE 12

INADEQUATE CORE COOLING MONITORING SYSTEM

SYSTEM DESIGN DESCRIPTION

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SAN ONOFRE NUCLEAR GENERATING - STATION, UNIT 1
INADEQUATE CORE COOLING MONITORING SYSTEM

1.0 BACKGROUND

By Order issued January 2, 1990 the NRC required SCE to install modifications to meet the requirements of NUREG 0737 Item II.F.2, "Inadequate Core Cooling Instrumentation". The Order required that by December 1, 1990 we submit specific plans for implementing these requirements during the Cycle 12 refueling outage. This submittal provides the specific plans for implementation of the SONGS 1 Inadequate Core Cooling Monitoring System (ICCMS).

2.0 IMPLEMENTATION REQUIREMENTS

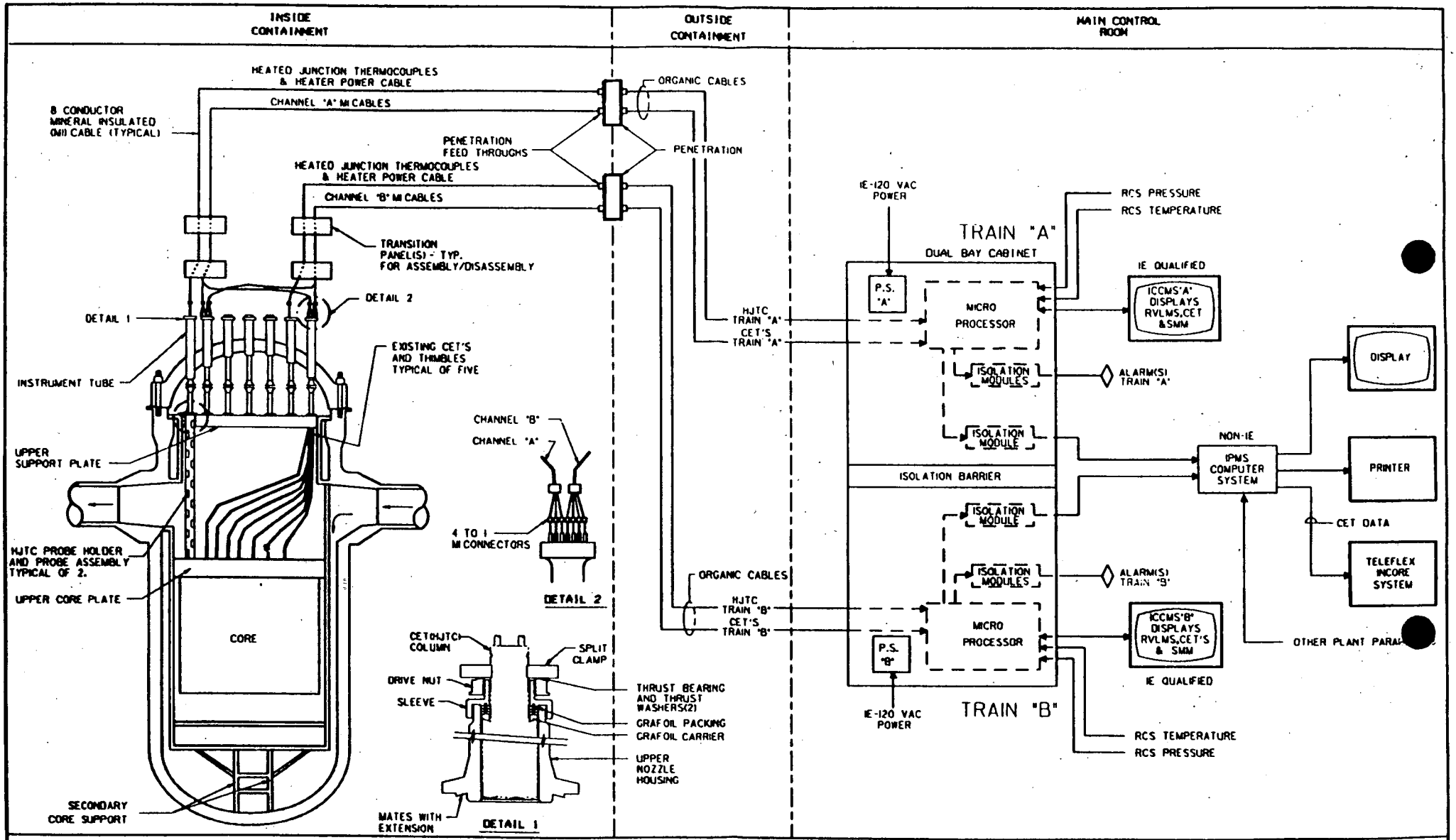
The ICC Monitoring System will consist of three major components:

1. Reactor Vessel Level Monitoring System (RVLMS)
2. Core Exit Thermocouples (CET)
3. Sub Cooled Margin Monitor (SMM)

All instrumentation will conform to the requirements of NUREG 0737, Appendix B, "Design and Qualification Criteria For Accident Monitoring Instrumentation" as clarified in section II.F.2.

Currently, the SONGS 1 facility has a qualified SMM, non qualified CET's and no Reactor Vessel Level Monitoring System. Subsequent to the Cycle 12 refueling SONGS 1 will have operable and qualified SMM's, CET's and RVLMS and will comply with the requirements of NUREG 0737 Item II.F.2.

The ICCMS for SONGS 1 will be an integrated system providing clear, concise information to the control room operators on the status of Inadequate Core Cooling. The ICCMS will provide Reactor Vessel Level, Core Exit Thermocouple and Sub Cooled Margin information to the control room operators. Figure 1 provides an overview of the SONGS 1 ICCM System Configuration.



SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1 CYCLE 12

INADEQUATE CORE COOLING MONITORING SYSTEM

FIGURE 1

G:/PROJECTS/96623/RVLIS.DGN

10-24-90

3.0 DESIGN ALTERNATIVES CONSIDERED

SCE has performed a detailed evaluation of the Westinghouse and Combustion Engineering companies RVLMS products. The Westinghouse RVLIS System, which is based on a differential pressure measurement, was concluded to be inappropriate due to significant uncertainties introduced by using a hot leg lower tap instead of the standard bottom tap found on other Westinghouse units. (SONGS 1 has no lower vessel pressure taps, nor does access exist to install one). It was further concluded by SCE that the unique coast down feature of the SONGS 1 reactor coolant pumps on turbine trip, coupled with a hot leg tap location could produce erroneous reactor vessel level indication for several minutes following a change in forced RCS flow which occurs during each reactor/turbine trip.

SCE has also evaluated a modified version of the Combustion Engineering's Heated Junction Thermocouple (HJTC) System. The modified system, based on a miniaturized version of the standard HJTC, would be placed in an incore instrument thimble and would require little or no modification to the reactor internals package. Although SCE considered the modified HJTC to be technically feasible, the issues of requalification, potentially long licensing exchanges, and unknown development costs eliminated this option.

Following a series of meetings between Combustion Engineering and SCE personnel it was concluded that SONGS 1 could be modified to accept the standard CE HJTC probe. A key factor in this decision was the discovery of original manufacturing drawings for the Unit 1 reactor internals at the fabrication facility which showed spare adjacent cutouts in the upper internals package which could accept the two new probe holder assemblies.

The installation of the HJTC system requires that CE and SCE conduct a number of walkdowns and inspections on the disassembled Unit 1 reactor vessel, internals package, and reactor head to verify these original manufacturing drawings and to assure that the HJTC probe and cabling can be pre-engineered and fabricated for Cycle 12 refueling installation. The final phase of these inspections is planned prior to completion of the in progress Cycle 11 refueling outage. These inspections consist of a detailed underwater camera inspection and measurement of the reactor internals package. Verification of the spare RCCA shroud locations, measurement of the bolt patterns on cover plates, determination of lock tab vs. welded bolting, interferences with incore instrument guide tubes and alignment with the spare instrument nozzles on the reactor head are all part of the inspection activities to be performed.

4.0 REACTOR VESSEL LEVEL MONITORING SYSTEM

The SONGS 1 Reactor Vessel Level Monitoring System will utilize the Heated Junction Thermocouple (HJTC) probe and technology developed and qualified by Combustion Engineering, Inc., Windsor, Connecticut.

There will be two independent HJTC instrumentation probes secured in the reactor vessel upper internals. Each probe, shown in Figure 2, consists of eight pairs of heated and unheated thermocouples placed at strategic locations along the probe length.

The principle of operation is based on the measured differential temperature of the heated/unheated thermocouple pairs as shown in Figure 3. When submerged in reactor coolant fluid, the heat generated by the heated thermocouple in the pair is dissipated and a comparison between the heated and unheated thermocouples shows the differential temperature as essentially zero. Conversely, when a heated/unheated thermocouple pair is uncovered the heated thermocouple temperature increases by several hundred degrees Fahrenheit and the resultant differential temperature is representative of lack of reactor coolant level. Continuous monitoring of the differential temperature and use of a bi-stable monitoring circuit feeds a display unit which indicates which thermocouple pairs are uncovered and which are covered. Control room alarms are provided to draw the operators attention to the displays during changes in the RCS inventory.

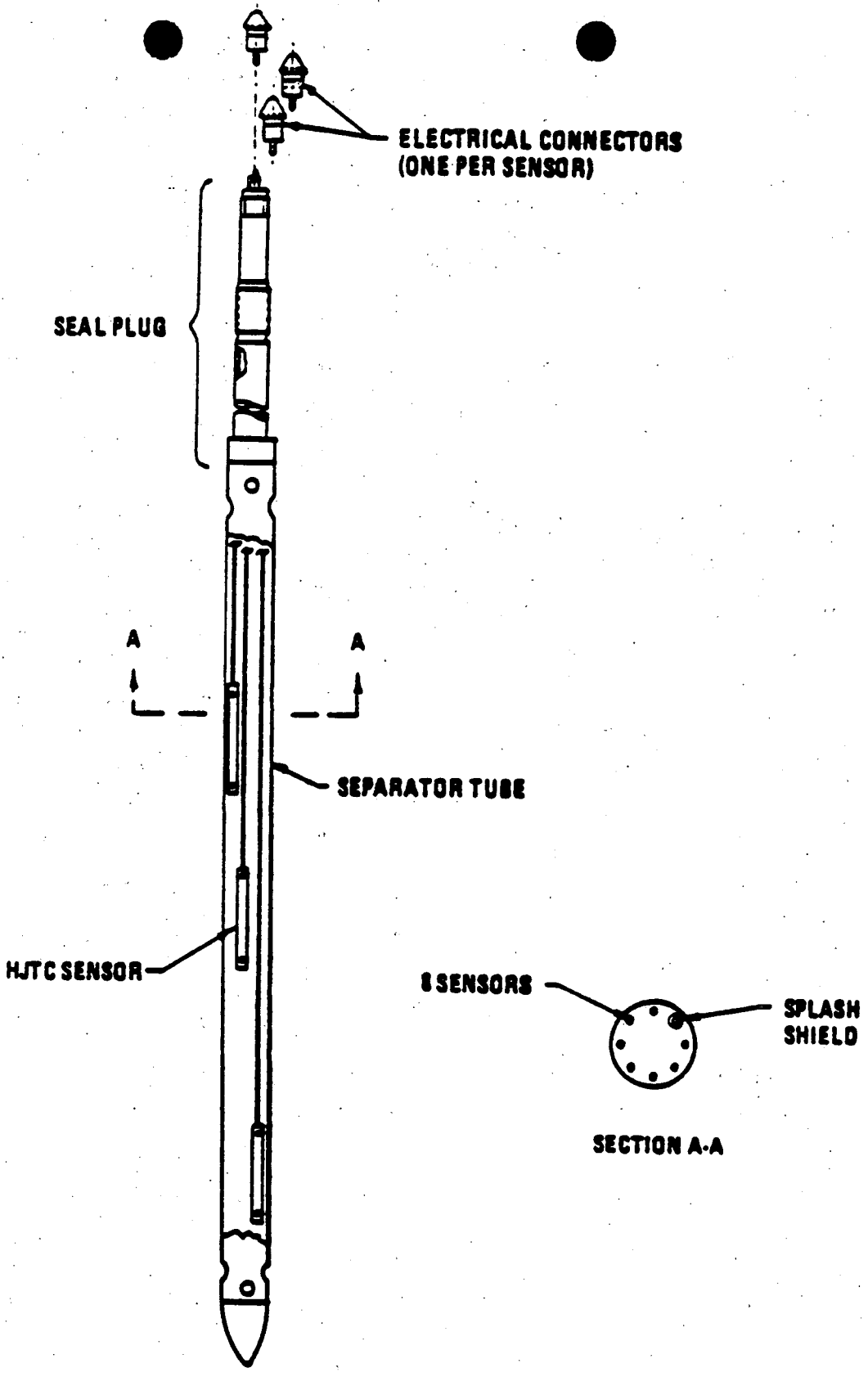
The CE HJTC technology has been successfully implemented at San Onofre Units 2 and 3 as well as over 20 other US nuclear facilities. Extensive qualification testing has been conducted on the HJTC technology and the application of that technology has been accepted and documented in March of 1982 by the NRC in NUREG/CR-2627 "Inadequate Core Cooling Instrumentation Using Heated Junction Thermocouples for Reactor Vessel Level Measurement".

The HJTC system and it's components will be qualified in accordance with IEEE-323 and IEEE-344 for the specific seismic, environmental, and post accident conditions at SONGS 1.

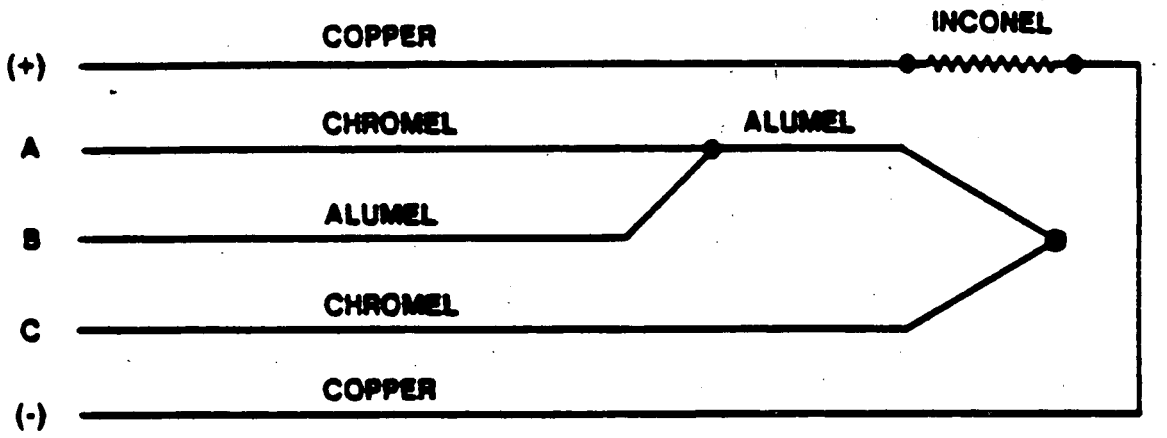
Installation of the HJTC probe will be accomplished by utilizing two spare incore instrumentation ports, or nozzles, located on the reactor vessel head. These nozzles will be modified to accept a removable instrumentation port adaptor which provides both pressure boundary retention and refueling disassembly capability.

Those portions of the HJTC probe exterior to the reactor vessel will consist of mineral insulation (MI) components and connectors qualified for the post LOCA harsh environment at SONGS 1.

Installation of the HJTC probe in the Reactor Vessel upper internals will include the addition of two probe support shrouds in spare Reactor Control Cluster Assembly (RCCA) locations. These spare locations are adjacent to the spare instrumentation port nozzles on the reactor head when the reactor is assembled. The probe support shrouds will be designed to be hydraulically similar to the existing RCCA shroud assemblies such that insignificant impact on RCS Thermal Hydraulic performance will occur due to the addition of the probe holders and probes. The holders, shown in Figure 4, will be functionally identical to the existing RCCA shroud assemblies minimizing structural reanalysis of the Reactor Vessel upper internals.



Southern California Edison	HEATED JUNCTION THERMOCOUPLE PROBE ASSEMBLY	Figure 2

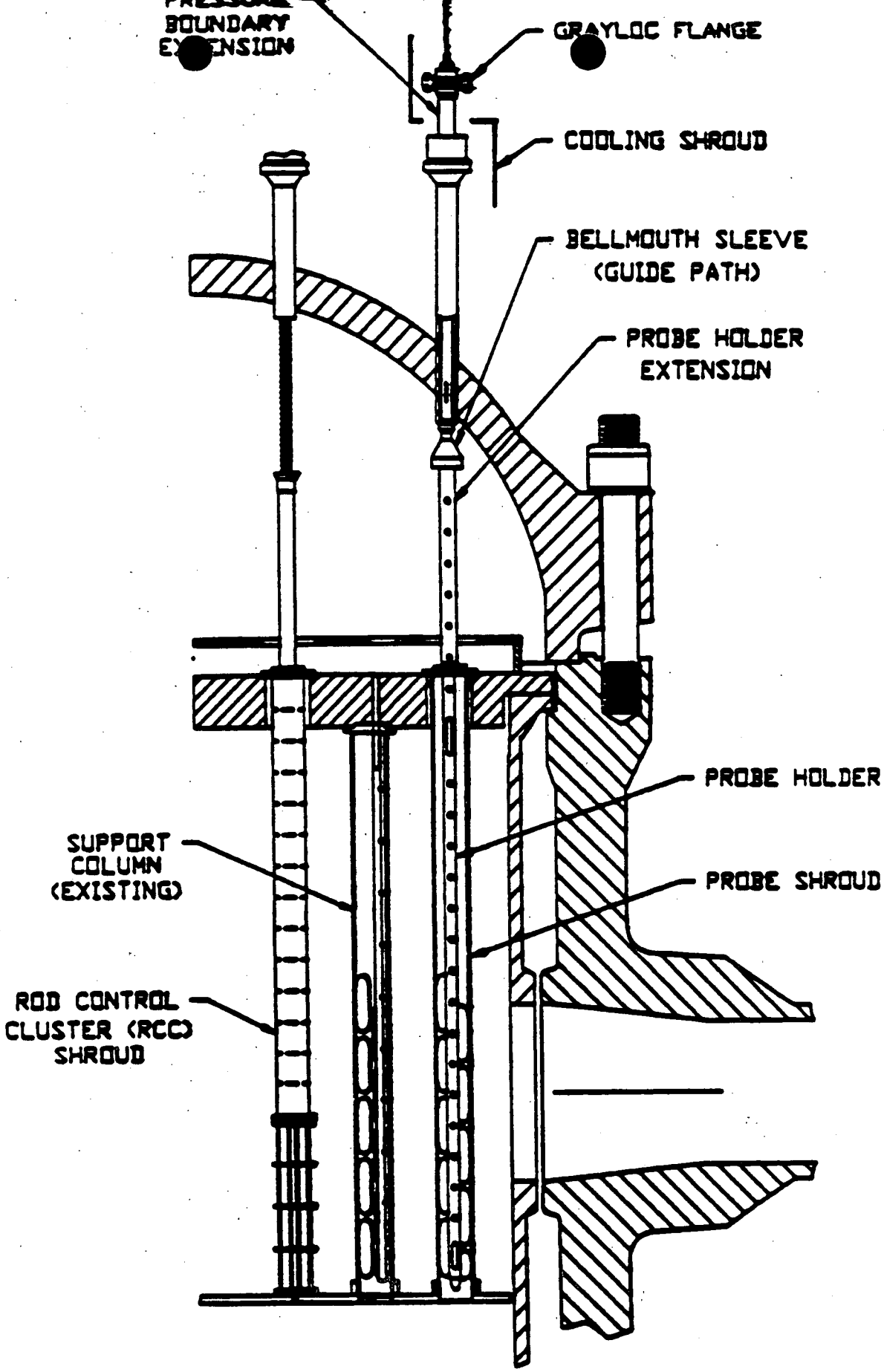


V (A-B) = ABSOLUTE TEMPERATURE, UNHEATED JUNCTION

V (C-B) = ABSOLUTE TEMPERATURE, HEATED JUNCTION

V (A-C) = DIFFERENTIAL TEMPERATURE

Southern California Edison	ELECTRICAL DIAGRAM OF HJTC	Figure 3



Southern California Edison

REACTOR CROSS-SECTION
AT UPPER GUIDE STRUCTURE ELEVATION

Figure 4

5.0 CORE EXIT THERMOCOUPLE UPGRADE

SONGS 1 was designed with 35 Core Exit Thermocouples (CET's) located uniformly across the top of the reactor core. Upgrade of the existing CET's to post accident qualification will occur as part of the ICCMS project.

The CET upgrade will utilize the existing incore portion of the CET's as clarified in Regulatory Guide 1.97. The CET components external to the reactor pressure boundary will be upgraded to post accident qualification.

The existing CET's currently have unqualified connectors and cables. (Containment penetrations for the CET's were replaced with post accident qualified components during the Cycle 9 refueling in 1986). The ICCMS modifications to the CET's will consist of removal of the existing CET connectors at the reactor head and replacement with post accident qualified connectors. Short segments of the CET between the pressure boundary and the existing connector will be enclosed with the new qualified connector assembly.

Existing Conoseal Assemblies (5), used for disassembly/reassembly of the incore instrumentation ports during refueling, will also be upgraded as part of this project and further minimize the potential for RCS seepage at the reactor head instrument nozzle locations and to reduce refueling radiation exposures. This modification will replace the CET's cabling, signal processing and displays as described in Sections 6, 7 & 8.

The CET's will be segmented into two trains consisting of four quadrants per train to meet the requirements of NUREG 0737 for number of operable CET's per quadrant. SONGS 1 currently has only 28 operable CET's. Reasonable effort will be made to restore the seven inoperable CET's to operable status as part of this upgrade. Any CET's that are inoperable as a result of broken guide thimble probably cannot be recovered.

6.0 CABLING FOR ICC COMPONENTS

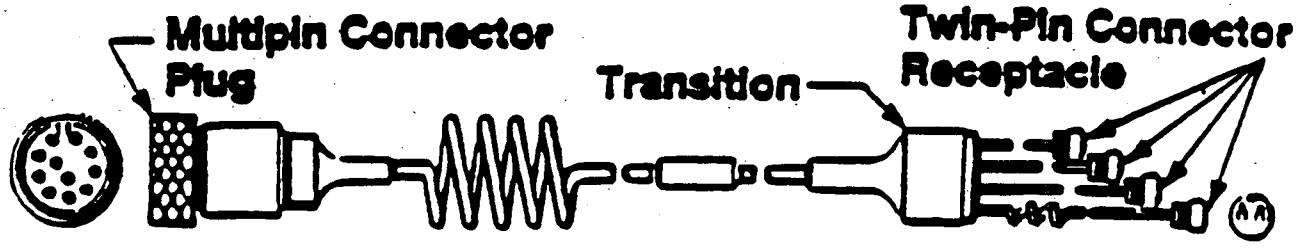
In-Containment Cabling

HJTC and CET instruments will be terminated at the reactor head by use of quick disconnect, multi conductor, post-accident qualified connectors that provide for simplified assembly/disassembly during refueling. These connectors will mate with similar connectors that have been spliced to Mineral Insulated (MI) Cable, shown in Figures 5, 6, and 7. All Containment internal cabling will be multi conductor MI cable. Transition panels will be provided on the reactor head lift rig and refueling operating deck to facilitate the reactor head assembly/disassembly.

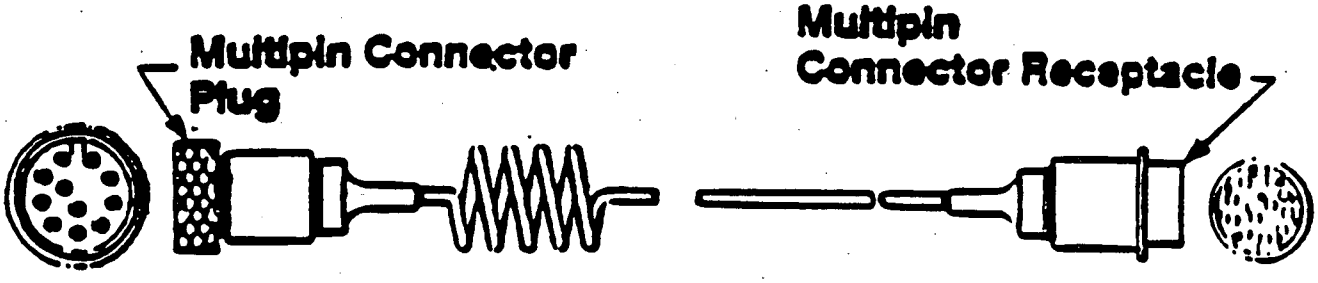
MI cable in containment will be seismically mounted and will terminate at the electrical penetrations on qualified electrical penetration feed throughs. New cable routing, up to the interface with existing equipment, will be done consistent with the requirements of Regulatory Guide 1.75. Separation of CET trains will occur as soon as possible after they exit the reactor pressure boundary.

Outside Containment Cabling

Cabling outside of containment will be train separated, and qualified for the post accident environment experienced by the respective areas. Qualified splices will be made to attach the new cable to the containment penetration pigtails. New cable routing up to the interface with existing equipment will be in accordance with the requirements of Regulatory Guide 1.75 for train separation.

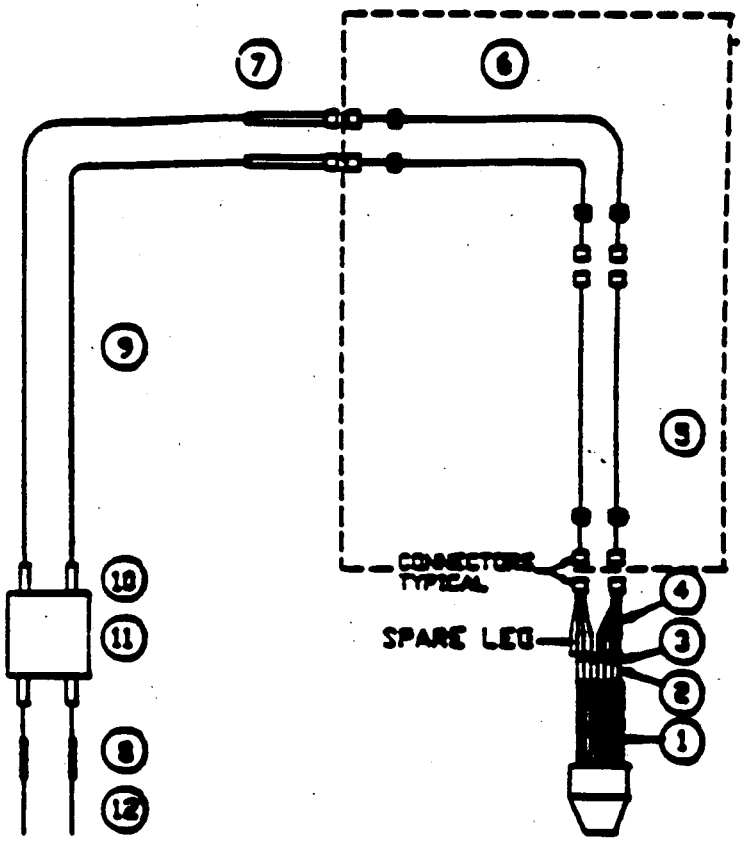


TRANSITION CABLE



MULTI WIRE CABLE

Southern California Edison	TYPICAL MINERAL INSULATED CABLE SECTION	Figure 5



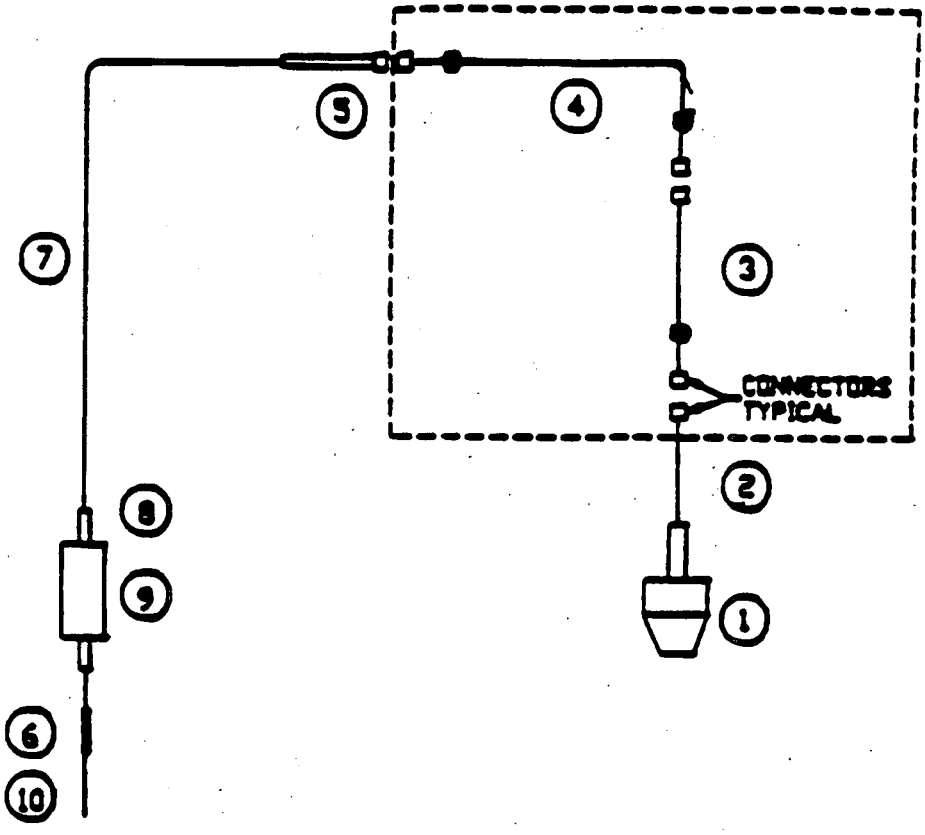
COMPONENT IDENTIFICATION

1. CET PRESSURE TUBE
2. CET
3. FIELD INSTALLABLE CONNECTOR
4. 4 TO 1 TRANSITION CABLE
5. HEAD LIFT RIG CABLE 50 FEET
6. BRIDGE CABLE 25 FEET
7. CONNECTOR
8. SPLICE
9. IN-CONTAINMENT MI CABLE
10. PENETRATION FEEDTHROUGH MODULE
11. EXISTING CONTAINMENT PENETRATION
12. EX-CONTAINMENT SOFTLINE CABLE

NOTES:

1. CABLES CONTAIN 4 CH AND 4 AL CONDUCTORS
2. — INDICATES REFUELING DISCONNECT POINTS
3. CABLING SHOWN IS FOR ONE CET NOZZLE

Southern California Edison	SCHEMATIC OF CET CABLE	Figure 6



COMPONENT IDENTIFICATION

1. HJTC PRESSURE BOUNDARY
2. HJTC PROBE ASSEMBLY
3. HEAD LIFT RIG CABLE 50 FT
4. BRIDGE CABLE 25 FT
5. CONNECTOR
6. SPLICE
7. IN-CONTAINMENT MI CABLE
8. PENETRATION FEEDTHROUGH MODULE
9. EXISTING PENETRATION ASSEMBLY
10. EX-CONTAINMENT SOFTLINE CABLE

NOTES:

1. EACH CABLE CONTAINS 5 CONDUCTORS
2. — INDICATES REFUELING DISCONNECT POINTS

Southern California Edison	ELECTRICAL DIAGRAM OF HJTC	Figure 7

7.0 ICC SIGNAL PROCESSING AND DISPLAY

The ICCMS electronics is composed of two independent and redundant channels (A and B) which meet the isolation and qualification standards for a Class 1E System. Each channel contains qualified micro computer based electronics to process and display Reactor Vessel Level, Core Exit Thermocouple temperatures, and Sub-cooled Margin.

Each channel of the ICCMS electronics consists of a qualified micro processor module for processing all of the associated inputs and outputs. The processor validates the inputs and performs various functions to calculate, alarm, and display the ICCMS parameters. The processor also provides controls for the HJTC heaters, provides optically isolated modem outputs and 1E/non 1E analog/digital outputs for interfacing with the existing plant systems.

Each channel of the ICCMS will have a seismically qualified dedicated Process Display Unit (PDU) which will be located strategically on the main control panel.

NUREG-0700 and other current Human Engineering guidelines will be used in the development of the actual displays.

Each qualified display (PDU) will have full access to its associated channels ICC information and is considered the 1E back-up to the primary displays of ICC Information in the Control Room.

Display Capability

SCE intends on using the Integrated Plant Monitoring System (IPMS) as the primary display device for ICC information in the control room. The IPMS will be installed as part of the Safety Parameter Display System (SPDS) implementation, which will occur concurrent with the ICCM System installation, during the Unit 1 Cycle 12 refueling. The PDU mentioned above will be considered as the back-up display as allowed in NUREG-0737.

A brief description of the SPDS as it applies to ICCM is given here. The SPDS will be an integral part of the IPMS. SCE will submit the details of the IPMS/SPDS under separate cover to the NRC six months prior to its implementation as stated in our July 12, 1989 letter to the NRC. The IPMS will consist of a Non 1E Computer System with full color graphics display capability. The ICCMS data will be electrically isolated and data linked to the SPDS computer system where it will be processed for display on human engineered color graphics displays. The display hierarchary and content will be constructed such that the control operator will have clear, unambiguous presentation of the ICC status.

Since the IPMS will display other plant parameters, the IPMS is expected to be used for everyday plant operations and maneuvers. This will enhance the overall usefulness of the ICC data during an accident situation as the operators will have previous daily experience with the

display system and be versed in its operation even in a stressful situation.

Data Trending

Primary data trending will be through the IPMS system. SCE will meet the requirements of the NUREG 0696 and NUREG 0737 for data trending.

Data Links

Each channel of the ICCMS will have the capability to provide 1E and non 1E analog and digital outputs to interface with the existing plant system.

The ICCMS interface with the SPDS will be done using a RS232 fiber optic data link. This will provide the 1E/non 1E isolation between the ICCMS and the SPDS.

Power Supply

Each ICCMS channel will be powered from an independent safety-related UPS. Sufficient battery capacity exists to support the additional load of the ICCM Systems at SONGS 1. The IPMS will be powered from a nonsafety-related UPS.

8.0 TECHNICAL SPECIFICATION CHANGES

SCE will submit a proposed change to the SONGS 1 Technical Specifications to address the ICC instrumentation installation approximately six months prior to the Cycle 12 refueling outage.

SCE intends to update Section 3.5.6 and 4.1.5 "Accident Monitoring Instrumentation" of the SONGS 1 Technical Specification to include the limiting conditions for operation, surveillance requirements, total number of channels, minimum channels operable, and action statements. Proposed Technical Specifications are expected to be similar to those currently in the Units 2 and 3 Tech specs for the Reactor Vessel Level Monitoring System, Core Exit Thermocouples and Sub-cooled Margin Monitor.

The requirements of NRC generic letter 83-87, as clarified by NRC letter from Mr. D. M. Crutchfield, office of Nuclear Reactor Regulation dated October 28, 1986 will be included in the Technical Specification submittal.

9.0 SCHEDULE FOR IMPLEMENTATION

The following represents an overview of the ICCMS implementation schedule. The implementation of the ICCMS will be during the Cycle 12 refueling outage which will occur on or about September, 1992.

ACTIVITY	DATE
Provide Specific Plans to NRC on ICCMS (this package fulfills this requirement)	12/1/90
Submit ICCMS Tech Spec Change for Approval	02/92*
Submit Details of the IPMS/SPDS	02/92*

* Dates shown are estimated, actual submittals will be six months prior to Cycle 12 refueling outage

10.0 REFERENCES

A. Letter, USNRC (Knighton) to Southern California Edison (Baskin), "Order For Modification of License-Inadequate Core Cooling Instrumentation System", dated May 10, 1989.

B. Letter, SCE (Ray) to USNRC, "Docket No. 50-206, Amendement Application No. 174", dated November 1, 1989.

C. NUREG 0737, "Clarification of TMI Action Plan Requirements".

D. Generic Letter 82-28, "Inadequate Core Cooling"

E. NUREG/CR 2627 "Inadequate Core Cooling Instrumentation Using Heated Junction Thermocouples for Reactor Vessel Level Measurement", March 1982.

F. Letter, Southern California Edison to the USNRC, "Docket No. 50-206, Response to NRC Generic Letter 89-06, San Onofre Nuclear Generating Station", dated July 12, 1989.

G. NRC letter, "Order Confirming Licensee Commitments on Full-Term Operating License Open Items", issued January, 1990.

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Mission Viejo, CA 92690

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Inadequate core cooling instrumentation is of prime concern to the NRC. SCE has taken the appropriate steps to ensure that the RVLMS is installed such that inadequate core cooling can be indicated and handled in an expeditious manner.

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ACTION

EDO Principal Correspondence Control

FROM:

BETTY GEISMAR

DUE: 01/07/91

EDO CONTROL: 0006070
DOC DT: 12/08/90
FINAL REPLY:

TO:

EXECUTIVE DIRECTOR

FOR SIGNATURE OF: ** GRN **

MURLEY

CRC NO:

DESC:

QUESTIONS RE SAN ONOFRE

ROUTING:

J. MARTIN, RV

DATE: 12/14/90

ASSIGNED TO: NRR CONTACT: MURLEY

Virgilio/Dyer

SPECIAL INSTRUCTIONS OR REMARKS:

REF: EDO 5335

Received NRR: December 14, 1990
Action: DRSP: Crutchfield/Boger

NRR Routing:
Murley
Miraglia
Partlow
Russell
Gillespie
Tana

ACTION

DUE TO NRR DIRECTOR'S OFFICE

BY 1/2/91