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October 24, 1985
ST-HL-AE-1464
File No.: G9.17

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Responses to DSER/FSAR Items
Regarding Chapter 7A, Item II.F.2

Dear Mr. Knighton:

The attachment enclosed provides STP's response to Draft Safety Evaluation Report (DSER) or Final Safety Analysis Report (FSAR) items.

The item numbers listed below correspond to those assigned on STP's internal list of items for completion which includes open and confirmatory DSER items, STP FSAR open items and open NRC questions. This list was given to your Mr. N. Prasad Kadambi on October 8, 1985 by our Mr. M. E. Powell.

The attachment includes mark-ups of FSAR pages which will be incorporated in a future FSAR amendment unless otherwise noted below.

The items which are attached to this letter are:

Attachment	Item No.*	Subject
1	D 4.4-4 D 4.4-5	Revision to Chapter 7A, Item II.F.2 to 1) provide item-by-item evaluation of Core Exit Thermocouple System against Attachment 1 of II.F.2 of NUREG 0737 and 2) address aspects of ICC system which deviate from NUREG 0737.

* Legend
D - DSER Open Item C - DSER Confirmatory Item
F - FSAR Open Item Q - FSAR Question Response Item

L1/DSER/aan

B001
1/1

Houston Lighting & Power Company

If you should have any questions concerning this matter, please contact Mr. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

CAA/bl

Attachments: See above

L1/DSER/aan

cc:

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1717 H Street
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Revised 9/25/85

L1/DSER/aan

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II.F.2 INSTRUMENTATION FOR DETECTION OF INADEQUATE CORE COOLING

Position (NUREG-0737)

Licensees shall provide a description of any additional instrumentation or controls (primary or backup) proposed for the plant to supplement existing instrumentation (including primary coolant saturation monitors) in order to provide an unambiguous, easy-to-interpret indication of inadequate core cooling (ICC). A description of the functional design requirements for the system shall also be included. A description of the procedures to be used with the proposed equipment, the analysis used in developing these procedures, and a schedule for installing the equipment shall be provided.

Clarification

(1) Design of new instrumentation should provide an unambiguous indication of ICC. This may require new measurements or a synthesis of existing measurements that meet design criteria (item 7).

(2) The evaluation is to include reactor water level indication.

(3) Licensees and applicants are required to provide the necessary design analysis to support the proposed final instrumentation system for ICC, to evaluate the merits of various instruments to monitor water level, and to monitor other parameters indicative of core cooling conditions.

(4) The indication of ICC must be unambiguous in that it should have the following properties: 40

   (a) It must indicate the existence of ICC caused by various phenomena (i.e., high-void fraction-pumped flow as well as stagnant boil-off).

   (b) It must not erroneously indicate ICC because of the presence of an unrelated phenomenon.

(5) The indication must give advanced warning of the approach of ICC.

(6) The indication must cover the full range from normal operation to complete core uncovery. For example, water level instrumentation may be chosen to provide advanced warning of two-phase level drop to the top of the core. This could be supplemented by other indicators such as incore and core exit thermocouples, provided that the indicated temperatures can be correlated to provide an indication of the existence of ICC, and to infer the extent of core uncovery. Alternatively, full-range level instrumentation to the bottom of the core may be employed in conjunction with other diverse indicators such as core exit thermocouples, to preclude misinterpretation due to any inherent deficiencies or inaccuracies in the measurement system selected.

(7) All instrumentation in the final ICC system must be evaluated for conformance to Appendix A*, "Design and Qualification Criteria for Accident Monitoring Instrumentation," as clarified or modified by the provisions of items 8 and 9 that follow. This is a new requirement.

(sic)

Reviewers Note: NUREG-0737 incorrectly references Appendix B -- Appendix A.

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II.F.2 (Continued)

(8) If a computer is provided to process liquid level signals for display, seismic qualification is not required for the computer and associated hardware beyond the isolator or input buffer at a location accessible for maintenance following an accident. The single-failure criteria of Item 2, Appendix A, (sic) need not apply to the channel beyond the isolation device if it is designed to provide 99 percent availability with respect to functional capability for liquid-level display. The display and associated hardware beyond the isolation device need not be Class 1E, but should be energized from a high reliability power source that is battery backed. The quality assurance provisions cited in Appendix A, (sic) Item 5, need not apply to this portion of the instrumentation system. This is a new requirement.

(9) Incore thermocouples located at the core exit, or at discrete axial levels of the ICC monitoring system and that are part of the monitoring system, should be evaluated for conformity with Attachment 1, "Design and Qualification Criteria for PWR Incore Thermocouples," which is a new requirement.

(10) The types and locations of displays and alarms should be determined by performing a human-factors analysis taking into consideration: 40

(a) The use of this information by an operator during both normal and abnormal plant conditions.

(b) Integration into emergency procedures.

(c) Integration into operator training.

(d) Other alarms during emergency and need for prioritization of alarms.

(The referenced Attachment 1 and Appendix A (sic) are attached to NUREG-0737.)

Attachment 1 is also reproduced here.

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Replace with attached response

II.F.2 (Continued)

STP Response

The STP design includes redundant instrumentation to monitor the approach to, existence of and recovery from inadequate core cooling (ICC). The monitored parameters are the reactor coolant system (RCS) subcooled margin, the water level above the reactor core and the RCS temperature at the core exit.

An indication of a declining subcooled margin in the RCS will provide the earliest warning that conditions are developing which could lead to ICC. If the event is allowed to progress, saturation conditions will be observed along with an indication of a declining water level above the reactor core. Reactor vessel water level alone does not identify the existence of ICC, only the potential for ICC. Maintaining the water level at a point above the core is not essential for adequate core cooling. A steam/water froth region extending down into the core could equate to a water level below the top of the core and yet provide adequate core cooling. Only as the top of the froth region drops below the top of the core would ICC tend to occur. RCS pressure and core exit temperatures indicate this phase of the event by a continuing decline in the margin to saturation progressing into the superheat region. Alternatively, the recovery from ICC and the subsequent stages of the event would be monitored to verify that corrective actions taken have resulted in the expected plant response.

The implementation of the instrumentation used for monitoring the RCS subcooled margin, reactor vessel water level, and core exit temperatures has been integrated with the activities of NUREG-0737, Supplement 1 (See Section S.1 through S.5 of Supplement 1 to this appendix) and the implementation of RG 1.97 (see Section 7.5.1 and Appendix 7B). Table 7.5-1 provides information as to instrument ranges, qualifications and display methodology. The Qualified Display Processing System (QDPS), as described in Section 7.5.6, performs the signal processing and display for the instrumentation to detect ICC. The instrumentation to detect ICC is further described below. 40

II.F.2.1 RCS Subcooled Margin

RCS subcooled margin monitoring is a function of the microprocessor-based QDPS. The QDPS is capable of determining the subcooled margin in the RCS based on the lowest measurement of the RCS pressure and the highest measured temperature in the RCS. The temperature used for the most current calculation and the subcooled margin are displayed together on the main control board. Redundant microprocessor systems and sensor devices maintain independence between the separate trains of temperature and pressure data. A diagram indicating the parameters used for the subcooled margin monitor is provided by Figure 7A.II.F.2-1.

II.F.2.2 Reactor Vessel Water Level

To provide the capability for measurement of the reactor coolant inventory in the upper head and plenum regions of the reactor vessel, STP has provided a heated junction thermocouple (HJTC) system supplied by Combustion Engineering, Inc. (C-E). This system includes two identical probe assemblies located 180°

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II.F.2. (Continued)

apart, each in the immediate vicinity of a cold leg inlet. Each probe assembly contains a series of eight HJTC sensors with individual splash shields which are axially distributed inside a separator tube. The HJTC sensor consists of two physically separated thermocouple junctions, one of which is electrically heated. The basic principle of the system is to determine whether or not a sensor is covered with water by detecting the temperature difference between adjacent heated and unheated thermocouples.

The HJTC probe assembly has undergone extensive testing by C-E and has demonstrated its ability to indicate the coolant inventory in the reactor vessel above the core.

When the water level inside the probe falls below a given sensor location during a loss-of-coolant event, the heated junction temperature increases due to the relatively poor cooling ability (lower heat transfer coefficient) of steam versus water. When the relative temperature difference between heated and unheated junctions exceeds a predetermined value, the sensor registers as being uncovered (i.e., surrounded by steam only). Once a sensor becomes uncovered, the potential increase in temperature of the heated junction depends upon the sensor heater power and the pressure. At low pressures, a high heater power can produce excessive junction temperatures and possible sensor failure. Therefore, a heater power control system is used to preclude excessive temperatures. However, should sensor damage occur due to overheating, the loss of a single HJTC sensor within a probe will not seriously compromise 40
the resolution or usefulness of the HJTC probe measurements due to system redundancy and the independence of the sensors within the probe.

The probes for STP are of the "split-probe" design, having two sensors located in the upper head region and six sensors located in the upper plenum region. Sudden depressurization of the upper plenum could result in localized voiding with no immediate comparable occurrence in the upper head region due the limited pressure equlization vent area in the upper support plate. The resulting pressure mismatch could result in ambiguous high indications without the "split-probe" design. This design allows unambiguous indication of water level in either region regardless of their instantaneous relative pressures. The measurement of decreasing water level in either region above the core gives immediate indication to the reactor operator that a loss-of-coolant condition exits and that the approach to ICC is imminent unless proper corrective actions are taken.

Control board displays are in the form of plasma graphic displays integrated in the QDPS showing the reactor vessel and two vertical level indicator columns, one for each HJTC probe. Each column contains a descrete indication corresponding to each of the HJTC sensors in each probe. Hard copy is available in the control room and TSC on records or colorgraphics printers.

A block diagram of the reactor vessel water level indication system is shown in Figure 7A.II.F.2-2.

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II.F.2.3 Core Exit Temperature

The core exit temperature measurement is performed by fifty type K thermocouples. The thermocouples are divided into two redundant groups of twenty five each. Each group takes measurements of all four quadrants of the core. Maximum achievable separation is maintained; however, complete separation is impossible in the reactor vessel head region. Due to spatial limitations, leads from both groups of thermocouples pass through both reactor vessel head penetrations. Above the vessel head, the thermocouple leads from the two groups are handled separately and physical separation is maintained from this point through the QDPS to the displays. A degree of separation is maintained through the vessel head by the use of individual thermocouple leads that are mineral oxide insulated and stainless steel jacketed. 40

A block diagram of the core exit thermocouples is shown in Figure 7A.II.F.2-3.

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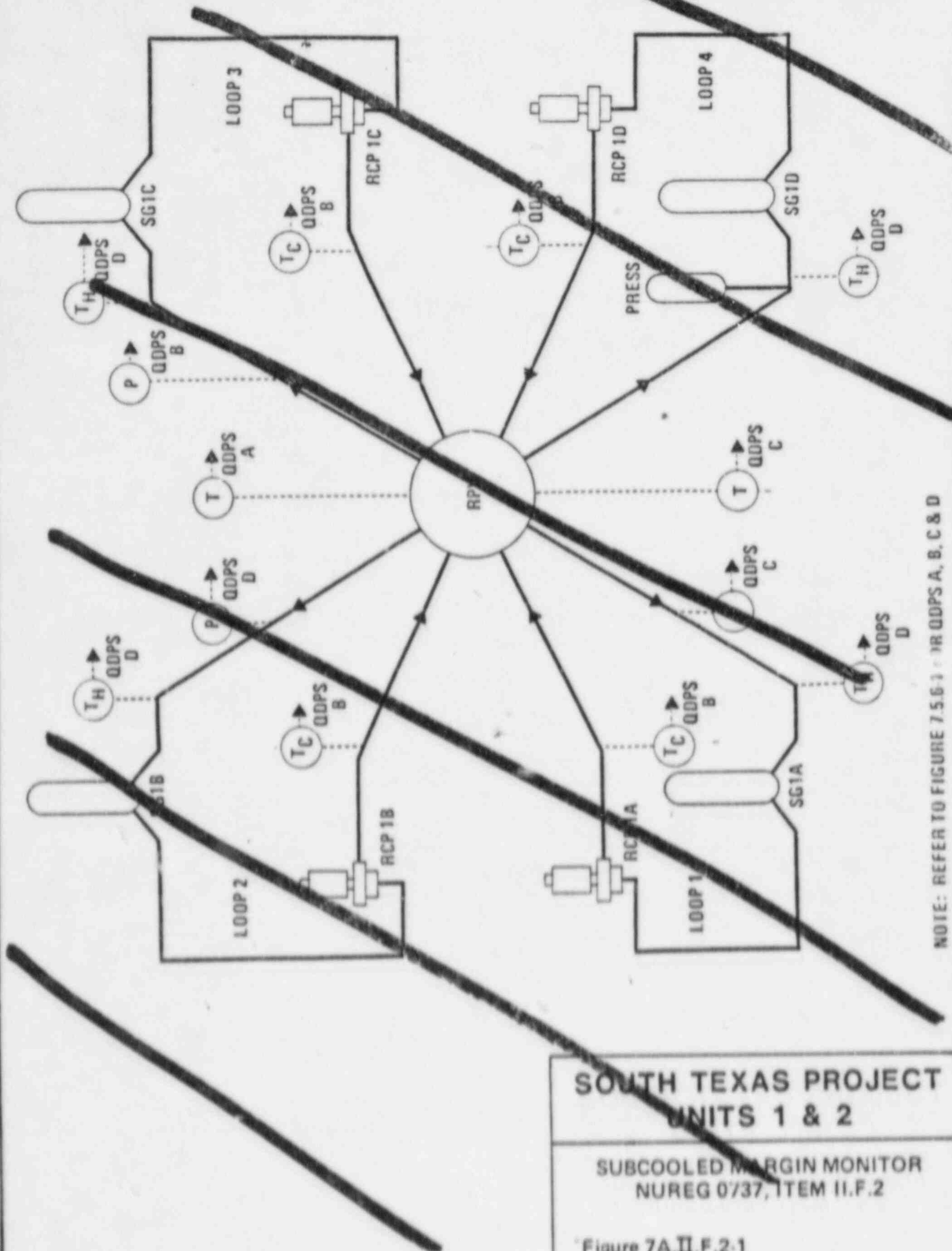

SOUTH TEXAS PROJECT
UNITS 1 & 2

SUBCOOLED MARGIN MONITOR
NUREG 0737, ITEM II.F.2

Figure 7A.II.F.2-1

Amendment 40

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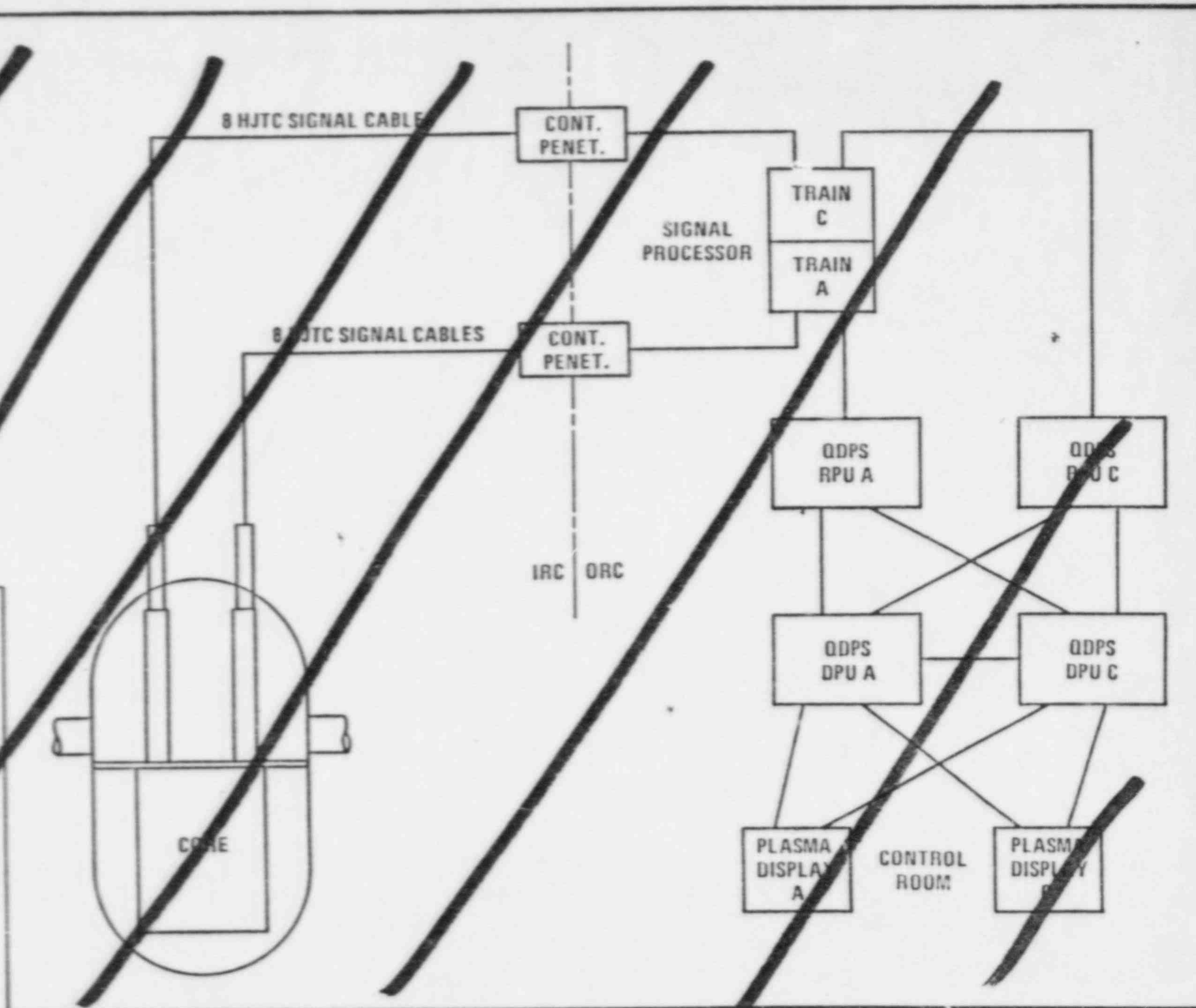

SOUTH TEXAS PROJECT
UNITS 1 & 2

REACTOR VESSEL WATER
LEVEL INSTRUMENTATION

Figure 7A.II.F.2-2

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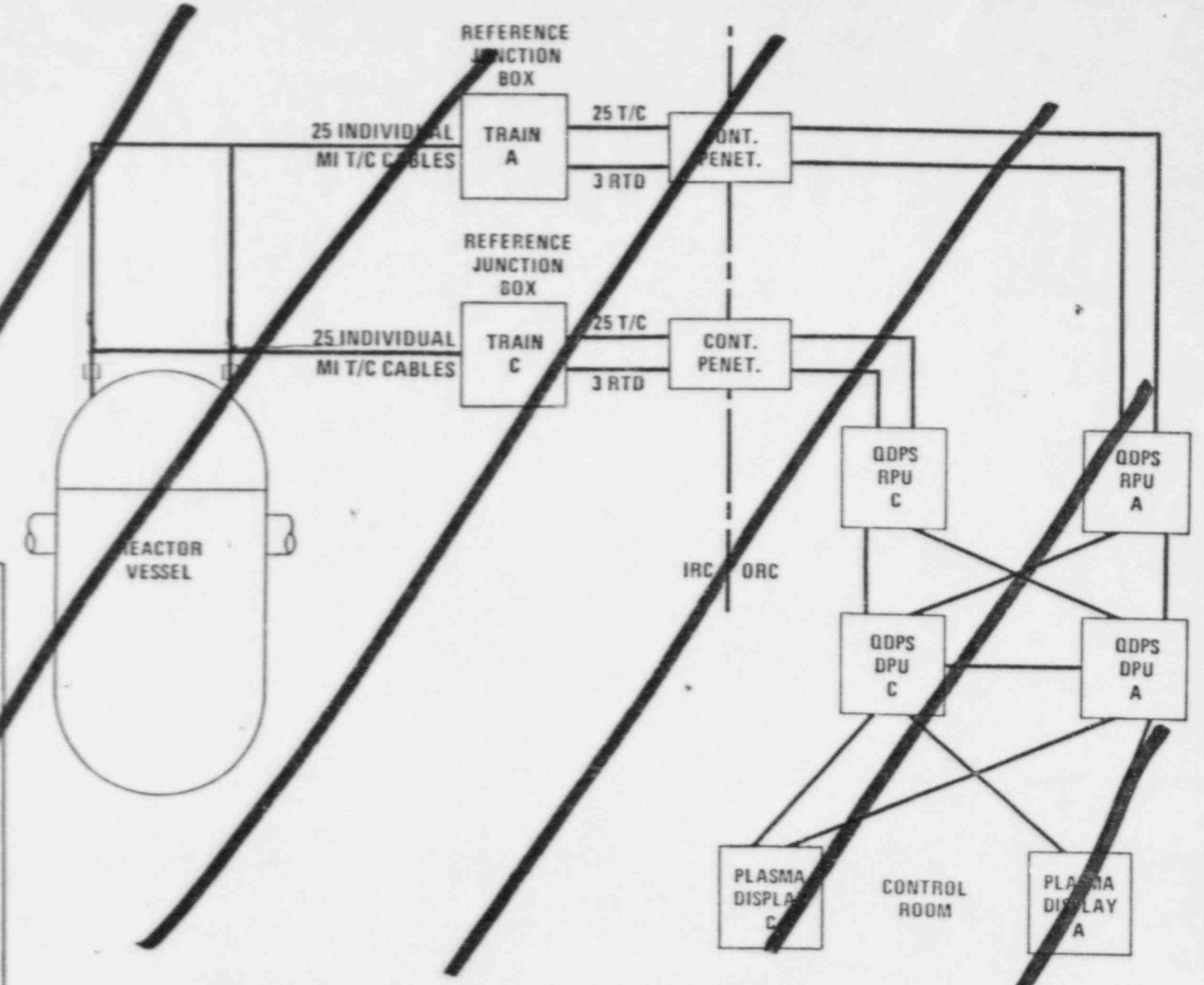

SOUTH TEXAS PROJECT
UNITS 1 & 2

INCORE THERMOCOUPLES
NUREG 0737, ITEM II.F.2

Figure 7A.II.F.2-3

Amendment 40

II.F.2 (Continued)

STP Response

The STP design includes redundant instrumentation to monitor the approach to, existence of and recovery from inadequate core cooling (ICC). The monitored parameters, selected to provide an unambiguous indication of ICC, are the reactor coolant system (RCS) subcooled margin, the water level above the reactor core and the RCS temperature at the core exit.

The implementation of the instrumentation used for monitoring the RCS subcooled margin, reactor vessel water level, and core exit temperatures has been integrated with the activities of NUREG-0737, Supplement 1 (See Section S.1 through S.5 of Appendix 7A) and the implementation of RG 1.97 (see Section 7.5.1 and Appendix 7B). Table 7.5-1 provides information as to instrument ranges, qualifications and display methodology. The Qualified Display Processing System (QDPS), as described in Section 7.5.6, performs the signal processing and display for the instrumentation to detect ICC.

The Inadequate Core Cooling Monitoring System installed on the South Texas project includes the following:

- Core exit thermocouple (T/C) monitoring
- Core subcooling margin monitoring
- Reactor vessel water level monitoring

A detailed system description of each of the above ICC monitoring subsystems is given below:

A. Core Exit Thermocouple System

The core exit thermocouple monitoring system consists of two redundant trains that monitor all 50 of the South Texas Project chromel-alumel core exit thermocouples (25 on each train). A block diagram of the system is shown in Figure 7A.II.F.2-1. The core exit thermocouples are mounted at the top of the core support plate.

The cables from the thermocouples are routed to the in-containment qualified reference junction boxes. Each reference junction box includes three redundant platinum resistance temperature detectors (RTD's) for reference junction temperature compensation.

The uncompensated core exit thermocouple signals and the reference junction box temperature signals are routed to the Class 1E remote processing units (RPU) A and C. Each RPU consolidates the input data, performs conversion to process units, and formats the data for transmission to the Class 1E database processing units (DPU) and to the non-Class 1E Emergency Response Facilities Data Acquisition and Display System (ERFDADS). The RPU to ERFDADS and DPU communications are via isolated RS-422 communication datalinks.

The Class 1E database processing units receive isolated datalink inputs from each RPU and calculate the compensated core exit thermocouple value. The value chosen for the reference junction box temperature is a function of data quality of the three RTD signals.

Following the calculation of all 50 compensated core exit thermocouple values, the information from the DPU's is transmitted to six control room and two auxiliary shutdown panel flat panel QDPS plasma displays. Each DPU also provides isolated analog outputs to drive non-Class 1E recorders in the main control room.

Each plasma display unit displays individual thermocouple temperatures and provides two levels of alarm when pre-set temperatures are exceeded. These plasma display units are seismically and environmentally qualified Class 1E components.

The analog recorders trend the hottest core-exit thermocouple and also the maximum quadrant average core exit T/C temperature.

The equipment used for core exit temperature monitoring (shown in Figure 7A.II.F.2-1) has been designed to meet the intent of IEEE 279-1971 as discussed in section 7.5.6.2.

B. Core Subcooling Margin Monitor

The core subcooling margin monitor is designed to give an early warning to the plant personnel that core conditions are approaching a saturation condition.

The inputs to the core subcooling margin monitor include the following:

- wide range and extended range RCS pressure (3 channels)
- core exit thermocouples (50 channels)
- reference junction box RTD values (6 channels)

A block diagram of the core subcooling margin monitor is shown in Figure 7A.II.F.2-2. One channel of RCS pressure (wide range/extended range) is input into each of RPU B, C, and D. Also 25 uncompensated thermocouple channels and the corresponding three reference junction box RTD signals are input into each of RPU A and C. The outputs of each of the RPU's are routed to each DPU. The core subcooling margin is then calculated using the wide range/extended range RCS pressure and compensated core exit thermocouple readings. The value of RCS pressure utilized in the calculation is the average of the valid pressure signals. The value of core subcooling margin is based upon the auctioneered high quadrant average temperature.

The subcooling margin calculated values are provided as margin to saturation, on all of the plasma displays at the main control room and auxiliary shutdown panel. Alarming functions are provided when the core subcooling margin indication moves into the superheat region.

The equipment used for core subcooling margin monitoring (shown on Figure 7A.II.F.2-2) has been designed to meet the intent of IEEE 279-1971 as discussed in section 7.5.6.2.

C. Reactor Vessel Water Level System

The Reactor Vessel Water Level System (RVWLS) provides the capability for measurement of the reactor coolant inventory in the upper head and plenum regions of the reactor vessel. STP has provided a heated junction thermocouple (HJTC) system supplied by Combustion Engineering, Inc. (C-E). This system measures the water level inventory in the reactor vessel above the upper core alignment plate, even when a steam/water two phase mixture exists in the reactor vessel. This is accomplished by the use of two identical probe assemblies, each containing eight HJTC sensors with individual splash shields which are axially distributed inside a separator tube. The HJTC sensors located inside this separator tube measure the collapsed water level (water inventory) in the reactor vessel above the upper core alignment plate. An HJTC sensor consists of two physically separated thermocouple junctions, one of which is electrically heated.

The basic principle of the system operation is to determine whether a sensor is covered with water by detecting the temperature difference between adjacent heated and unheated thermocouples. When the water level inside the probe falls below a given sensor location during a loss of coolant event, the heated junction temperature increases due to the relatively poor cooling ability (lower heat transfer coefficient) of steam versus water. When the relative temperature difference between heated and unheated junctions exceeds a predetermined value, the sensor registers as being uncovered (i.e. surrounded by steam only).

The probes for STP are of the "split-probe" design, having two sensors located in the upper head region and six sensors located in the upper plenum region. This design allows unambiguous indication of water level in either region regardless of their instantaneous relative pressures. The sensors are located from the top of the vessel down to the top of the fuel alignment plate, giving the operator unambiguous indication of water level during system conditions associated with the approach to and recovery from ICC.

The two upper sensors are located in the uppermost position possible in each region of the probe (one sensor in the upper head region and one sensor in the upper plenum region) to indicate the formation of a void space as early as possible. Two sensors (one in each region) are located as low as practical to indicate the draining of the water inventory in that region. This lower sensor in the upper head is located 2 inches above the reactor vessel closure head mating surface. This elevation is important because when the liquid level falls below the closure head head mating surface, communication between the upper head and downcomer annulus through the orifice holes essentially ceases. The fluid in the "bottom hat" trough does not communicate with any other region in the reactor vessel. Hence, location of a sensor in this region would not provide the reactor operator with any useful information, and quite possibly could be misleading.

There are four other HJTC sensor locations in the lower (upper plenum) portion of each probe. These sensors do not have separator tube flow holes or support tube slots associated with their position. Three of these sensor locations are in the upper plenum at the elevation of the top of the hot leg, centerline of the hot leg and bottom of the hot leg. The sensor location at the top of the hot leg is important since it indicates to the reactor operator when natural circulation cooling is possible. When the water level in the reactor vessel falls below this elevation, the loss of natural circulation becomes imminent. A sensor located at the bottom of the hot leg is important because when the water level drops below this elevation, communication between the liquid inventory in the reactor vessel and the reactor coolant system piping ceases and the water inventory in the reactor vessel may drop more rapidly than before. A liquid level below this elevation implies that core cooling could be threatened. The fourth sensor is positioned half-way between the sensor located at the bottom of the hot leg and the sensor located just above the upper core plate. This sensor location provides continuity in the liquid level indication in the upper plenum. The maximum distance between sensors in the upper plenum is slightly less than 1.5 ft.

The RVWLS system is composed of two trains of HJTC instruments. Each HJTC instrument is assembled into a probe assembly. Each probe has eight electrically independent HJTC sensors as discussed above. Each HJTC train is powered from Class 1E power. The cables from the probes are routed to in-containment qualified junction boxes. The signals are then routed to the Class 1E HJTC processors outside containment. The HJTC processors perform the following functions:

1. Determine if liquid inventory exists at each HJTC sensor position.

2. Provide control of heater power for proper HJTC output signal level.

3. Provide status of each HJTC assembly.

4. Provide a Class 1E redundant datalink with the QDPS, which then transmits the following data for display in the control room:

   a. Temperature of each heated/unheated thermocouple.

   b. Status of each HJTC sensor: covered, uncovered, operating or failed.

   c. Liquid level inventory above the alignment plate.

   d. Liquid level inventory in the upper head.

The QDPS displays items c and d. The ERFDADS displays items a, b, c, and d.

The QDPS provides control room displays showing the reactor vessel and two vertical level indicator columns, one for each HJTC probe. Each column contains a discrete indication corresponding to each of the HJTC sensors in the probe and a percentage indication of the liquid level inventory in the head and plenum areas.

The information transmitted to the QDPS is retransmitted to the non-Class 1E ERFDADS via isolated RS 422 communication datalinks and is then used to provide display capabilities in the Technical Support Center (TSC) and Emergency Operations Center (EOC).

A block diagram of the reactor vessel water level system is shown in Figure 7A.II.F.2-3.

The equipment used for reactor vessel water level monitoring (shown on Figure 7A.II.F.2-3) has been designed to meet the intent of IEEE 279-1971 as discussed in section 7.5.6.2.

NUREG-0737 Required Documentation

Item II.F.2 of NUREG-0737 specifies the following required documentation concerning instrumentation for detection of inadequate core cooling (ICC):

(1) A description of the proposed final system including:

   (a) a final design description of additional instrumentation and displays;

   (b) a detailed description of existing instrumentation systems (e.g., subcooling meters and incore thermocouples), including parameter ranges and displays, which provide operating information pertinent to ICC considerations; and

(c) a description of any planned modifications to the instrumentation systems described in item 1.b above.

(2) The necessary design analysis, including evaluation of various instruments to monitor water level, and available test data to support the design described in item 1 above.

(3) A description of additional test programs to be conducted for evaluation, qualification, and calibration of additional instrumentation.

(4) An evaluation, including proposed actions, on the conformance of ICC instrument system to this document, including Attachment 1 and Appendix A. Any deviations should be justified. (sic)

(5) A description of the computer functions associated with ICC monitoring and functional specifications for relevant software in the process computer and other pertinent calculators. The reliability of nonredundant computers used in the system should be addressed.

(6) A current schedule, including contingencies, for installation, testing and calibration, and implementation of any proposed new instrumentation or information displays.

(7) Guidelines for use of the additional instrumentation, and analyses used to develop these procedures.

(8) A summary of key operator action instructions in the current emergency procedures for ICC and a description of how these procedures will be modified when the final monitoring system is implemented.

(9) A description and schedule commitment for any additional submittals which are needed to support the acceptability of the proposed final instrumentation system and emergency procedures for ICC.

The following is a discussion of each of the above items as they relate to the STP instrumentation for detection of ICC:

(1) The inadequate core cooling systems are described above.

The parameter ranges and the control room displays are summarized in Table 7.5-1.

(2) An indication of a declining subcooled margin in the RCS will provide the earliest warning that conditions are developing which could lead to ICC. If the event is allowed to progress, saturation conditions will be observed, along with indication of a declining water level above the reactor core. Reactor vessel water level alone does not identify the existence of ICC, only the potential for ICC. Maintaining the water level at a point above the core is not essential for adequate core

cooling. A steam/water froth region extending down into the core could equate to a water level below the top of the core and yet provide adequate core cooling. Only as the top of the froth region drops below the top of the core would ICC tend to occur. RCS pressure and core exit temperatures indicate this phase of the event by a continuing decline in the margin to saturation progressing into the superheat region. Alternatively, the recovery from ICC and the subsequent stages of the event would be monitored to verify that corrective actions taken have resulted in the expected plant response.

The ICC instrumentation previously described has been designed to provide these indications of approaching ICC to the operator.

(3) The ICC instrumentation systems have been successfully tested to demonstrate their ability to perform all required functions.

(4) An evaluation of the conformance of the thermocouple/core subcooling margin monitor system and the reactor vessel water level system to NUREG-0737 Attachment 1 and Appendix B is as follows:

(a) Attachment 1, Item (1)

The 50 Class 1E core exit thermocouples are fully qualified and comply with the recommendations of Regulatory Guides 1.89 and 1.100. The thermocouples are located at the core exit and in an arrangement such that each of the redundant microprocessor systems has core exit thermocouples distributed over the entire core, in sufficient number to determine the radial temperature rise across representative regions of the core. Power distribution symmetry was considered in determining proper T/C locations.

The wide range/extended range RCS pressure sensors are located on three separate RCS loops, as shown on Figure 5.1-1.

The RVWLS probes for STP are of the "split-probe" design, having two sensors located in the upper head region and six sensors located in the upper plenum region, ranging from the top of the vessel down to the top of the fuel alignment plate. The two probes are located approximately 180° from each other, in opposite core quadrants.

(b) Attachment 1, Item (2)

The following illustrate the utilization of the ICC QDPS displays when monitoring the STP Critical Safety Function trees.

i. Core Cooling - This display is utilized in monitoring the core cooling status tree. Core exit thermocouple temperature, core subcooling and RVWL indications are utilized.

ii. Inventory - This display is utilized in monitoring the inventory status tree. The only ICC indication utilized is RVWL.

The South Texas QDPS display structure also enables the operators to monitor various subsystems within the plant. Included on these displays is ICC information as follows:

i. RCS - The RCS subsystem display exhibits all of the ICC information, i.e., core subcooling, maximum thermocouple indication and RVWL reading. The associated RCS trend display shows the RVWL variable trends for the previous 30 minutes.

ii. P-T SAT-LMT - The QDPS display structure also includes a pressure-temperature plot as a function of time which illustrates to the operator the RCS temperature margin to saturation. Also illustrated on the display is a digital value corresponding to subcooling margin and auctioneered high quadrant T/C average temperature.

iii. SI TERM/REIN - The STP Emergency Operating Procedures utilize ICC indications for specifying the conditions necessary for safety injection termination and reinitiation.

iv. T/C QUAD TEMP - A QDPS display is also available to the operator which provides a summary of core exit thermocouple quadrant data (minimum, average and maximum reading) and their relationship to RCS hot leg and cold leg wide range temperatures. Also illustrated on the display is a digital value corresponding to subcooling margin.

v. CORE EXIT T/C MAP - A more detailed level of display is also available on the core exit thermocouples. This page provides a core map of all 50 core exit thermocouples at their respective core locations.

vi. T/C TEMP - Finally, a detailed data list of all 50 core exit thermocouples is available. The information provided on this page includes the following: the power train associated with each T/C; the sensor tag number; the T/C location; and the T/C reading in degrees F. Also provided on this page are reference junction box RTD readings.

The QDPS display structure provides an integrated display of all the STP Regulatory Guide 1.97, Rev. 2 Category 1 variables, including the ICC instrumentation. The ICC data, which is displayed in a mimic of the reactor vessel, includes: (1) the maximum core exit T/C temperature; (2) the core subcooling margin; and (3) the RVWL reading.

Alarm capability - The core exit thermocouple display pages are designed such that any numeric thermocouple readout greater than 1200°F will be displayed in inverse video and flashed.

The core subcooling margin will indicate "SUBCOOL" when the auctioneered high quadrant T/C average temperature is at or below the RCS coolant saturation point. "SUBCOOL" and the respective numeric value in degrees F will be displayed in inverse video when the subcooling margin is less than a specified value. "SUPERHEAT" and the respective numeric value in degrees F will be displayed in inverse video and flashed when the auctioneered high quadrant T/C average temperature exceeds the coolant saturation temperature.

Trend Capability - In addition to being displayed on the QDPS, the maximum core exit thermocouple channel, the maximum quadrant average temperature, the RVWL readings and the core subcooling margin are sent to the QDPS recorder demultiplexer in order to obtain a paper copy of the parameter time history of the respective variables.

(c) Attachment 1, Item (3)

Backup Display - Since the STP QDPS features two redundant trains of display, one train of display units is considered the primary display and the other train of display units is considered the backup display. As such, the backup displays for monitoring ICC are also qualified displays. Item (h) below addresses T/C operability.

(d) Attachment 1, Item (4)

Human factors consideration of the types and locations of displays and alarms is discussed in Appendix 7A, Section S.5. The ICC display instrumentation is considered in the overall human factors evaluation.

(e) Attachment 1, Item (5)

Conformance to the specific items of Appendix B of NUREG-0737 is addressed in the analysis presented in Appendix 7B. Table 7.5-1 provides further information as to instrument ranges, qualification, and display methodology.

(f) Attachment 1, Item (6)

The QDPS trains are electrically independent, are energized from independent Class 1E power sources, and are separated in accordance with RG 1.75 except in the reactor vessel head, where the required circuits to the thermocouples are separated to the maximum extent possible. Both the primary and backup displays and associated hardware are Class 1E.

(g) Attachment 1, Item (7)

The instrumentation for ICC monitoring is seismically and environmentally qualified as discussed in Sections 3.10 and 3.11.

(h) Attachment 1, Item (8)

The QDPS and the ICC monitoring instrumentation are designed to provide 99 percent availability for each channel. The operability requirement of a minimum of four thermocouples per core quadrant has been addressed in the Technical Specifications.

(i) Attachment 1, Item (9)

Quality assurance requirements for these instruments are addressed in Appendix 7B.

(5) The QDPS features two redundant trains of Class 1E displays. One train of display units is considered the primary display and the other train of display units is considered the backup display. The QDPS is also datalinked to the ERF computer which performs independent processing of the ICC instrumentation inputs to independently display all required ICC parameters.

(6) The ICC instrumentation will be installed, tested and operational prior to fuel load.

(7&8) The ICC instrumentation is part of the integrated design for STP. Plant specific emergency operating procedures addressing use of the information from the ICC instrumentation system will be developed taking into account recommendations from the C-E generic procedures and from the Westinghouse Owners Group Emergency Response Guidelines. The STP operator training program will include material associated with the use of the ICC instrumentation system.

(9) No additional submittals are anticipated to support the acceptability of the STP ICC instrumentation. Emergency Operating Procedures will be developed and will be available for NRC review as required.

ATTACHMENT 1
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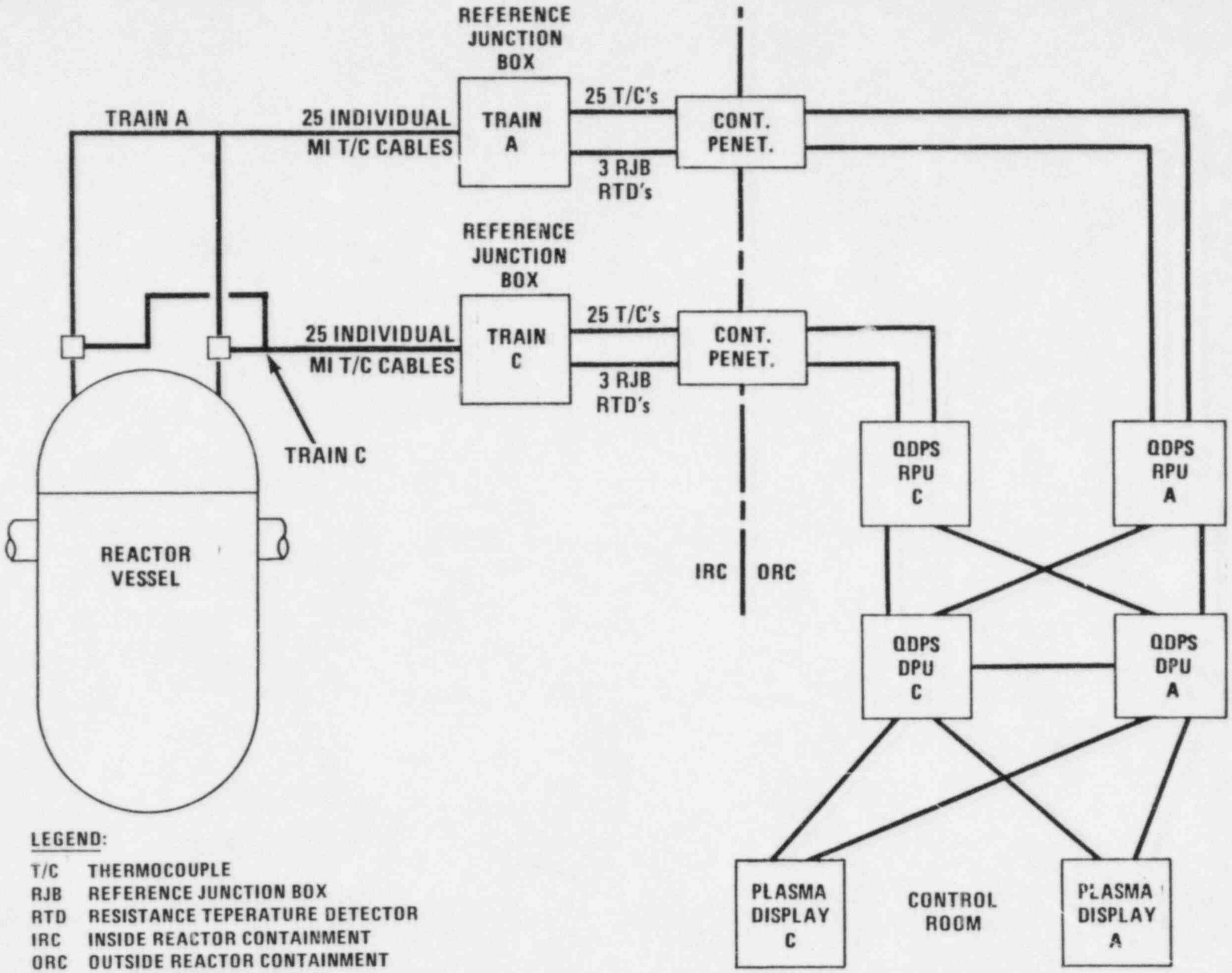


LEGEND:

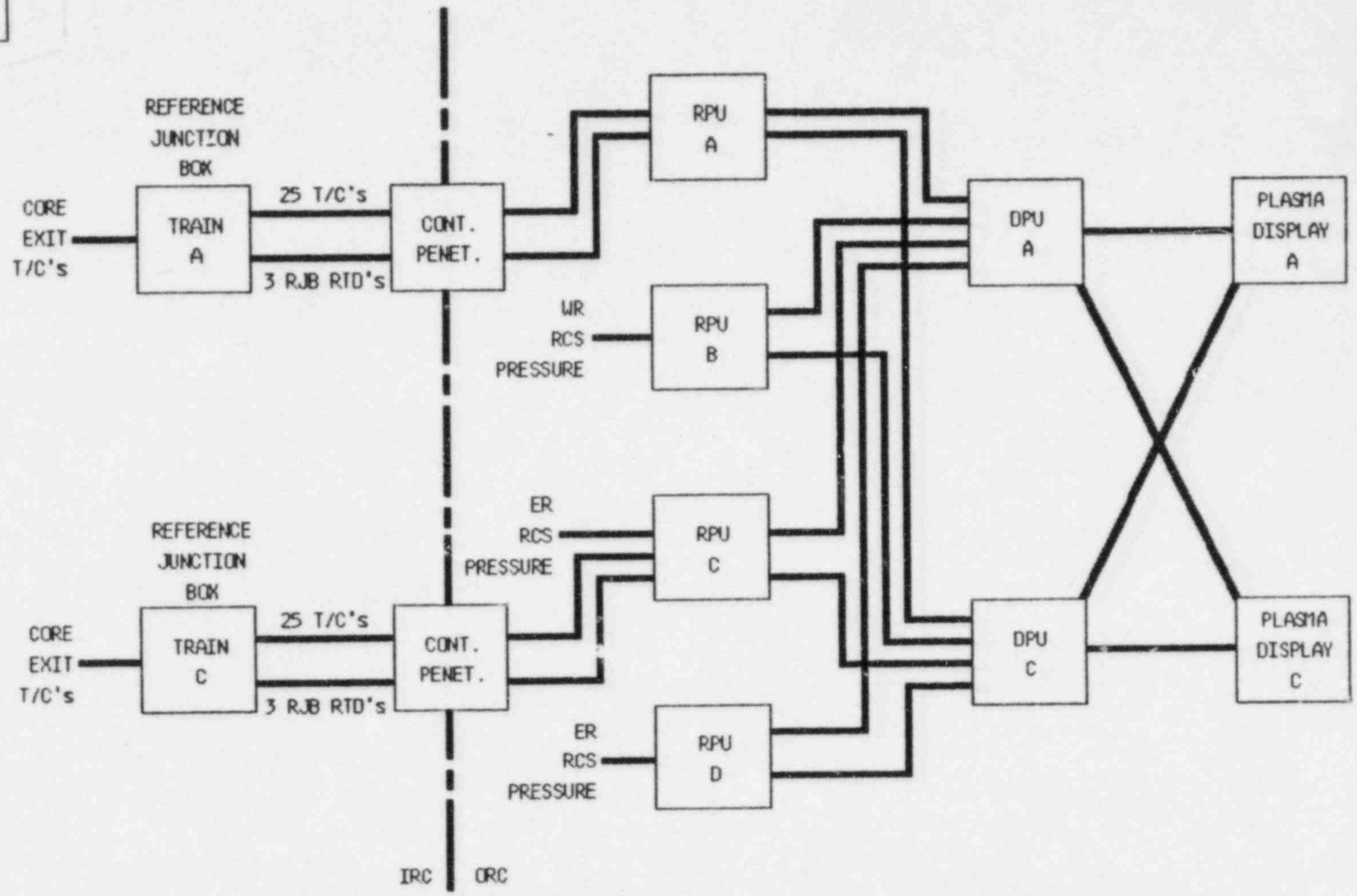
T/C	THERMOCOUPLE
RJB	REFERENCE JUNCTION BOX
RTD	RESISTANCE TEPERATURE DETECTOR
IRC	INSIDE REACTOR CONTAINMENT
ORC	OUTSIDE REACTOR CONTAINMENT
RPU	REMOTE PROCESSING UNIT
DPU	DATABASE PROCESSING UNIT

SOUTH TEXAS PROJECT
UNITS 1 & 2

CORE EXIT THERMOCOUPLE SYSTEM

Figure 7A.II.F.2-1

LEGEND:
SEE FIG. 7A.II.F.2-1
WR WIDE RANGE
ER EXTENDED RANGE



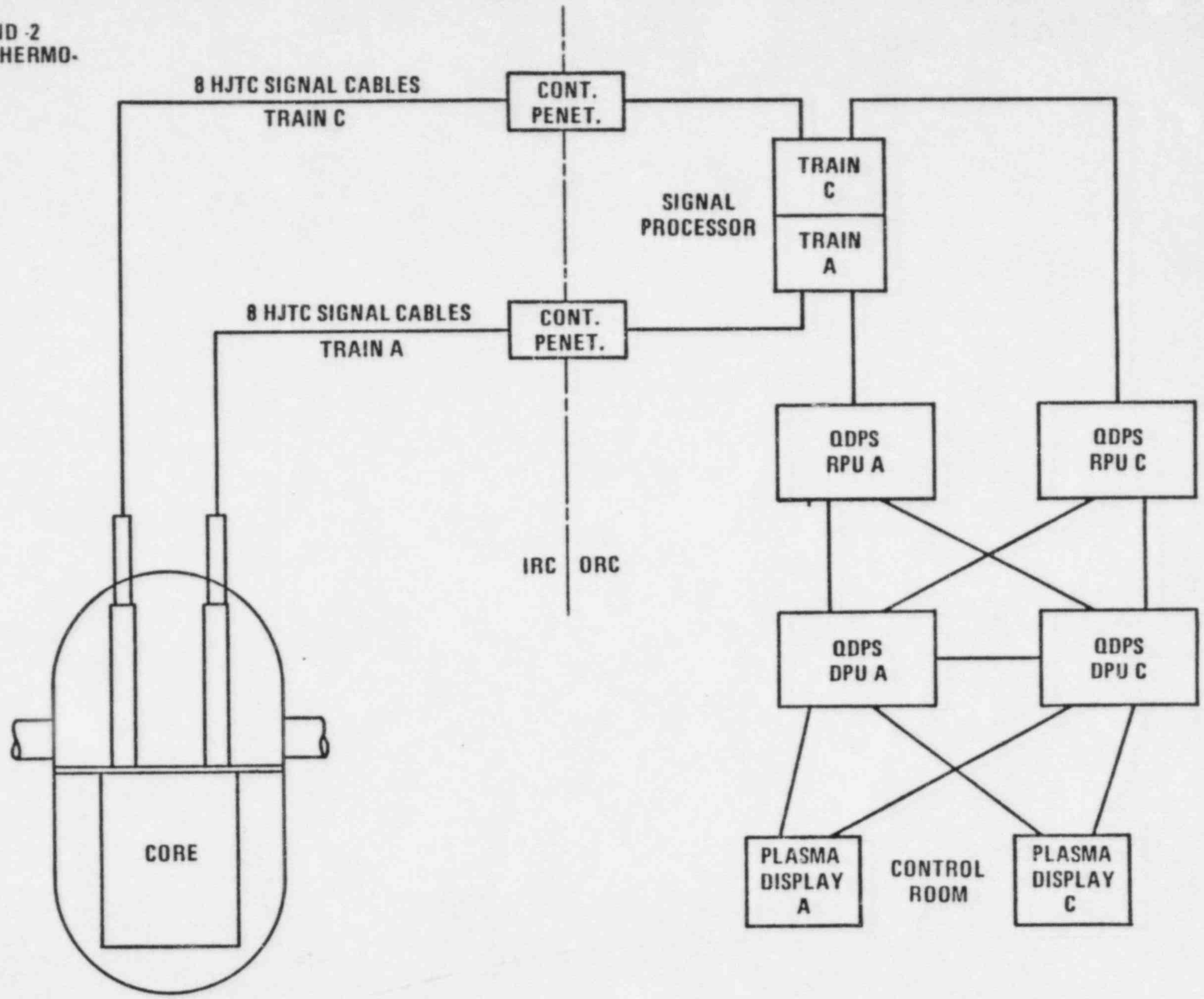
D-1

SOUTH TEXAS PROJECT UNITS 1 & 2

CORE SUBCOOLING MARGIN SYSTEM

Figure 7A.II.F.2-2

LEGEND:
SEE FIGURES 7A.II.F.2-1 AND -2
HJTC HEATED JUNCTION THERMOCOUPLE



SOUTH TEXAS PROJECT
UNITS 1 & 2

REACTOR VESSEL WATER LEVEL INSTRUMENTATION

Figure 7A.II. F.2-3