TOLEDO EDISON

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Docket No. 50-346
License No. NPF-3
Serial No. 924
March 23, 1983

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Eisenhut:

This letter is in response to the NRC "Order for Modification of License" for Davis-Besse Nuclear Power Station, Unit 1 dated December 10, 1982. (Log No. 1157) The Order requires Toledo Edison to install an Inadequate Core Cooling (ICC) instrumentation system in conformance to the NUREG-0737, Item II.F.2. recommendation. Attached is Toledo Edison's response.

Very truly yours,

RPC:FRM

Attachment

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ATTACHMENT FOR TOLEDO EDISON'S RESPONSE TO NRC ORDER ON ICC INSTRUMENTATION SYSTEM

Order Item No. 1

The licensee shall install an ICC instrumentation system consisting of subcooling margin monitors, core-exit thermocouples and a reactor coolant inventory tracking system all of which conform to the design parameters specified in NUREG-0737, Item II.F.2. Installation of the ICC instrumentation system shall be completed and made operational in accordance with the timetables approved pursuant to the terms of this Order.

Response 1

Toledo Edison will complete the installation of the ICC instrumentation system as committed herein.

Order Item No. 2

Within 90 days of the date of this Order, the licensee must complete a conceptual design review for a reactor coolant inventory tracking system, identify the design selected and submit to the Director, Division of Licensing detailed schedules for engineering, procurement and installation of the inventory tracking system. References to generic design descriptions, where applicable, are acceptable.

Response 2

The Davis-Besse Unit 1 reactor coolant inventory tracking system includes a Hot Leg Level Measurement System (HLLMS) and a Reactor Coolant Pump Monitoring Program (RCPMP).

The conceptual design and the schedule for implementation of the HLLMS have been submitted to the Staff on December 10, 1982 (Serial #856). The RCPMP will utilize existing plant computer data points for reactor coolant system pressure, temperature and reactor coolant pump motor power as input parameters to a computer program. This program will calculate the void fractions that each reactor coolant pump sees in the reactor coolant system. The software will be implemented by the end of the 1983 refueling outage.

The equation to be used in the RCPMP computer software is as follows:

$$\alpha = \frac{\rho f - \rho o \frac{P}{Po} \frac{\eta}{\eta o}}{\rho f - \rho g}$$

where

α = Void fraction in the reactor coolant system

ρf = density of saturated liquid (function of temperature and pressure)

ρg = density of saturated vapor (function of temperature and pressure)

ρo = density of liquid at a reference point (a constant)

P = Reactor coolant pump motor input power

Po = Reactor coolant pump motor input power at the reference point (a constant)

η = Pump and motor efficiency accounting for motor losses, mechanical friction at the seals and bearings, hydraulic friction and eddy losses in the impeller, not including the hydraulic frictions and eddy losses in the diffuser.

ηo = Pump and motor efficiency at the reference point (a constant)

Reactor coolant system pressure and temperature will be used to define ρf, ρg. η is a function of pump motor input power P and therefore, can be determined at any power. Pump motor input power is a input parameter in the plant computer. ρo, ηo, Po will be constants. All the input parameters for the software is defined and, thus the void fraction α can be calculated.

The RCPMP is a software program to calculate the void fraction. It is available prior to an accident, no continuous indication is provided, the computer printouts and storage provide the recording for the calculation. No environmental qualification testing has been performed and the system is non-Class 1E.

Order Item No. 3

Within 90 days of the date of this Order, the licensee shall review the status of conformance of all components of the ICC instrumentation system with NUREG-0737, Item II.F.2, and submit a report on the status of such conformance. For your convenience in performing the status reveiw, a checklist of the nine items of documentation cited on pp. II.F.2 - 3 and 4 of that document is provided in the Appendix to this Order.

Response 3

Toledo Edison's response to the checklist items is Appendix A of this letter.

Order Item No. 4

The licensee shall develop a schedule for installation and making operational the ICC instrumentation system which ensures installation during the earliest refueling shutdown consistent with the existing status of the plant and practical design and procurement considerations. This schedule shall be subject to approval by the Director, Division of Licensing.

Response 4

The core exit thermocouples and the Subcooling Margin Monitor (SMM, or, Tsat meter) have been installed. The HLLMS will be installed in the 1984 refueling outage. The software for the RCPMP will be installed in the 1983 refueling outage.

Order Item No. 5

Prior to using the installed ICC instrumentation system as a basis for operator decisions or actions, final documentation, including calibration data and proposed emergency procedure revisions, shall be submitted for NRC review and approval, and the task analysis portion of the control room design review must be completed by the licensee. Prior to NRC approval, the system may be used for the purpose of operator training and familiarization and may be used with prudence as supplemental input to plant operating decisions.

Response 5

Toledo Edison will provide the final documentation, the calibration data and the proposed emergency procedure revisions for the ICC instrumentation system as per the schedule outlined in the response for Item 9 in the Checklist. (Appendix A)

Order Item No. 6

The licensee may request from the Commission an extension of time for submittals of the required information. Such a request must set forth the proposed schedule and justification for the delay. Such request shall be directed to the Secretary of the Commission, U. S. NRC, Washington, D. C. 20555. Any such request must be submitted at least 30 days prior to the date the information is required.

Response 6

No additional request for extension is made. The information on the proposed continous head vent will be supplied on April 15, 1983 as approved by your letter dated March 15, 1983 (Log No. 1240).

APPENDIX A

Checklist
for Plant Specific Review of
Inadequate Core Cooling (ICC) Instrumentation System

For Davis-Besse Unit 1. License No. NPF-3 Docket No. 50-346

Operated by: Toledo Edison Company
300 Madison Avenue
Toledo, OH 43652

The following items for review are taken from NUREG-0737, pp II.F.2-3, and 4. Responses should be made to full requirements in NUREG-0737, not abbreviated forms below. Applicants should provide reference to either the applicant's submittal or the generic description under the column labled "Reference". These items are required to be reviewed on a plant specific basis by NUREG-0737 for all plants. Differences from the generic descriptons provided by Westinghouse, the Westinghouse Owner's Group, Combustion Engineering, or Combustion Engineering Owner's Group must be indicated by "yes or no" in the column labled deviations and must be justified. Under the Column labeled schedule, either indicate that your documentation of the item is complete or provide a proposed schedule for your submittal.

1. Description of the proposed final system including:

   a. A final design description of additional instrumentation and displays.

   b. Detailed description of existing instrumentation systems.

   c. Description of completed or planned modifications.

   Response

   Item a and b:

   A description of the HLLMS was provided to the NRC in our letter Serial No. 856 dated December 10, 1982.

   The core-exit thermocouple temperature indication system is designed using eight (8) of the existing 52 incore thermocouples, per channel (2 channels for a total of 16 thermocouples), calibrated 0-2300°F. The thermocouples to be used were selected to ensure two temperature readings per quadrant in the core, per channel. New Class 1E signal conditioning instrumentation will be provided to receive the thermocouple signal and transmit them to the Tsat system and to the plant and Technical Support Center (TSC)

computers. Each thermocouple temperature reading can be selected as an input to the indicator and to the Tsat system, (one indicator per channel, both core exit thermocouple and the Tsat meters are 2 channel systems). All 52 core exit thermocouples are connected to the plant computer and are transmitted to the TSC computers.

The existing Tsat monitoring system has been upgraded to provide Class 1E inputs. The input is then displayed on a Tsat/Psat Meter on the corresponding post accident indicating panel and is recorded in the TSC computers. Four 100 ohm platinum dual RTD's (calibrated from 120°F to 920°F) are used to measure RCS hot leg temperature. RCS pressure (calibrated 0-2500 psig) is monitored by existing pressure transmitters which presently input into the Safety Features Actuation System (SFAS). New Class IE signal conditioning instrumentation are provided to receive the temperature and pressure signals and input them to the Tsat monitors (1 indicator per channel). In place of the RCS temperature, any one of the eight incore thermocouples per channel may be manually selected as the temperature input for determing core exit subcooling or superheat. The Tsat meter has 2 independent channels and therefore, will be single failure proof. It is available prior to an accident and provides continuous indications. Signal isolation is provided for the instruments. The Tsat meter is not built under a QA program. The TSC computer serves as the recorder for the Tsat meter.

Item c: See response for order No. 4.

2. A design analysis and evaulation of inventory trend instrumentation, and test data to support design in Item 1.

Response

Description and evaluation of the Davis-Besse HLLMS was submitted for staff review and approval on December 10, 1982 (Serial #856). An evaluation for the reactor coolant pump monitoring program is provided in the response for order No. 2.

Toledo Edison is involved in the B&W owner's group activity on the Integrated System Tests (IST) to verify the B&W system transient computer codes. A dp HLLMS is included in the IST matrix. No test is planned for the RCPMP system.

3. Description of tests planned and results of tests completed for evaluation, qualification, and calibration of additional instrumentation.

Response

A dp HLLMS is included in the IST for the evaluation of the Davis-Besse HLLMS.

No tests are planned at this time for the RCPMP.

A shake table test has been performed for the Tsat meter cabinet. The Tsat meter and all of its inputs are calibrated at least every 18 months.

The instrumentation associated with the core exit thermocouples are calibrated at least every 18 months. The core exit thermocouples cannot be calibrated after use due to high irradiation.

4. Provide a table or description covering the evaluation of conformance with NUREG-0737: II.F.2, Attachment 1, and Appendix B (to be reviewed on a plant specific basis)*

Response

See attached Attachment 1 and Appendix B.

5. Describe computer, software and display functions associated with ICC monitoring in the plant.

Response

The computer software function for the RCPMP is provided in the response for order No. 2.

The software and display functions for the core exit thermocouples will be provided before plant startup from the 1983 refueling outage.

6. Provide a proposed schedule for installation, testing and calibration and implementation of any proposed new instrumentation or information displays.

Response

Toledo Edison has installed the Tsat meter and the core exit thermocouples. The HLLMS will be installed in the 1984 refueling outage. The RCPMP will be installed in the 1983 refueling outage.

7. Describe guidelines for use of reactor coolant inventory tracking system, and analyses used to develop procedures.

Response

The general guideline for the operators on reactor coolant inventory tracking system will be to use the system only to obtain confirmatory information that ECCS equipment is working properly and, not to use the information as basis for initiating any manual operation of equipment.

The B&W generic Abnormal Transient Operating Guidelines (ATOG) has been submitted for staff review and approval by Duke Power Company under the B&W owner's group activities. In the ATOG procedure, specifically those actions required to mitigate the ICC conditions, the operators are not instructed to rely on the inventory tracking system to perform any safety related functions. Extensive analyses have been extended for the development of the ATOG procedures. Toledo Edison has no plan at this time to perform additional analyses to develop procedures for the inventory tracking system.

Schedule: The ATOG guidelines are complete and they will be implemented in accordance with the schedule to be submitted on April 15, 1983 as part of the responses to the Generic Letter 82-33.

8. Operator instructions in emergency operating procedures for ICC and how these procedures will be modified when final monitoring system is implemented.

Response

As noted in Item 7. above, the ATOG procedure that is under the staff review contains a section on ICC. It includes the instructions for the recognition of the ICC conditions as well as the steps to be taken for its mitigation.

Toledo Edison has implemented the use of core exit thermocouples in our existing abnormal operating procedure for ICC. We intend to replace the interim ICC procedure by the ATOG procedure when implemented.

Schedule: See response for Item 9 below.

9. Provide a schedule for additional submittals required.

Response

1. Schedule for additional submittals on the Davis-Besse ATOG is still under preparation. It will be submitted by April 15, 1983 as part of the responses to the Generic Letter 82-33.

2. The computer software and display for the core exit thermocouples with calibration data will be provided by the end of 1983 refueling outage.

3. The Integrated System Test results and schedule will be provided under NUREG-0737 Item II.K.3.30 submittals.

*II.F.2 Attachment 1 (for Core Exit Thermocouples)

In response to Item 4 in the above checklist, the following materials should be included to show that the proposed system meets the design and qualification criteria for the core exit thermocouple system.

1. Provide diagram of core exit thermocouple locations or referenced the generic description if appropriate.

   Response

   A diagram (Fig. 3) is provided.

2. Provide a description of the primary operator displays including:

   a. A diagram of the display panel layout for the core map and description of how it is implemented, e.g., hardware or CRT display.

   b. Provide the range of the readouts.

   c. Describe the alarm system.

   d. Describe how the ICC instrumentation readouts are arranged with respect to each other.

   Response

   a. The display panel layout diagram is provided in Figure 1 and 2. The description for implementation can be found in Appendix A checklist item No. 1.a and 1.b.

   b. Range of readouts are provided in Table 1.

   c. Only computer alarms are provided for the core exit thermocouples (TC).

   d. See response for item a. above.

3. Describe the implementation of the backup display(s) (including the subcooling margin monitors), how the thermocouples are selected, how they are checked for operability, and the range of the display.

   Response

   For the core exit thermocouples and the Tsat meter the backup displays are the indicators as provided in Figure 1 and 2. They are already installed and procedures are implemented.

   No backup displays are planned for the HLLMS and the RCPMP.

   Backup display for core exit thermocouples are selected by a hand selector switch (one for each channel). The operability is checked once every 18 months during a refueling outage.

The range for the displays are as follows:

1. RCS pressure (0 - 2500 psig)

2. RCS hot leg temperature (120°F - 920°F)

3. Core exit thermocouples (0 - 2300°F)

4. Describe the use of the primary and backup displays. What training will the operators have in using the core exit thermocouple instrumentation? How will the operator know when to use the core exit thermocouples and when not to use them? Reference appropriate emergency operating guidelines where applicable.

Response

The description for the primary and backup use of the core exit thermocouples is included in the ATOG procedure which is under staff review. As an interim measure Toledo Edison has implemented the use of the core exit thermocouples into our Abnormal procedures for ICC. All operators received classroom as well as simulator trainings on this subject.

5. Confirm completion of control room design task analysis applicable to ICC instrumentation. Confirm that the core exit thermocouples meet the criteria of NUREG-0737, Attachment 1 and Appendix B, or identify and justify deviations.

Response

The control room design task analysis for ICC instrumentation will be performed as part of the control room design review. Schedule for submittal on this subject will be provided in accordance with NUREG-0737 Supplement 1 recommendations.

The core exit thermocouple temperature monitoring system meets the criteria of NUREG-0737, Attachment 1 and Appendix B except as follows:

a. The spacially oriented core map is built into the selector switch for the incore thermocouples. (See Fig. 1 and 2)

b. The incore thermocouples and their cables from the temperature elements to the termination blocks at the containment vessel are not Class 1E. This system utilizes sixteen (16) existing incore thermocouples that previously did not require 1E qualification. The signal cables, once outside the containment, have been re-routed from the terminal block to the control room isolation devices to provide both electrical and physical separation to make this part of the system Class 1E.

c. Data from the core exit thermocouple is recorded on the Technical Support Center Computer. It is available prior to an accident. Continuous indication can be achieved by the use of the computer CRT's or the backup display.

Table 1

POST ACCIDENT PANEL INDICATORS

C-5798 & C5799

ITEM	DESCRIPTION	SCALE
TI4627	CORE EXIT TEMP	0-2300°F
TI4628	" " "	0-2300°F
PIRC2A4A	LOOP 2 PRESS	0-2500 PSIG
PIRC2B4A	LOOP 1 "	0-2500 PSIG
TDI4950	MARGIN TO SATURATION	MFG SUPPLIED
TDI4951	" " "	" " "
TIRC3B5/RC4B2A	LOOP 1 TEMP (HOT AND COLD LEG)	0-700°F/50-650°F
TIRC3B6/RC4B4	LOOP 1 " " " " "	" " " "
TIRC3A5/RC4A4	LOOP 2 " " " " "	" " " "
TIRC3A6/RC4A2A	" " " " " " "	" " " "

6. Describe what parts of the systems are powered from the 1E power sources used, and how isolation from non-1E equipment is provided. Describe the power supply for the primary display. Clearly delineate in two categories which hardware is included up to the isolation device and which is not.

Response

The core-exit thermocouple system is designed to be 1E as much as practicable. The (TC) temperature input utilizes eight existing non-1E elements per channel and uses existing non-1E cable routes through the containment. The temperature input signals are 1E from the termination block in the Auxiliary Building at the containment vessel up to and including the isolation device interfacing with the station and TSC computers.

Power for the 1E portion is provided for each channel of these systems via the Class 1E essential instrument power sources. The 1E portions of the core-exit thermocouple system are designed to meet the separation requirements of IEEE-279-1971. All power used within this system is battery backed and highly reliable.

7. Confirm the environmental qualification of the core exit thermocouple instrumentation up to the isolation device.

Response

The Class 1E components of the systems were designed to meet the environmental qualification requirements of IEEE-323-1974 and the seismic qualification requirements of IEEE-344-1975.

Appendix B (of NUREG-0737, II.F.2)

Confirm explicitly the conformance to the Appendix B items listed below for the ICC instrumentation, i.e., the SMM, the reactor coolant inventory tracking system, the core exit thermocouples and the display systems.

		Tsat Meter		Core Exit Thermocouples	
		Reference	Deviations	Reference	Deviations
1.	Environmental qualification	Checklist Item No. 1	Yes	Attachment 1 Item 5d	Yes
2.	Single failure analysis	Checklist Item No. 1	No	Attachment 1 Item 5d	Yes
3.	Class 1E power source	Checklist Item No. 1	No	Attachment 1 Item 5b	No
4.	Availability prior to an accident	Checklist Item No. 1	No	Attachment 1 Item 5c	No
5.	Quality Assurance	Checklist Item No. 1	No	Item 5b	Yes
6.	Continuous indications	Checklist Item No. 1	No	Attachment 1 Item 5c	No
7.	Recording of instrument outputs	Checklist Item No. 1	No	Item 5c	No
8.	Identification of instruments	Fig. 1 & 2	No	Fig. 1 & 2	No
9.	Isolation	Checklist Item No. 1	No	Item 5b	Yes

Appendix B (of NUREG-0737, II.F.2)
(Continued)

Confirm explicitly the conformance to the Appendix B items listed below for the ICC instrumentation, i.e., the SMM, the reactor coolant inventory tracking system, the core exit thermocouples and the display systems.

	HLMMS		RCPMP	
	Reference	Deviations	Reference	Deviations
1. Environmental qualification	Serial No. 856	Yes	Response Order No. 2	Yes
2. Single failure analysis	Serial No. 856	Yes	Response Order No. 2	Yes
3. Class 1E power source	Serial No. 856	No	Response Order No. 2	Yes
4. Availability prior to an accident	Serial No. 856	No	Response Order No. 2	No
5. Quality Assurance	Serial No. 856	No	Response Order No. 2	Yes
6. Continuous indications	Serial No. 856	No	Response Order No. 2	No
7. Recording of instrument outputs	Serial No. 856	No	Response Order No. 2	No
8. Identification of instruments	Serial No. 856	No	Computer Display	No
9. Isolation	Serial No. 856	No	None	Yes

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FIGURE 1

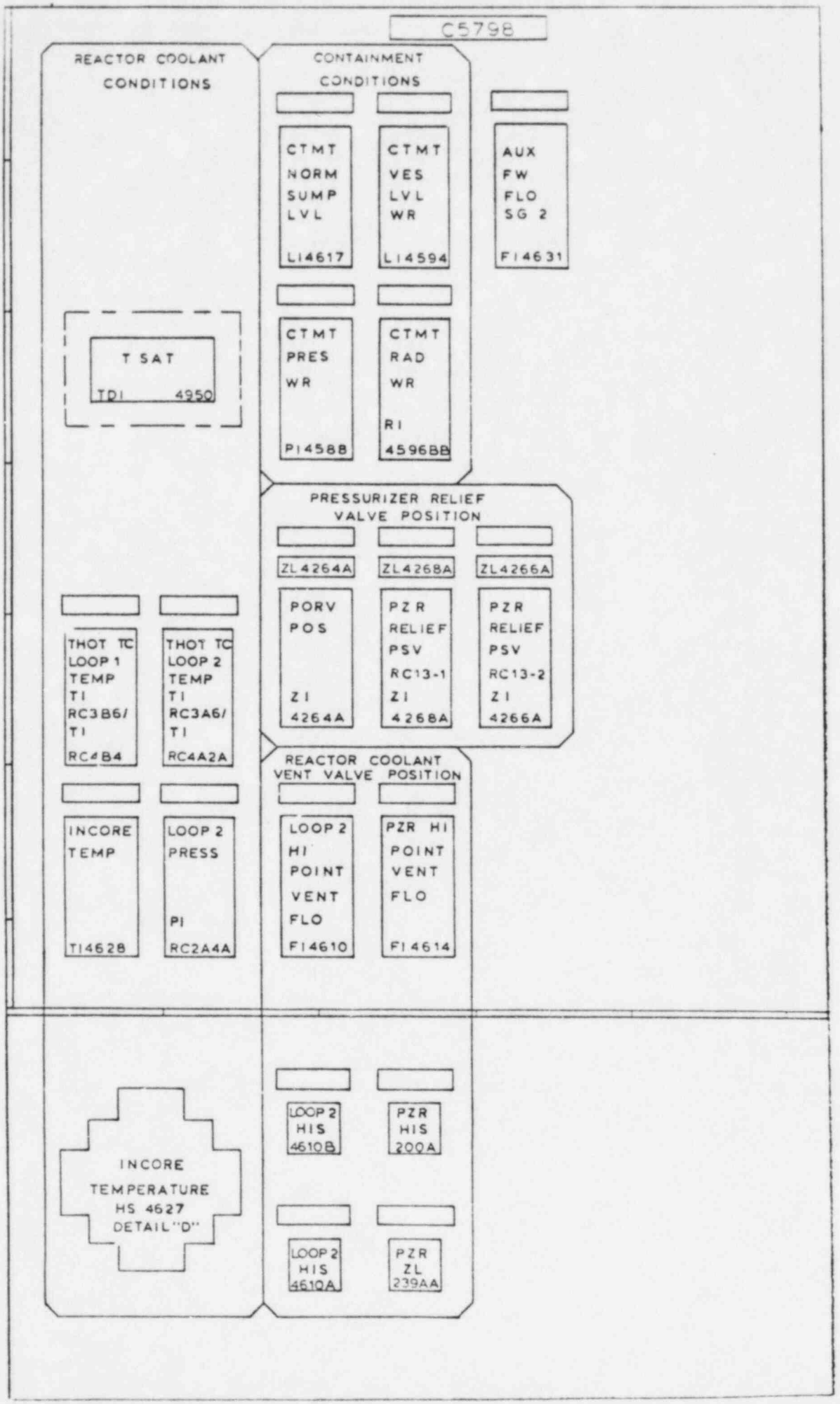

C5798
REACTOR COOLANT CONDITIONS
CONTAINMENT CONDITIONS
CTMT NORM SUMP LVL
LI4617
CTMT VES LVL WR
LI4594
AUX FW FLO SG 2
FI4631
T SAT
TDI 4950
CTMT PRES WR
PI4588
CTMT RAD WR
RI 4596BB
PRESSURIZER RELIEF VALVE POSITION
ZL4264A
ZL4268A
ZL4266A
PORV POS
ZI 4264A
PZR RELIEF PSV RC13-1
ZI 4268A
PZR RELIEF PSV RC13-2
ZI 4266A
THOT TC LOOP 1 TEMP TI RC3B6/ TI RC4B4
THOT TC LOOP 2 TEMP TI RC3A6/ TI RC4A2A
REACTOR COOLANT VENT VALVE POSITION
INCORE TEMP
TI4628
LOOP 2 PRESS
PI RC2A4A
LOOP 2 HI POINT VENT FLO
FI4610
PZR HI POINT VENT FLO
FI4614
INCORE TEMPERATURE HS 4627 DETAIL "D"
LOOP 2 HIS 4610B
PZR HIS 200A
LOOP 2 HIS 4610A
PZR ZL 239AA

FIGURE 2

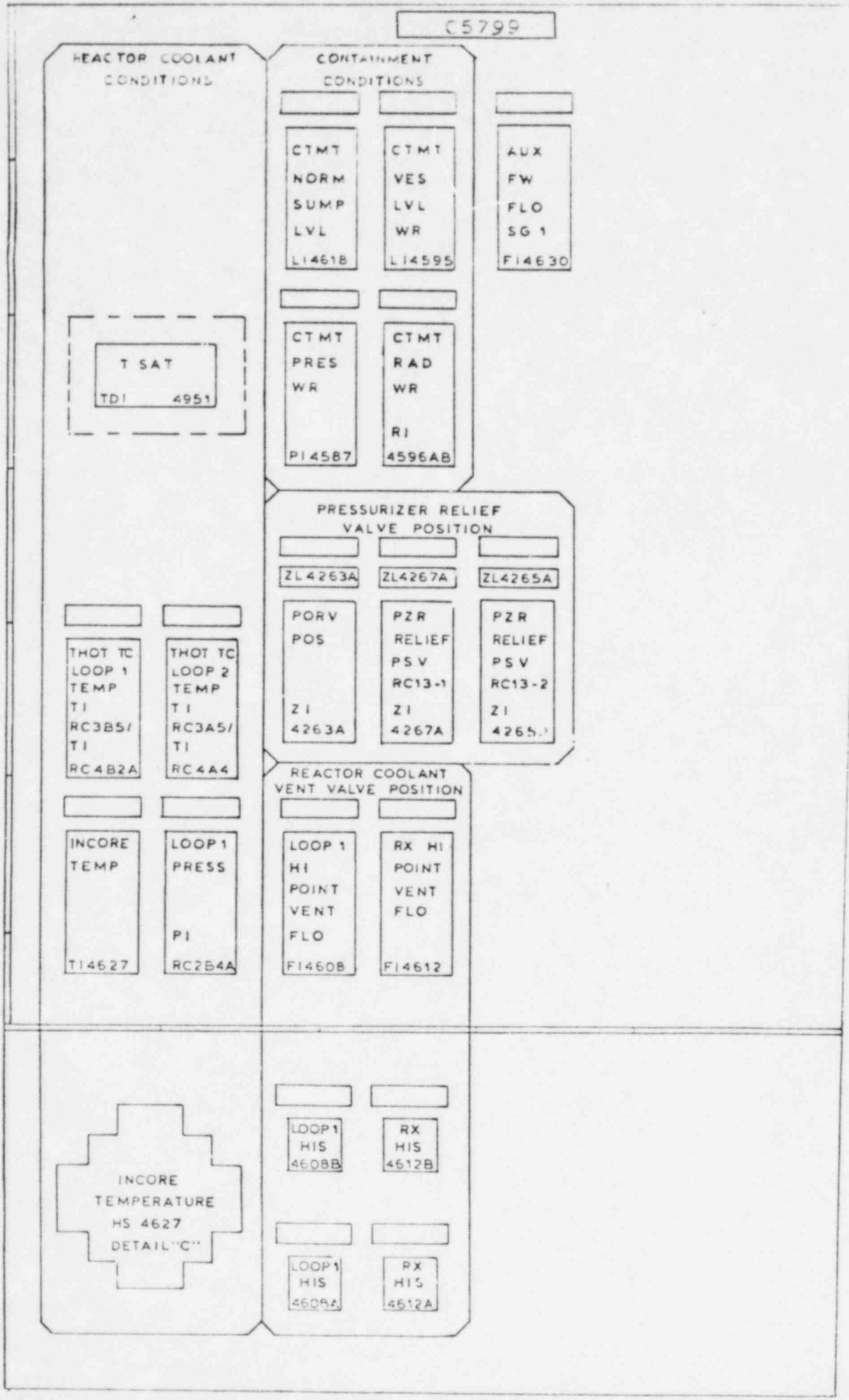
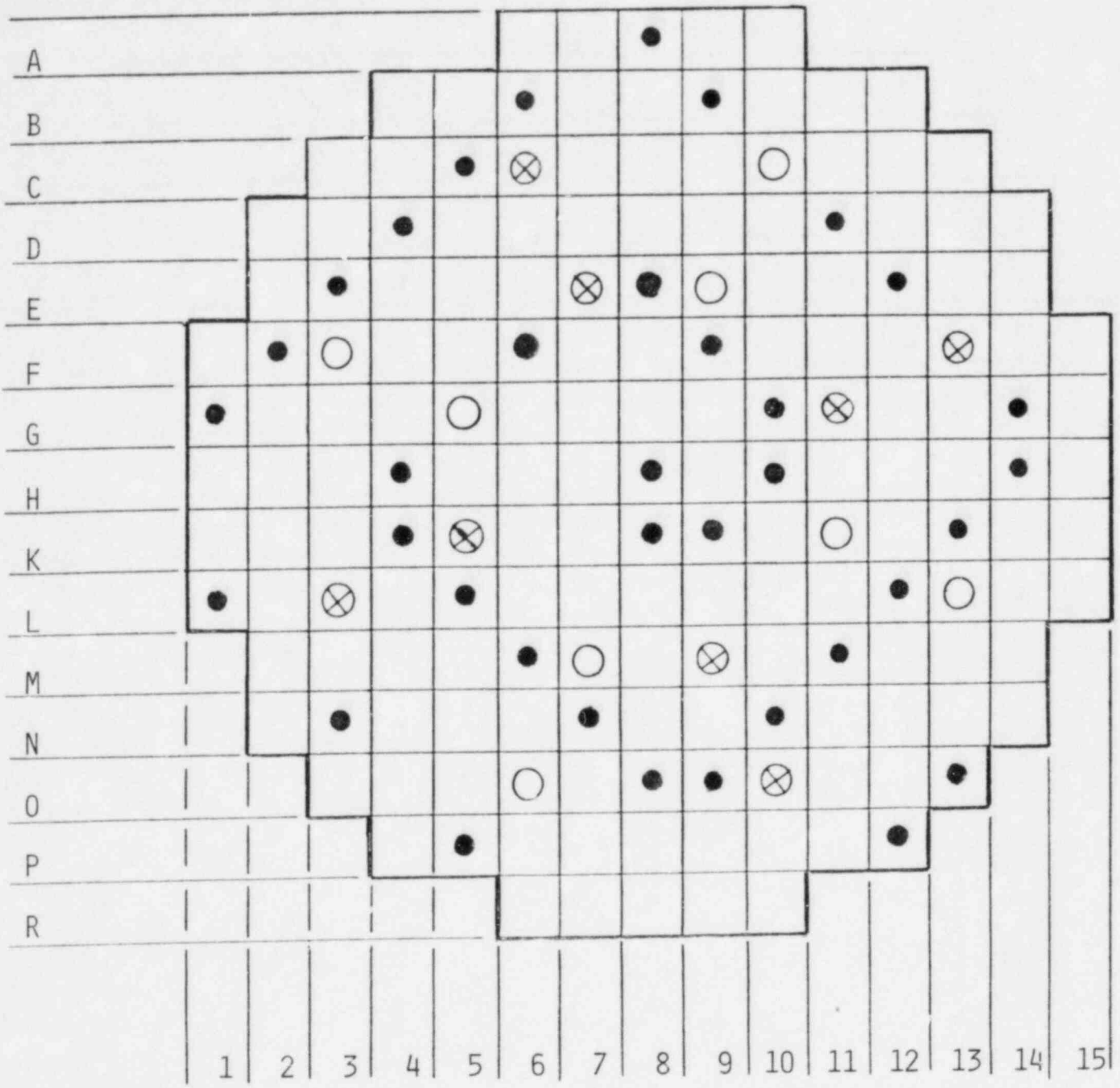

C5799
REACTOR COOLANT CONDITIONS
T SAT
TD1 4951
CONTAINMENT CONDITIONS
CTMT NORM SUMP LVL
L14618
CTMT VES LVL WR
L14595
AUX FW FLO SG 1
F14630
CTMT PRES WR
P14587
CTMT RAD WR
RI
4596AB
PRESSURIZER RELIEF VALVE POSITION
ZL4263A
ZL4267A
ZL4265A
PORV POS
ZI 4263A
PZR RELIEF PSV RC13-1
ZI 4267A
PZR RELIEF PSV RC13-2
ZI 4265A
THOT TC LOOP 1 TEMP TI RC3B5/ TI RC4B2A
THOT TC LOOP 2 TEMP TI RC3A5/ TI RC4A4
REACTOR COOLANT VENT VALVE POSITION
INCORE TEMP
T14627
LOOP 1 PRESS
PI RC2B4A
LOOP 1 HI POINT VENT FLO
F14608
RX HI POINT VENT FLO
F14612
INCORE TEMPERATURE HS 4627 DETAIL "C"
LOOP1 HIS 4608B
RX HIS 4612B
LOOP1 HIS 4609A
RX HIS 4612A

FIGURE 3



○ TSAT CHANNEL 1

⊗ TSAT CHANNEL 2

● STATION COMPUTER

SKETCH

CORE EXIT THERMOCOUPLES

CORE LOCATIONS