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RECIP. NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Application to amend to License DPR-23, adding reactor vessel level instrumentation sys operability requirements to Tech Spec Table 3.5-5, "Instrumentation to Follow Course of Accident." Response to NRC 841231 SER also encl. Fee paid.

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TITLE: OR Submittal: Inadequate Core Cooling (Item II.F.2) GL 82-28

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SEP 16 1987 SERIAL: NLS-87-152

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
INADEQUATE CORE COOLING INSTRUMENTATION
GENERIC LETTER 82-28, NUREG-0737 ITEM II.F.2
IMPLEMENTATION LETTER/LICENSE AMENDMENT REQUEST

Gentlemen:

As required by the Commission's December 31, 1984 Safety Evaluation Report (SER) for the Inadequate Core Cooling Instrumentation (ICCI) system at the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR2), Carolina Power & Light Company (CP&L) hereby submits the implementation letter addressing the subjects defined in Enclosure 2 of that SER. Basically, this letter notifies the NRC that CP&L has completed specified actions in preparation for final NRC approval of the ICCI system at HBR2. Enclosure 1 to this letter provides a discussion for each of the subjects specified by that SER.

One of the requirements for this implementation letter was the inclusion of a request for modification of the Technical Specifications to include all ICC instrumentation for accident monitoring. Therefore, in accordance with the Code of Federal Regulations, Title 10, Parts 50.90 and 2.101, CP&L requests a revision to the HBR2 Technical Specifications to incorporate appropriate operability and surveillance requirements for the Reactor Vessel Level Instrumentation System (RVLIS) function of the ICCI system. Specifically, RVLIS operability requirements would be added to Table 3.5-5, "Instrumentation to Follow the Course of an Accident." This change will require at least one operable channel or submission of a special report to the NRC within 14 days if operability cannot be reestablished within 7 days. The change would also incorporate a monthly surveillance check of the system and 18-month calibration requirements within Table 4.1-1, "Minimum Frequencies for Checks, Calibrations, and Tests of Instrument Channels."

SIGNIFICANT HAZARDS ANALYSIS

Carolina Power & Light Company has reviewed the subject TS change request in accordance with the standards set forth in 10 CFR 50.92 and determined that this change does not constitute a significant hazard based upon the following considerations:

1. Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously analyzed because RVLIS improves the operator's capability to recognize the condition of inadequate cooling of the reactor core. Improving the capability to monitor this crucial plant parameter should reduce the probability and potential consequences of previously analyzed accidents.

w/check $150
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2. Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated because the system has been designed and installed with provisions to ensure that it does not adversely affect the plant. Newly installed piping, tubing, conduit, and equipment have been seismically supported to protect other safety equipment. The design ensures that new potential losses of reactor coolant are restricted to within the capacity of the makeup capability of the Emergency Core Cooling System. Furthermore, the RVLIS design has special provisions to prevent potential breaches of containment for either reactor coolant or the containment atmosphere. Finally, the system neither replaces nor shares components with systems that could adversely affect existing capabilities.

3. Operation of the facility, in accordance with the proposed amendment, would not involve a significant reduction in a margin of safety because the system does not interact with or degrade any plant safety equipment.

ADMINISTRATIVE

The TS pages reflecting these changes are provided for your use as Enclosure 3 to this letter. Changes are indicated by a single bar in the right margin. Schedule for implementation of the Technical Specification change must be coordinated with final NRC approvals and subsequent procedural changes required to incorporate the RVLIS in the Plant Operating Manual.

In accordance with 10CFR170.12, a check in the amount of $150 in payment of a license amendment application fee is enclosed.

If you have any questions concerning this request, please contact Mr. S. R. Zimmerman at (919) 836-6242.

Yours very truly,

L. W. Eury
Senior Vice President
Operations Support

ABC/MDM/ppo (5242MDM)

Enclosures

cc: Dr. J. Nelson Grace (NRC-RII)
Mr. K. Eccleston (NRC)
Mr. H. Krug (NRC Resident Inspector - RNP)
Mr. Heyward G. Shealy (SC)
Attorney General (SC)

L. W. Eury, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

Ruby R. Morgan
Notary (Seal)

My commission expires: 11/27/89

RUBY R. MORGAN NOTARY PUBLIC WAKE COUNTY, N.C.

ENCLOSURE 1

CP&L RESPONSE TO ITEMS SPECIFIED BY NRC
SAFETY EVALUATION REPORT OF DECEMBER 31, 1984

(5242MDM/ppo)

ENCLOSURE 1

Item 1: Notification that the system installation, functional testing, and calibration are complete and test results are available for inspection.

Response: The above items are complete and test results are available for inspection.

Item 2: Summary of license conclusion based upon test results, e.g.:

(a) the system performs in accordance with design expectation and within design error tolerances, or

(b) description of deviations from design performance specifications and basis for concluding that the deviations are acceptable.

Response: The HBR2 ICCI system is a standard Westinghouse design and is therefore subject to the same "larger than expected post-accident-induced errors" reported as a 10CFR21 item by Westinghouse on May 9, 1985. Subsequent detailed evaluations conducted by Westinghouse and documented in their February 20, 1986 letter to James M. Taylor of the NRC Office of Inspection and Enforcement, demonstrated that the reduced accuracies achievable with the system are acceptable. That investigation reviewed the functional requirements of the system as specified in the Emergency Operating Procedures (EOP) and verified that the accuracy provided by the Westinghouse ICCI system is adequate to perform these functions. In some cases, revisions of the EOP setpoints may be necessary to account for the additional instrument uncertainty.

On October 24, 1986, Westinghouse provided to CP&L revised accuracy requirements for the HBR2 ICCI system based upon their investigation. The results of the Westinghouse supplied test procedure demonstrate that the system accuracies are within these revised requirements.

Item 3: Description of any deviations of the as-built system from previous design descriptions with any appropriate explanation.

Response: The conceptual design of the ICCI system is basically the same Westinghouse design that was approved in the December 31, 1984 SER. However, several design evolutions have changed the way in which the concept was implemented. In order to facilitate review and ensure that an accurate portrayal of the system is provided, a revised, comprehensive system description has been included as Enclosure 2 to this letter.

The primary differences from the original description result from major upgrades in the ICCI system display equipment and the core exit thermocouple (CET) system. The use of the P-250 plant computer described in the original submittal has been abandoned and the ICCI system electronics have been consolidated into a single cabinet with plasma display capabilities. This modification resolves previous concerns with instrument display scale adequacy and the relative proximity of the various ICCI system components within the control room. It also minimizes impact upon critical control room panel space availability.

In addition, previous concerns regarding the qualification of our Core Exit Thermocouples (CET) in accordance with the requirements of NUREG 0737 have been resolved with the recent effort to upgrade the CETs with a new bottom entry system.

In each case, the changes from the original design description are considered upgrades which improve the system reliability or operability.

<u>Item 4</u>: Request for modification of Technical Specification to include all ICC instrumentation for accident monitoring.

Response: Request for subject license amendment is addressed in the main body of this letter.

<u>Item 5</u>: Request for NRC approval of the plant-specific installation.

Response: This implementation letter provides notification that the necessary tasks have been completed to allow NRC evaluation of the site-specific installation. Formal incorporation of the ICC instrument into the plant procedures and TS is now pending NRC approval of the as-built configuration and capabilities.

<u>Item 6</u>: Confirm that EOPs used for operator training will conform to the technical content of the NRC approved EOP guidelines (generic or plant-specific).

Response: Following NRC approval of the installation, the EOPs will be modified to reflect use of the ICCI system. The revision will conform to the technical content of the NRC approved EOP Guidelines and incorporation of the site-specific evaluation of setpoints with respect to the revised accuracies identified by Westinghouse (see response to Item 2). Operator training will use these revised procedures.

ENCLOSURE 2

REVISED SYSTEM DESCRIPTION AND RESPONSE TO NUREG-0737, ITEM II.F.2 REQUIREMENT

(5242MDM/ppo)

"INSTRUMENTATION FOR DETECTION OF INADEQUATE CORE COOLING"

The following documentation provides a comprehensive-updated version of the ICCI system description including a discussion of compliance with the requirements of the "Documentation Required" section of NUREG-0737, Section II.F.2.

I. Description of System

The Inadequate Core Cooling (ICC) Monitoring System installed at the H. B. Robinson Steam Electric Plant includes the following:

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

A detailed electrical and layout description of each of the above ICC monitoring subsystems is given below:

A. Core Exit Thermocouple Subsystem

The core exit thermocouple subsystem at the H. B. Robinson unit consist of 47 thimble assemblies with Type K chromel-alumel thermocouples at fixed core outlet positions. The core exit thermocouple monitoring subsystem consists of two redundant independent trains that monitor 47 of the chromel-alumel core exit thermocouples (24 on Train A and 23 on Train B). A layout sketch of the system is shown in Figure 1. The train and quadrant orientation of the thermocouples are presented in Table 1 and 2. The core exit thermocouples exit the core through the bottom. Of the 94 thermocouples, an active and spare thermocouple in each of the 47 thimbles exit the vessel and are routed through conduit to the seal table where the thermocouples are terminated with qualified electrical connectors. Beyond the seal table the cables of the active and spare sensors are routed to the intermediate disconnect box and connectors in a manner consistent with the requirements of Regulatory Guide 1.75 to the containment penetrations. The spare sensors will be readily connectable when the active sensor is removed from service. The active uncompensated core exit thermocouple signals, 24 for Train A and 23 for Train B, are then sent to the reference junction box (RJB). Upon exiting the RJB, the cables are routed to containment penetrations where another connector and splice are located. The outputs of this system are then sent to the Inadequate Core Cooling Monitor cabinets for engineering unit conversion, numerical manipulation, and remote display (Figure 2).

The thermocouples have a range of greater than 40°F to 2300°F. The thermocouple data is presented in various formats on the plasma displays for quick reference by the operating staff. The display pages contain the following information.

Core Cooling 1 (Figure 3) - Summary Display - core exit temperature, based on an average of the five highest thermocouples in a train, and wide range RCS pressure including presentation of the various curves which include saturation and subcooling.

Core Cooling 2 (Figure 4) - Average five highest CET temperature Temperature Trending - a thirty-minute trend history of the average five highest CET temperature, including identification of the location of the five hottest valid thermocouples.

Core Cooling 3 (Figure 5) - Core Temperature Map - quadrant core exit thermocouple values (maximum, average, minimum), and subcooling margins.

Core Cooling 4 (Figure 6) - Core Exit Thermocouple Map - spatially oriented thermocouple readings; one display is provided for each train of thermocouples.

Core Cooling 5 (Figure 7) - Core Exit Thermocouple Listing - lists thermocouple location, tag designation, and sensor reading per quadrant, one for each train.

Core Cooling 6 (Figure 8a and 8b) - Train A diagnostic page with status codes for use in equipment servicing. Since these are primarily maintenance-related displays, the control room operating staff would not normally use this display page.

B. Core Subcooling Margin Monitor

The inputs, on a train basis, to the core subcooling margin monitor include the following:

- Wide range RCS pressure (1 channel)
- Core exit compensated thermocouple values (average of the five hottest thermocouple channels)

The RCS subcooling margin is calculated based upon the wide range RCS pressure and the average of the five hottest compensated core exit thermocouple readings. There is also a subcooling margin based on RCS hot leg temperature. (See Figures 3 and 5.) The value of RCS pressure utilized in the calculation is the output of the data quality algorithm implemented in the subcooling margin monitor. The subcooling margin calculated values are routed to the plasma displays where they are presented on various display pages. Additionally, the subcooling margin is displayed at the main control board. The cable routing from sensor input to display meet the requirements of Regulatory Guide 1.75.

The upper and lower range limits of the core subcooling calculation are adjustable up to a reactor coolant system pressure of 3000 psig. The Regulatory Guide 1.97 limits of 200°F subcooling and 35°F superheat can be accommodated by this calculation. The calculated value is displayed on Core Cooling 1, 2, and 3 (Figures 3, 4, and 5, respectively).

C. Reactor Vessel Level Instrumentation System

The Reactor Vessel Level Instrumentation System (RVLIS) consists of two redundant independent trains that monitor the water level in the reactor vessel.

The system provides the operating staff with three instrumentation ranges. The full range RVLIS reading provides an indication of reactor vessel water level from the bottom of the vessel to the top of the vessel during natural circulation conditions. The upper range reading provides an indication of reactor vessel level from the top of the hot legs to the top of the vessel, also during natural circulation conditions. The dynamic head RVLIS reading provides an indication of reactor core internals and outlet nozzle pressure drop for any combination of operating reactor coolant pumps. Comparison of the measured pressure drop with the normal, single-phase pressure drop provides an approximate indication of the relative void content of the circulating fluid. The inputs to the RVLIS system on a train basis include the following:

1. Wide- range RCS hot leg temperature (1 signal).
2. RVLIS capillary line RTD (5-Train A, 3-Train B).
3. Wide-range RCS pressure (1 signal).
4. Differential pressure (3 signals).,
5. RVLIS hydraulic isolator contacts (3 signals)

All calculated RVLIS values are sent to the remote plasma displays for presentation on the train-oriented display pages and on the main control board indicators. The cable routing from sensor input to display meet the requirements of Regulatory Guide 1.75.

The range of the full-range reading extends from 0 to 120% of the reactor vessel height. The upper range reading extends from approximately 60% of the vessel height, corresponding to the top of the hot leg, to 120% of vessel height. The range of the dynamic head channels corresponds to 0 to 120% of the delta-p under the reference unvoided, 0% reactor power conditions. The range maxima were selected to bound the cases of operation under conditions differing from these reference conditions. These ranges will bound all conditions differing from the reference calibration conditions.

RVLIS readings are presented on the following four displays dedicated to RVLIS indications:

RVLIS 1 (Figure 9) - RVLIS Summary Page - the current full range, upper range, and dynamic head readings are displayed. When reactor coolant pumps are not operating, the full and upper range readings are the appropriate ranges to be used by the operating staff. Under these circumstances, the dynamic head reading is forced to the "all RCPs off" location on the dynamic head meter display to prevent use of inappropriate data. Similarly, when any combination of reactor coolant pumps are operating the dynamic head reading is appropriate, and the full and upper range readings are forced to the "RCPs on" location of their respective scales. In addition, current RCP status is displayed separate from the scales for easy determination by the operating staff of the proper scale to be used.

RVLIS 2 (Figure 10) - RVLIS Dynamic and Full Range Level Trending - a thirty-minute trend history of percent reading for dynamic head and present level static head readings, including sensor quality data tagging. Display input is driven to the bottom of each trend when the status of the reactor coolant pumps causes the trending information to be no longer applicable.

RVLIS 3 (Figure 11) - Reactor Vessel Level Instrumentation Fluid System Layout Drawing - provides a schematic presentation of the RVLIS sensor layout, the status of the impulse line RTDs, hydraulic isolators, and differential pressure transmitters. Additionally, wide-range RCS pressure and hot leg temperature current values are displayed with their status.

RVLIS 4 (Figure 12) - Train A diagnostic page with readings and status codes for use in equipment servicing. Not used by the control room operating staff.

II. Design Analyses and Test Data

Several analyses have been performed to verify the design of the RVLIS system described in Item I.C. The results of these are discussed in the following documents:

A. Summary Report, Westinghouse Reactor Vessel Level Instrumentation System for Monitoring Inadequate Core Cooling, December 1980 submitted to the NRC via T. M. Anderson to Darrell G. Eisenhut, NS-TMA-2358, dated December 23, 1980, including informal response to NRC Request for additional information on the Westinghouse RVLIS.

B. Supplemental Information on the Westinghouse RVLIS, submitted to the NRC via E. P. Rahe to L. E. Phillips, NS-EPR-2579, dated March 19, 1982.

C. Westinghouse Evaluation of Inadequate Core Cooling Instrumentation Accuracy Requirements, submitted to the NRC via E. P. Rahe to J. M. Taylor, NS-NRC-86-3099, dated February 20, 1986.

In addition to the analyses and evaluations conducted in the three references above, the hydraulic components of the RVLIS system were installed at the Semiscale Test Facility in Idaho so that transient response characteristics could be obtained during small-break LOCA and other accident conditions. A description of the tests conducted and a discussion of the test results are presented in the following documents:

D. Westinghouse Evaluation of RVLIS Performance at the Semiscale Test Facility, December 1981 submitted to the NRC via E. P. Rahe to L. E. Phillips, NS-EPR-2526, dated December 8, 1981.

E. Westinghouse Evaluation of RVLIS Performance at the Semiscale Test Facility for Test S-UT-8, January 1982 submitted to the NRC via E. P. Rahe to L. E. Phillips, NS-EPR-2542, dated January 13, 1982.

F. Westinghouse Evaluation of RVLIS performance at the Semiscale Test Facility for Test S-IB-7 submitted to the NRC via E. P. Rahe to L. E. Phillips, SED-SA-00081, dated June 28, 1982.

Core exit temperature and subcooling margin monitoring rely on direct RCS process measurement do not involve significantly new design principles. As such, no system testing is necessary.

III. Future Testing

The acceptability of the RVLIS transient response has been shown in the Idaho semiscale testing. As noted above, core exit temperature and subcooling margin monitoring do not involve significantly new design principles. As such, no additional testing is necessary for any of the 3 ICCI subsystems.

IV. Response to II.F.2, Attachment I, Design and Qualification Criteria for Pressurized Water Reactor Incore Thermocouples

A. Thermocouple Location

The H. B. Robinson plant has 94 thermocouples, 48 per train A and 46 per Train B, spread uniformly across the core. Forty-seven thermocouples are active and the remaining 47 are reserved as spares. Locations are such that during the plant life, when power distributions vary from reload to reload, adequate information is provided to the staff to indicate a relative radial distribution of the core exit temperature. The radial distribution is as shown in Figure 6 (Core Cooling 4) for a single train.

B. Primary Operator Display Capabilities

Remote plasma displays with access to each of the ICCMS display pages in a single train is the primary means of operator display. As shown in Figure 6 (Core Cooling 4), a spatially oriented core map, available on demand, indicating temperature at the core exit, is provided for Train A. Core exit temperature at each of the locations can be displayed continuously. In addition, the average temperature of the five hottest valid thermocouples is provided on Core Cooling 1 (Figure 3), Core Cooling 2 (Figure 4), and the control board for use with the plant-specific inadequate core cooling procedures. Trending capability is provided for a period of 30 minutes, as shown in Core Cooling 2 (Figure 4). Eight analog outputs per train of the ICCM electronics are reserved for a recorder. The low and high current limits of the analog signal correspond to a temperature range of 80°F to 2300°F. Rapid access to the core exit temperature displays is provided by a single key to the core cooling displays and a page key allowing quick transfer from one display to another.

C. Backup Display Capability

The local display at the ICCM is the fully qualified backup display. The operators have access, via thumbwheel switches, to all thermocouple values in engineering units and will be able to access at least four thermocouples per quadrant in less than six minutes. The range is greater than 40 to 2300°F.

D. Types and Locations of Displays

The display pages are described in Section I, above, and shown in Figures 3 through 8 for core cooling and Figures 9 through 12 for the RVLIS.

The readings displayed by the ICCMS can be used directly by the operating staff while implementing the emergency operating procedures. The five hottest thermocouples are presented on Core Cooling 2 (Figure 4) for use in

determining an inadequate core cooling condition, consistent with the emergency procedures. The subcooling and RVLIS readings can be used directly to evaluate the respective procedure steps using these indications.

Alarms for core exit thermocouples, RCS subcooling, and RVLIS are not utilized in the steps of the emergency procedures in order to alert the operating staff.

V. Response to II.F.2, Appendix B, Design and Qualification for Accident Monitoring Instrumentation

1. Equipment Qualification

Listed below are the appropriate documents indicating the qualification tests conducted on the ICCI subsystems.

a. Core Exit Thermocouple Monitoring

	Component	Document
1.	Connectors	ESE-43B
2.	Splices	ESE-43G
3.	Microprocessors and cabinets	ESE-53
4.	Modular Plasma Display	ESE-61A

b. Core Subcooling Margin Monitoring

	Component	Document
1.	Wide-Range RCS Pressure	ESE-1A
2.	Connectors and Splices	Same as above
3.	Microprocessors	ESE-53
4.	Plasma Display	ESE-61A

c. RVLIS Monitoring System

	Component	Document
1.	Wide-Range RCS Pressure	ESE-1A
2.	Differential Pressure	ESE-4
3.	Connectors and Splices	Same as above
4.	Hydraulic Isolator	ESE-49
5.	Reference Leg RTDs	ESE-42
6.	Microprocessors	ESE-53
7.	Plasma Display	ESE-61A

2. Single Failure Criteria

RVLIS, subcooling margin monitors, and inadequate core cooling monitors are train oriented and therefore meet the single failure criteria.

3. Power Supply

The ICC monitors and plasma displays for both trains are powered by 120 VAC vital buses.

4. Channel Availability and Indication

The operator has access to ICCI channels, both pre- and post-accident, on the displays discussed in this report.

5. Quality Assurance

Hardware associated with the ICCMS meets the applicable portions of the quality assurance regulatory guides.

6. Indication

Direct readout is provided through the plasma graphics. Hard copy capability is provided via data links to the ERFIS computer or thermocouple recorder.

7. Isolation

Electrical isolation is provided in the ICCM electronics to prevent any credible faults that could cause a system failure. Isolation is provided as shown in Figure 2.

8. Capability for Sensor Checks

The ICC monitor provides the means for quality coding ICCMS outputs. Quality codes that include GOOD, POOR, BAD, SUSPECT, are displayed on the various plasma display pages (Figures 4 & 10). Reverse video of the codes is also used as shown on Figures 6, 9, and 11.

9. Capability for Test and Calibration

Servicing, testing, and calibration programs are specified to maintain the capability of the monitoring instrumentation. In addition, a self-testing capability has been provided. This consists of the sensor data checks described above, continuous program diagnostics and self-calibration. Program diagnostics check for system memory failure, mathematical errors, clock and timing errors. Self-calibration is performed serially on each channel. One channel is taken off line at a time to minimize the impact of the self-test on the ability of the system to monitor the plant. The self-calibration is initiated every 12 hours. By this self-calibration, the effects of drift are essentially eliminated in the analog portion of the hardware.

10. Channel Removal from Operation

Whenever means for removing channels from service are included in the design, the design facilitates administrative control of the access of such removal.

11. <u>Access to Setpoints Adjustments, Calibration, and Test Points</u>

The design facilitates administrative control of the access to setpoint adjustments, module calibration adjustments, and test points.

12. <u>Information Readout</u>

The monitoring instrumentation design utilizes human-factored displays to minimize indications potentially confusing to the operator.

13. <u>System Repair</u>

The instrumentation is designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components of modules.

14. <u>Derivation of System Inputs</u>

To the extent practicable, monitoring instrumentation inputs are from sensors that directly measure the desired variables. An indirect measurement is made only when it can be shown by analysis to provide unambiguous information.

15. <u>Instrumentation Utilization</u>

To the extent practical, the ICCMS has been designed and located in such a manner that the operator uses the ICCMS displays during both normal operation and post accident situations.

16. <u>Periodic Testing</u>

Periodic checking, testing, and calibration verification capabilities are in accordance with the applicable portions of Regulatory Guide 1.118.

VI. <u>Integration with Emergency Operating Procedures</u>

The H. B. Robinson Steam Electric Plant has adopted the format and content of the Westinghouse Owners' Group (WOG) Emergency Response Guidelines for writing the plant-specific emergency operating procedures. Variables necessary to implement the core cooling status tree are provided by the ICC instrumentation system. The Functional Restoration Guideline, to which the operator is directed based upon the logic dictated by the tree, also utilizes the information provided by the ICC instrumentation.

Train A Core Locations

Quadrant I	Quadrant II	Quadrant III	Quadrant IV
B07	B10	J12	H04
D03	C08	J15	J03
D05	D12	L08	L06
F04	E11	L11	M03
F06	F09	N10	N07
G07	F13	R08	
	H11		

LO5 - no thimble, RVLIS pressure sensing line connection

Train B Core Locations

Quadrant I	Quadrant II	Quadrant III	Quadrant IV
B05	A09	H13	H01
B08	C12*	J10	J05
D07	D10	L09	J07
E05	F11	L14	L04
F02	G09	N12	N05
F08	G14		N08
H03*			
H06			

*Not installed - thimbles were too long

Table 1 - Thermocouple Orientation by Train and Core Quadrant

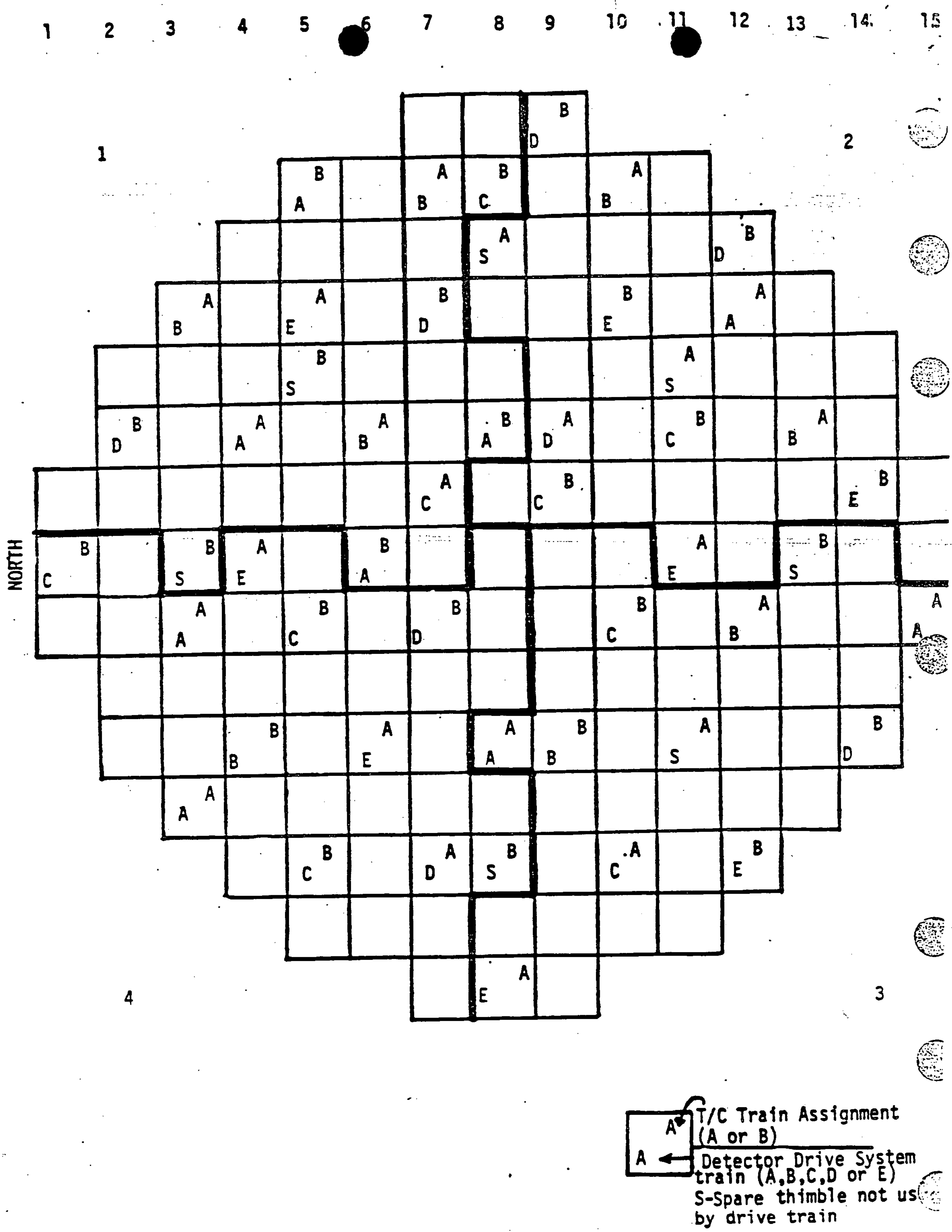


TABLE 2: THERMCOUPLE CORE MAP

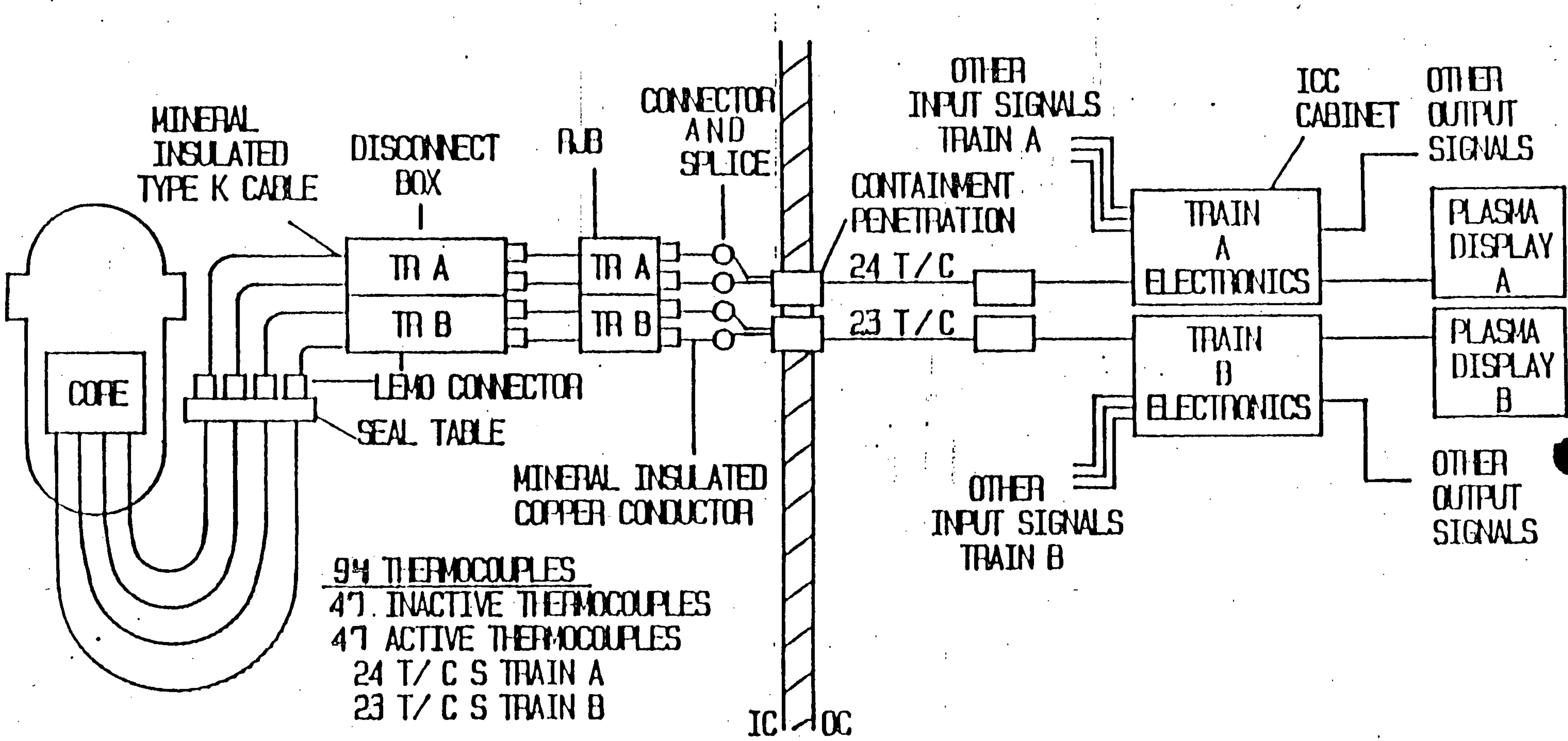


FIGURE 1: SCHEMATIC DIAGRAM OF BOTTOM-MOUNTED INCORE THERMOCOUPLE SYSTEM

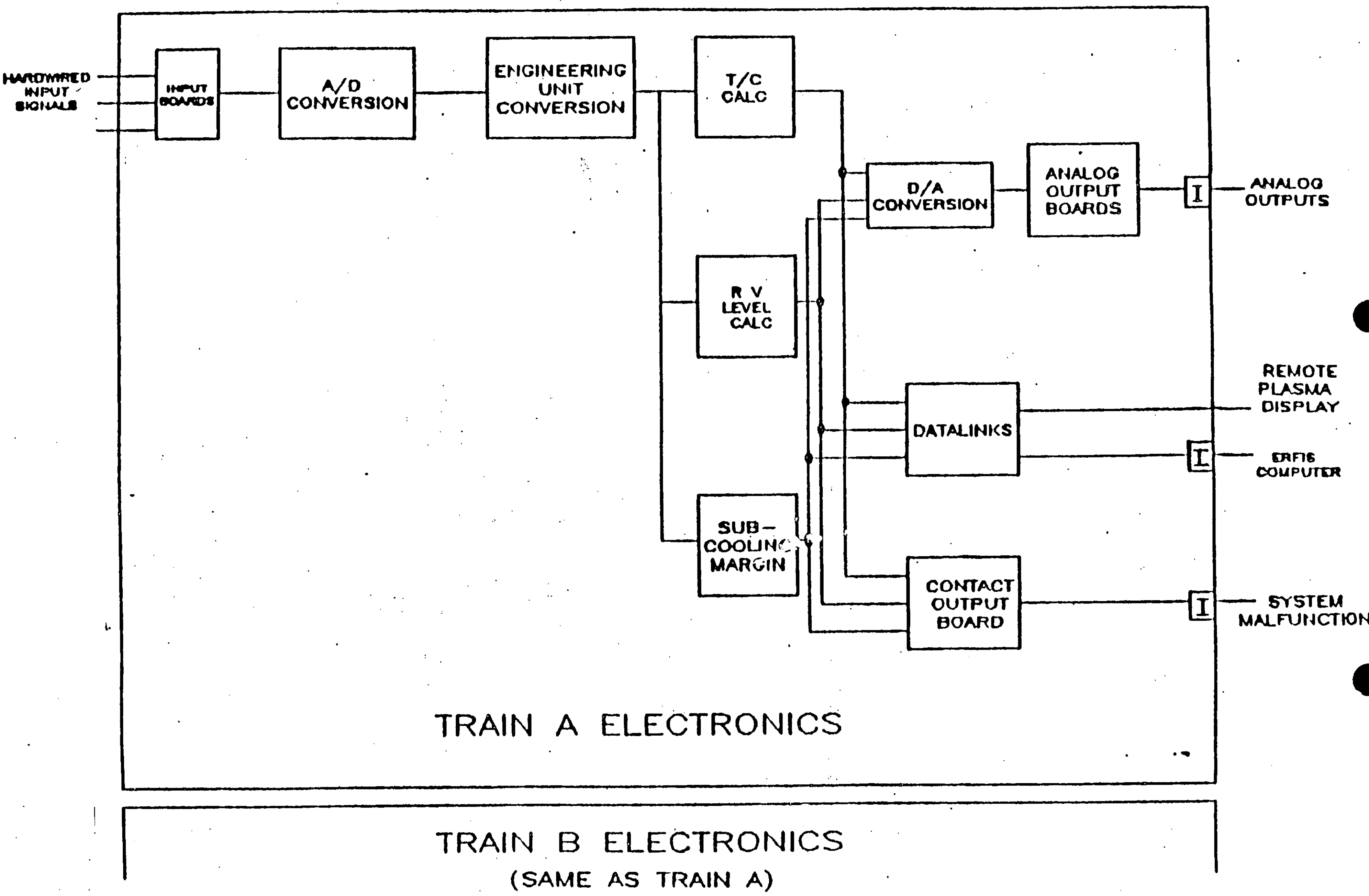


FIGURE 2 SIMPLIFIED DIAGRAM OF ICCI ELECTRONICS

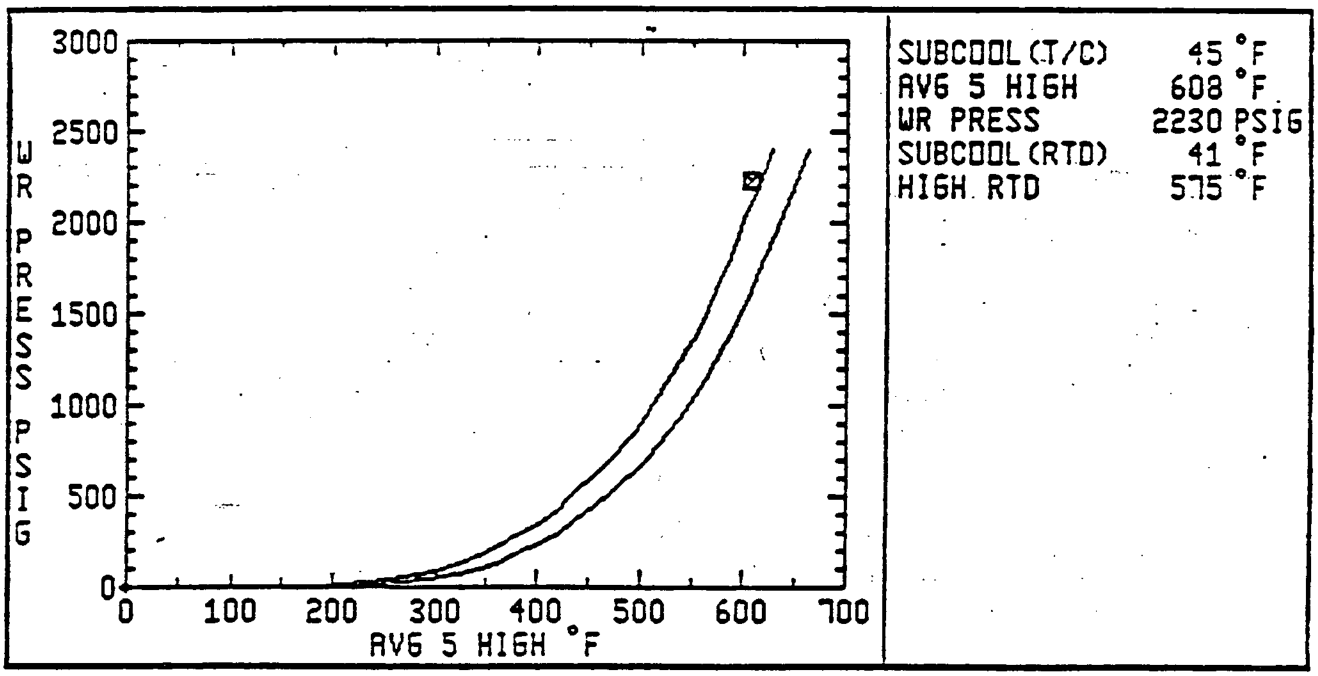


FIGURE 3-Core Cooling 1

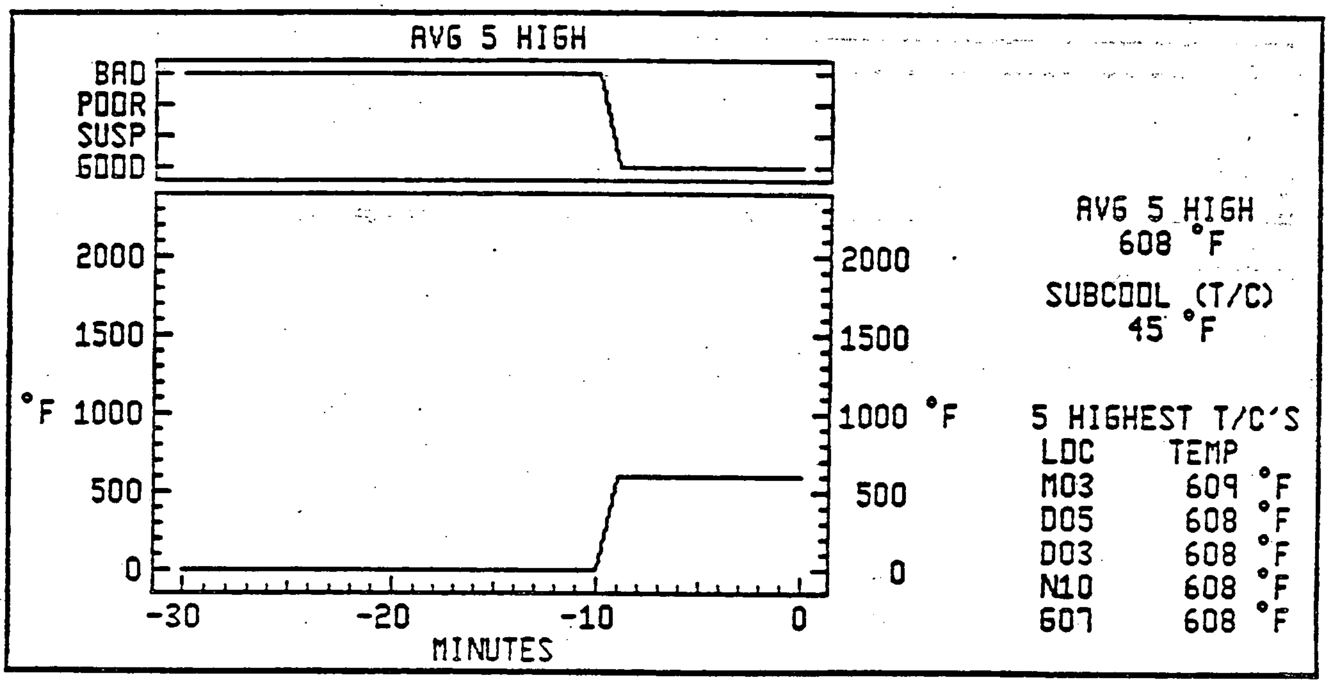


FIGURE 4-Core Cooling 2

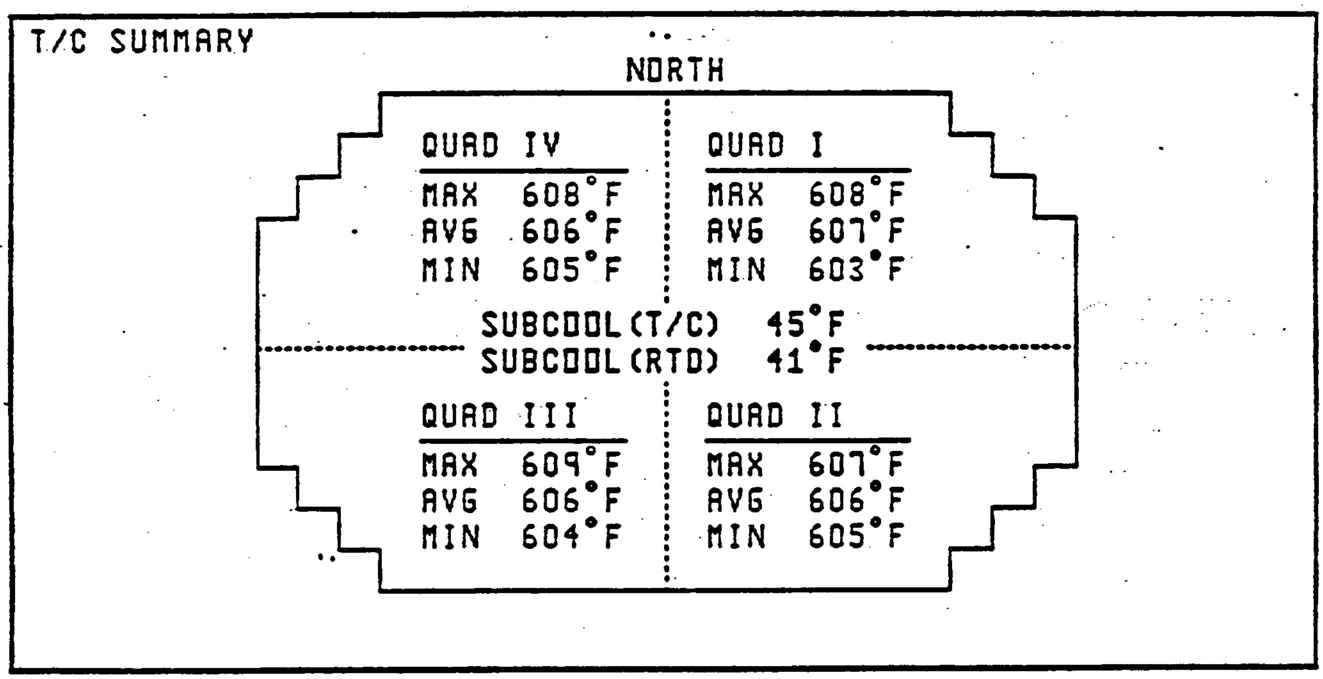
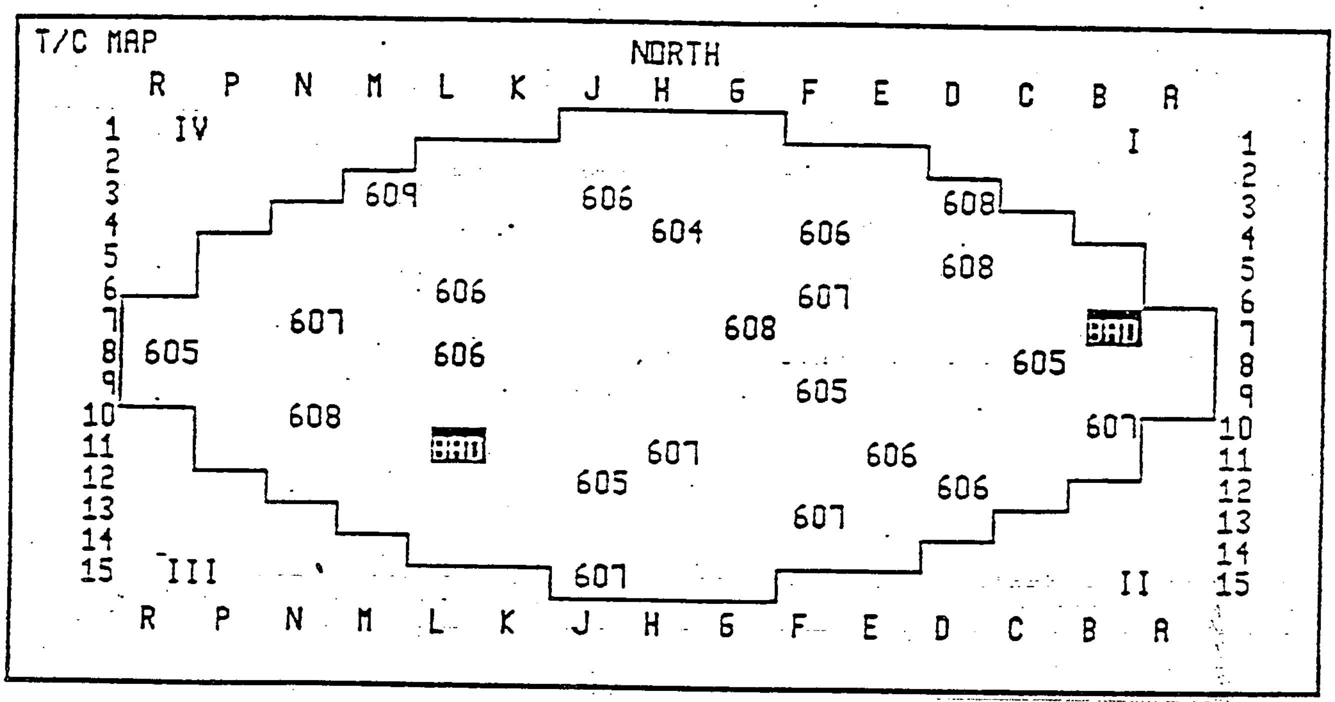


FIGURE 5 – Core Cooling



B7 & L11 Locations are Operable - "BAD" Display Indicates
Appearance of an Out of Limits Display

FIGURE 6-Core Cooling 4

QUAD I		QUAD II		QUAD III		QUAD IV	
LOC	°F	LOC	°F	LOC	°F	LOC	°F
B07	603	B10	607	J12	605	H04	604
				J15	607		
D03	608	C08	605			J03	606
D05	608			L08	606		
		D12	606	L11	607	L06	606
F04	606						
F06	607	E11	606	N10	608	M03	609
G07	608	F09	605	R08	605	N07	607
		F13	607				
		H11	607				

FIGURE 7-Core Cooling 5

THERMOCOUPLE DIAGNOSTIC PAGE 1 TIME 10:13:42

B07	603.318	30	C0	H04	604.476	30	00	TE-523	98.266	30	00
B10	607.286	30	00	H11	607.294	30	00	TE-524	100.486	30	00
C08	605.002	30	00	J03	606.299	30	00	TE-525	99.863	30	00
D03	608.387	30	00	J12	605.250	30	00				
D05	608.739	30	00	J15	607.017	30	00				
D12	606.283	30	00	L06	606.374	30	00				
E11	606.835	30	00	L08	606.843	30	00				
F04	606.473	30	00	L11	607.294	30	C0				
F06	607.171	30	00	M03	609.390	30	00				
F09	605.945	30	00	N07	607.294	30	00				
F13	607.023	30	00	N10	608.203	30	00				
G07	608.012	30	00	R08	605.973	30	00				

DIAGNOSTIC INFORMATION

FIGURE 8a-Core Cooling 6

THERMOCOUPLE DIAGNOSTIC PAGE 2 TIME 10:13:42

MAX I	608.739	30	00
AVG I	607.017	30	00
MIN I	603.318	30	00
MAX II	607.294	30	00
AVG II	606.523	30	00
MIN II	605.002	30	00
MAX III	609.390	30	00
AVG III	606.767	30	00
MIN III	604.476	30	00
MAX IV	608.203	30	00
AVG IV	606.841	30	00
MIN IV	605.250	30	00

AVG 5 HIGH	608.546	30	00
SUBCOOL(T/C)	45.780	30	00
SUBCOOL(RTD)	41.293	30	00

TCHOT1	M03	609.390
TCHOT2	D05	608.739
TCHOT3	D03	608.387
TCHOT4	N10	608.203
TCHOT5	G07	608.012

B07	(AD)	603.318	G07	(AD)	608.012
B10	(AD)	607.286	H11	(AD)	607.294
H04	(AD)	604.476	N07	(AD)	607.294
J12	(AD)	605.250	R08	(AD)	605.973

DIAGNOSTIC INFORMATION

FIGURE 8b–Core Cooling 6

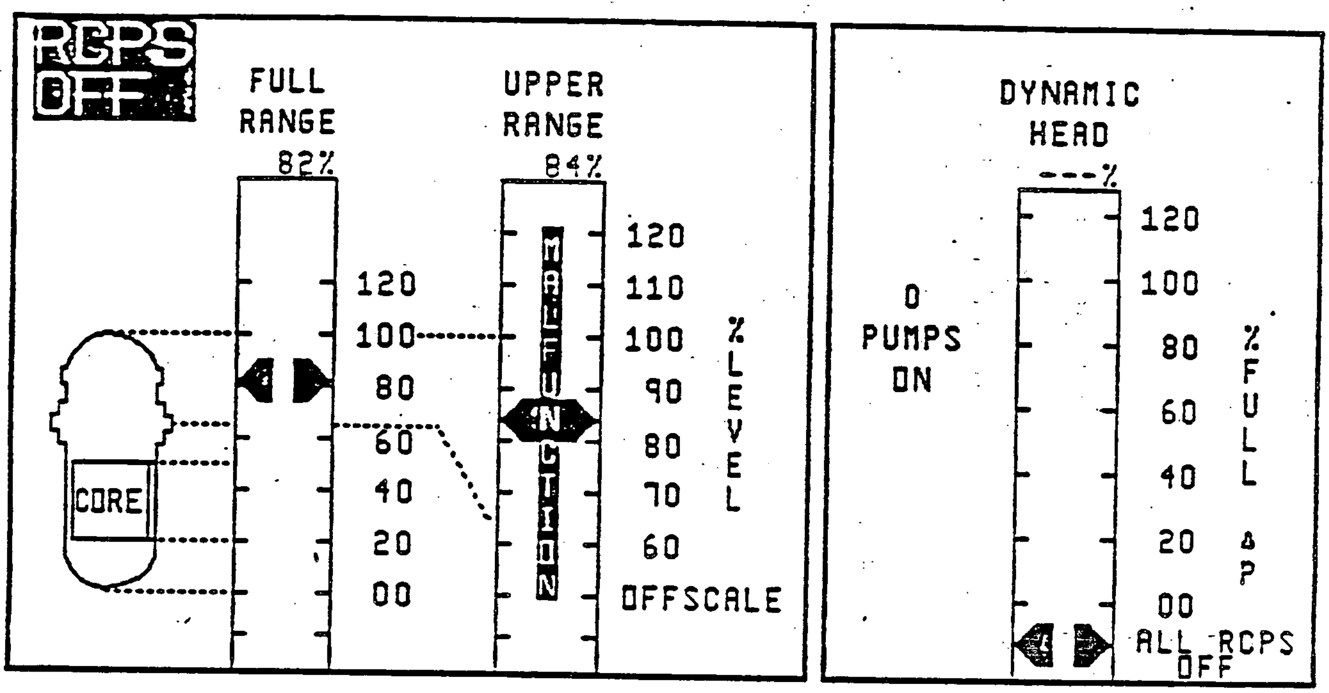


FIGURE 9 – RVLIS 1

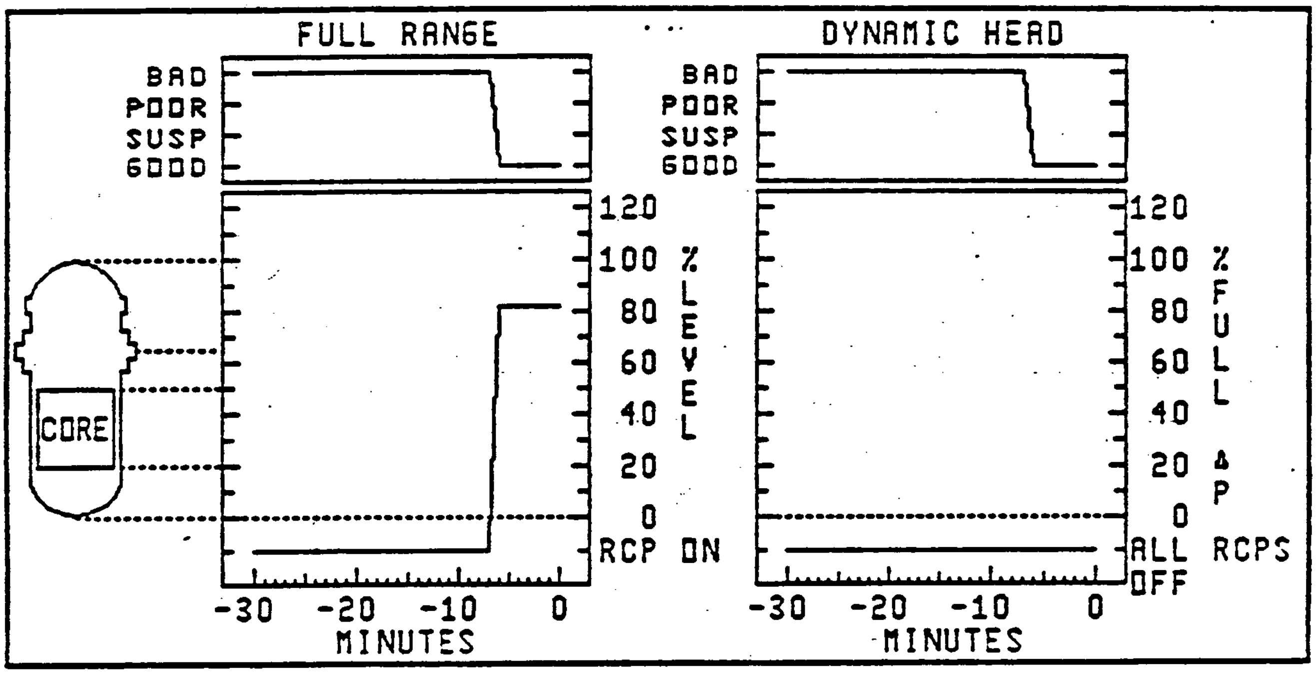


FIGURE 10—RVLIS 2

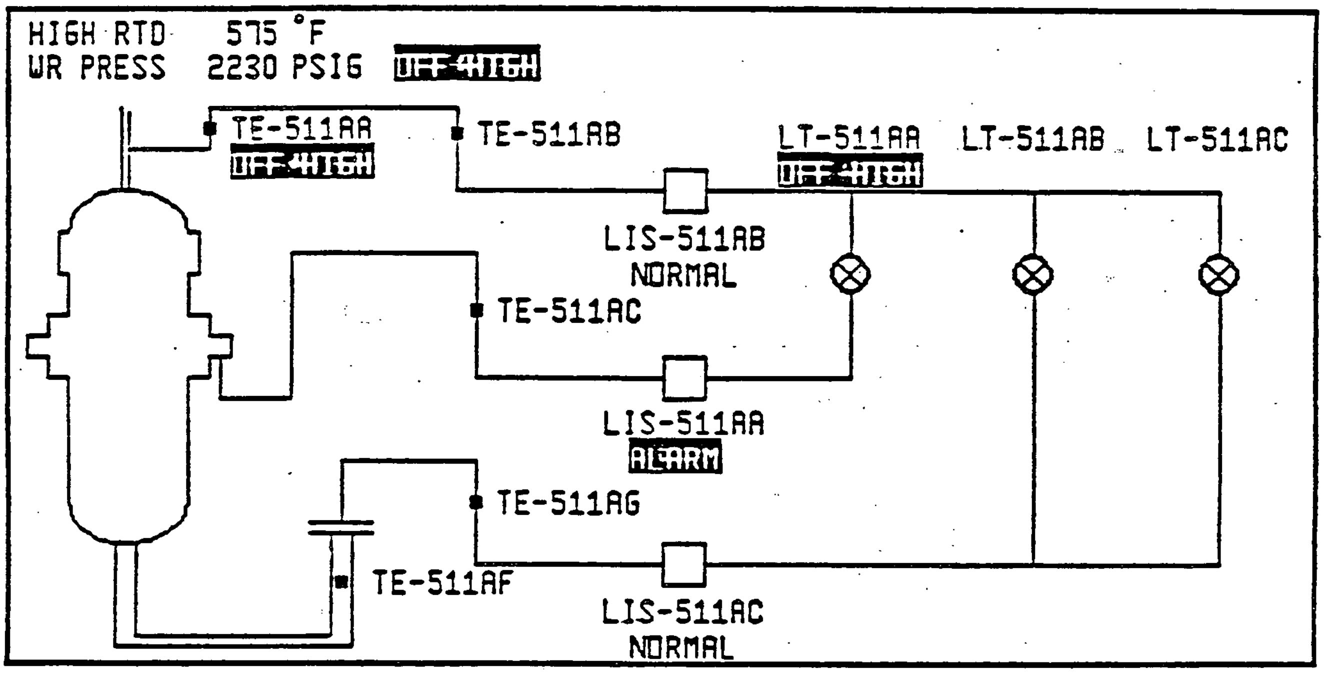


FIGURE 11 – RVLIS 3

RVLIS DIAGNOSTIC PAGE TIME 09:39:13

LT-511AA	-6.250	50	00	UR LEVEL	84.247	30	02					
LT-511AB	-3.177	30	00	FR LEVEL	82.678	30	00					
LT-511AC	47.176	30	00	DH D/P	98.490	30	00					
TE-511AA	89.234	40	00	NORM UR	81.488	30	00					
TE-511AB	90.347	30	00	NORM FR	82.731	30	00					
TE-511AC	92.588	30	00	NORM DH	100.000	30	00					
TE-511AF	90.279	30	00									
TE-511AG	91.934	30	00									
									RCP-A	00	00	
PT-511AA	2230.093	50	00						RCP-B	00	00	
									RCP-C	00	00	
TE-413	571.202	30	00	TE-413 (AO)	571.202							
TE-423	575.146	30	00	TE-423 (AO)	575.145				LIS-511AA	FO	00	
									LIS-511AB	00	00	
HIGH RTD	575.146	30	00	MALFUNCTION	00				LIS-511AC	00	00	

DIAGNOSTIC INFORMATION

FIGURE 12 - RVLIS 4

DISPLAY OUT OF SERVICE.

DATA LINK FROM PROCESSOR
TO DISPLAY HAS FAILED.

FIGURE 13–Failure Display