Duquesne Light

Nuclear Group
P.O. Box 4
Shippingport, PA 15077-0004

Telephone (412) 393-6000

January 12, 1987

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
NUREG-0737, Item II.F.2, ICC Instrumentation System

Gentlemen:

By letter dated November 12, 1986, you requested additional information on our April 24, 1984 submittal describing the Inadequate Core Cooling Instrumentation (ICCI) system for Beaver Valley 1.

Attached is an update to our April 24, 1986 submittal along with a brief comparison of the Unit 1 and Unit 2 ICCI systems.

If you have any questions on this information, please contact my office.

Very truly yours,

J. D. Sieber
Vice President, Nuclear

cc: Mr. W. M. Troskoski, Resident Inspector
U. S. Nuclear Regulatory Commission
Beaver Valley Power Station
Shippingport, PA 15077

U. S. Nuclear Regulatory Commission
Regional Administrator
Region 1
631 Park Aver
King of Prussia, PA 19406

Mr. Peter S. Tam
U. S. Nuclear Regulatory Commission
Project Directorate No. 2
Division of PWR Licensing - A
Washington, DC 20555
- Mail Stop 340

Director, Safety Evaluation & Control
Virginia Electric & Power Company
P.O. Box 26666
One James River Plaza
Richmond, VA 23261

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E N C L O S U R E I

Response to NRC Request for Information dated November 12, 1986 on Inadequate Core Cooling Instrumentation

I. Update your April 1984 submittal to reflect completed installations and design changes.

Response

A. Completed Installations

1. The RVLIS was completed and placed in service at the fourth refueling outage.

2. Modification of the Safety Parameter Display System (SPDS) to include core exit thermocouple inputs has been completed as described in our April 24, 1984 submittal. In addition, Train A and B upper range, full range and dynamic head RVLIS level signals have been included as inputs to the SPDS and PVC computers.

3. Preliminary work was begun during the fifth refueling outage on the Inadequate Core Cooling (ICC) upgrade of the core exit thermocouple system. This consisted of environmental qualification splices of the thermocouple cables at the containment penetration. The final ICC system upgrade will be completed at the 6th refueling outage scheduled for November 1987.

B. Proposed Upgrade

The final configuration for the ICC monitoring system will be essentially as described in our April 24, 1984 submittal with the following exceptions and clarifications.

1. The current RVLIS microprocessor cabinet and associated Control Room plasma displays will be replaced with a Westinghouse ICC-86 monitor and displays. The new ICC monitor consists of two sections, Train A and B, designed to electrical Class 1E requirements. The ICC monitor will functionally replace the RVLIS, the subcooling monitor and the current core exit thermocouple monitoring system. Inputs to the ICC monitor will include the existing RVLIS inputs plus core exit thermocouple (CETC) and reference junction RTD inputs, as shown on the attached block diagram, drawing ICC 668-1.

2. The ICC monitor and displays will be powered from two separate Class 1E power sources backed by the station emergency diesel generators. The power source for Train A and Train B will be consistent with channel identification of the existing RVLIS Train A and B inputs.

3. The ICC displays will be located in the control room, as determined by human factors review. Train A display will be located on the vertical board with a keypad on the benchboard. Train B will be installed in the location of the existing APDMS panel to the left of the control board.

4a. The core exit thermocouple system will be upgraded by replacing the thermocouple connectors at the reactor head with environmentally qualified connectors. Environmentally qualified thermocouple extension cable will be installed from the connectors to a new, environmentally qualified reference junction system inside containment. At this point, EQ splices will be made to the existing copper thermocouple cables to the containment penetrations. Use of the existing copper cable is based on EQ testing of originally installed BVPS-1 instrument cables.

b. Outside containment, the thermocouple and reference junction RTD cables, which are now routed to the existing thermocouple indicator, the plant computer, the SPDS and PVC computers, and the subcooling monitor, will be pulled back, in part, and routed directly to the ICC monitor. The thermocouple indicator, which is incompatible with the new (unheated) reference junction system, will be deleted. The plant computer, SPDS and PVC computers will obtain CETC signals via isolated outputs from the ICC monitor. This configuration differs from that shown on Figure 1 of our April 24, 1984 submittal, which depicted the thermocouple signals branching off to other non-Class 1E equipment without isolation. This change in the proposed configuration was made to achieve a greater degree of compliance with separation and independence criteria, and because of the possibility of a computer malfunction that could load down the input, thus affecting the signals to the ICC monitor.

c. As noted in our April 24, 1984 submittal, the routing of the CETC cables will not fully satisfy the separation criteria of NUREG-0737 and Regulatory Guide 1.75 in the following respects. Due to the configuration of the CETCs, Train A and Train B cables will be physically adjacent at the thermocouple columns exiting he reactor vessel head. Separation of Train A and B into separate raceways will begin at the closest practical location on the refueling deck. From this point on, Train A and Train B thermocouple and reference junction RTD cables will be routed in separate raceway. However, the existing neutral color-coded raceway routing will be utilized; therefore, the cables will be in raceway with other non-safety related cables. Rerouting of the cables directly to the ICC monitor described previously, will eliminate Train A and Train B common routing outside containment.

II. Provide a brief description of the similarities and differences of the Unit 1 and 2 ICC designs.

Response

The following describes significant similarities and differences between the proposed Unit 1 ICC system and the Unit 2 system as described in submittals dated April 11, 1986 and July 31, 1986. (Docket No. 50-412)

A. Core Exit Thermocouple System

1. Unit 1 core exit thermocouple system will be generally similar to the Unit 2 system in that there will be 51 thermocouples (26 Train A and 25 Train B) with environmentally qualified reference junction systems. Differences may exist in actual hardware description, since other manufacturers will be considered for the connectors, cable and reference junctions.

2. Unit 1 will not utilize the Remote Processing Units (RPUs) described for Unit 2 and each display will read out only the thermocouples associated with that train. Displays of all 51 thermocouples and the associated reference junction RTDs will be available on the non-1E SPDS, PVC and plant computers.

B. Core Subcooling Margin

1. Inputs for the core subcooling margin calculation will include:

	Number of Channels	
	Unit 1	Unit 2
Wide range RCS pressure	1 per train	3
Core exit thermocouples	26 Train A, 25 Train B	51
Hot Leg Temperature	2 Train A, 1 Train B	----
Reference junction RTD	2 per train	6

2. For Unit 1, core subcooling will be calculated based on average of 5 hottest thermocouples per train for use in the emergency operating procedures. Subcooling based on the hottest temperature will be displayed for information. Subcooling margin calculation will also be performed in the SPDS and PVC computers.

For Unit 2, core subcooling will be calculated based on auctioneered high thermocouple quadrant average temperture.

3. The RPUs described for Unit 2 will not be used in Unit 1, therefore, each ICC microprocessor will have inputs only from the sensors in its associated train.

C. Reactor Vessel Level Instrumentation System

1. The RVLIS inputs for Unit 1 are similar to Unit 2 except for the number of channels:

	Number of Channels	
	Unit 1	Unit 2
RCS hot leg wide range RTD	2 Train A, 1 Train B	2
Wide range RCS pressure	1 per train	4
Differential pressure	6	6
Reference leg temperature	6 Train A, 7 Train B	12
Reactor coolant pump status	6	4

2. For Unit 1, each plasma display will contain only one train of RVLIS information. Train A RVLIS level will be recorded on a 3-pen recorder. Train A and B RVLIS signals will be input to the SPDS/PVC computer.

D. Displays

In Unit 2 the ICC instrumentation parameters are integrated into the Plant Safety Monitoring System which has two redundant seismically qualified flat panel displays, each capable of displaying all channels of ICC parameters in addition to other plant safety parameters.

For Unit 1 the ICC parameters will be input to the Safety Parameter Display System and Plant Variable Computer via isolators from existing process instrumentation and the new ICC microprocessor. These computers will be capable of displaying thermocouple core maps, subcooling margin and RVLIS levels. Additionally, to meet the recommendation of NUREG-0737 for 1E powered backup CETC display, dedicated ICC displays will be installed. Typical display pages for the Unit 1 ICC displays are provided as Attachments.

E. Trend Capability

Unit 2 has recorders for one train of RVLIS, one train of subcooling and one CETC channel. The Unit 2 displays have the capability for 2-hour trend of CETC trisector maximum temperature, core subcooling margin, RVLIS level and RCP status.

Unit 1 has a recorder for one train of RVLIS levels. The ICC display will trend average of 5 hottest thermocouples per train for 30 minutes. Other ICC parameters may be trended on the SPDS display for 30 minutes and the PVC display for 2 hours.

F. Alarm Capability

The Unit 1 ICC displays will display alarm parameters in reverse video in a manner similar to that described for Unit 2.

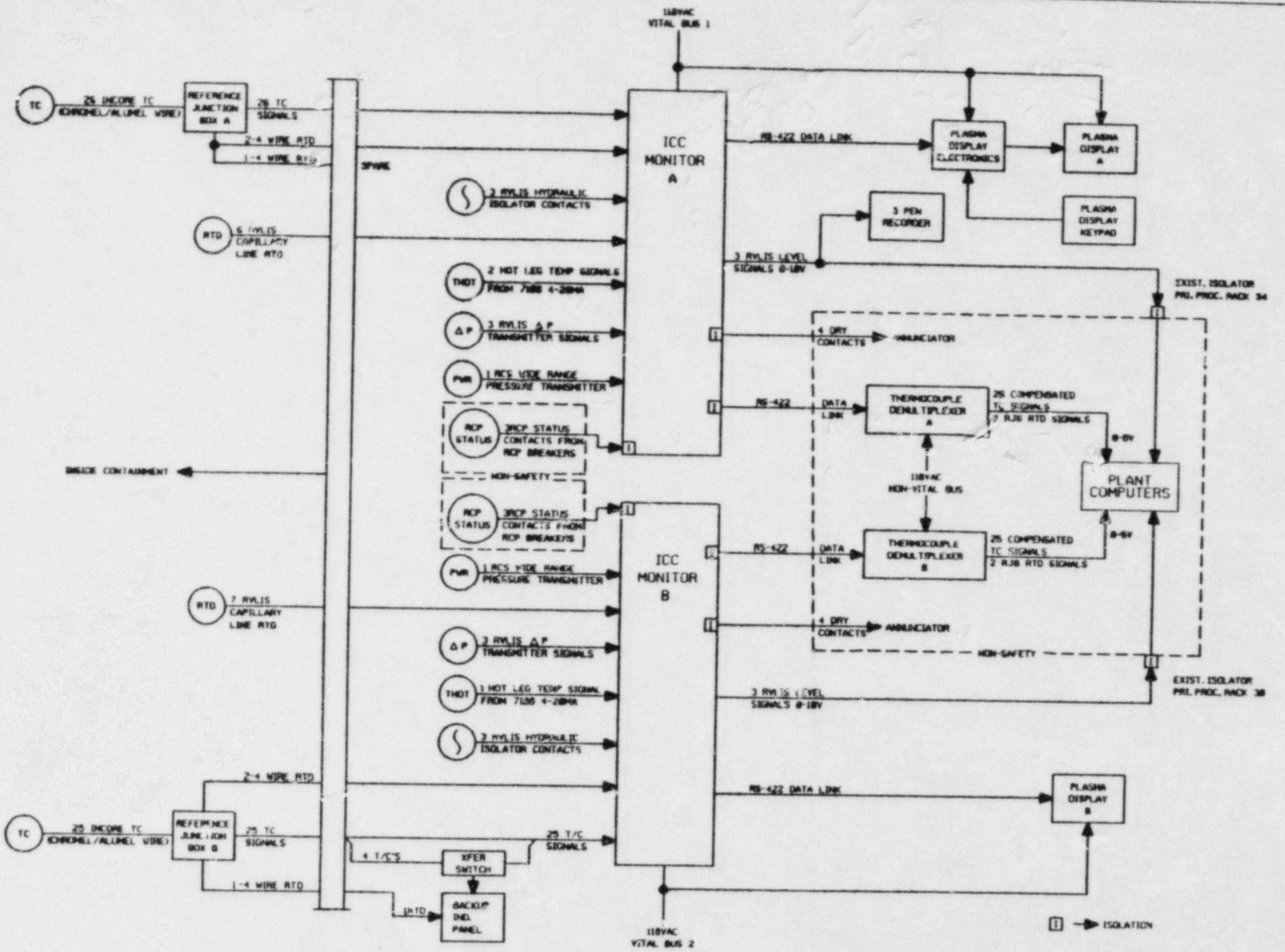
For Unit 1 Alarms on the plant annunciator system will be provided for the following condition:

- Low margin to saturation
- Core exit thermocouple average of 5 hottest CETC per train $\geq$ 1200°F.
- RVLIS full range $\leq$ 40 and 5 hottest CETC average $\geq$700°F with no RCP running.
- ICC monitor malfunction.

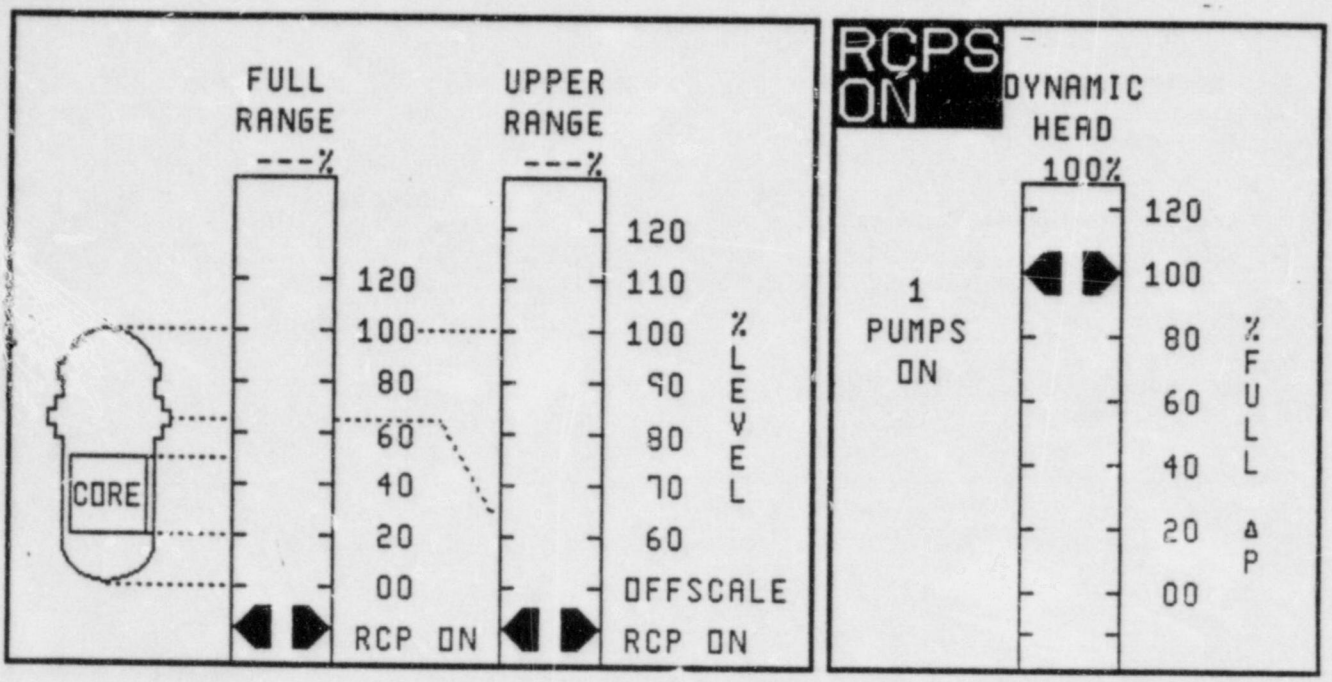
III. Provide the projected implementation date for your ICCI including revised Technical Specifications.

A. Installation of the ICCI upgrade is to be completed during our sixth refueling outage, tentatively scheduled to begin in November 1987.

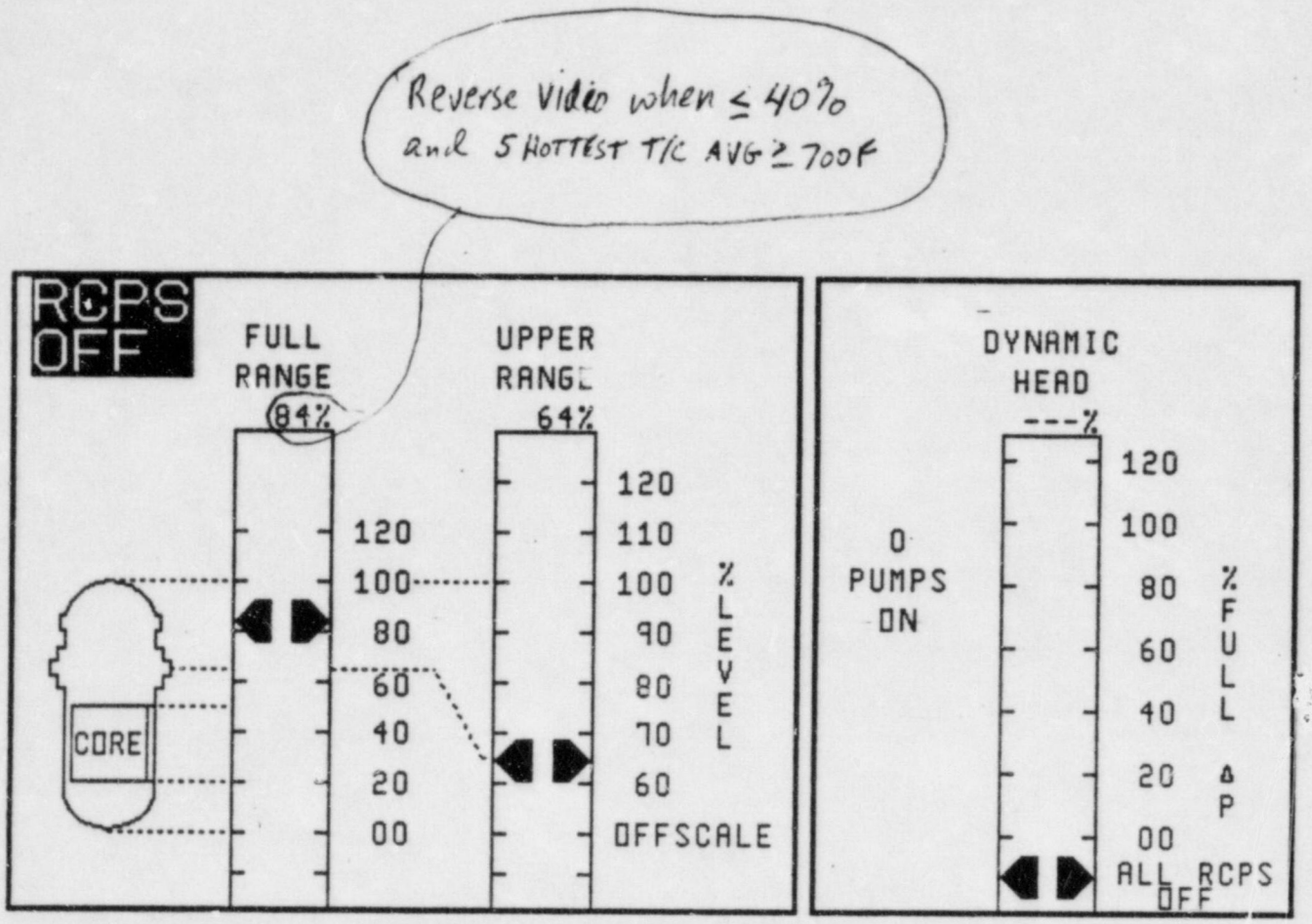
B. Technical Specifications for the sub-cooling monitor are presently in place. Technical Specifications for the upgrade will be submitted after installation, functional testing is completed and the system is demonstrated operable.



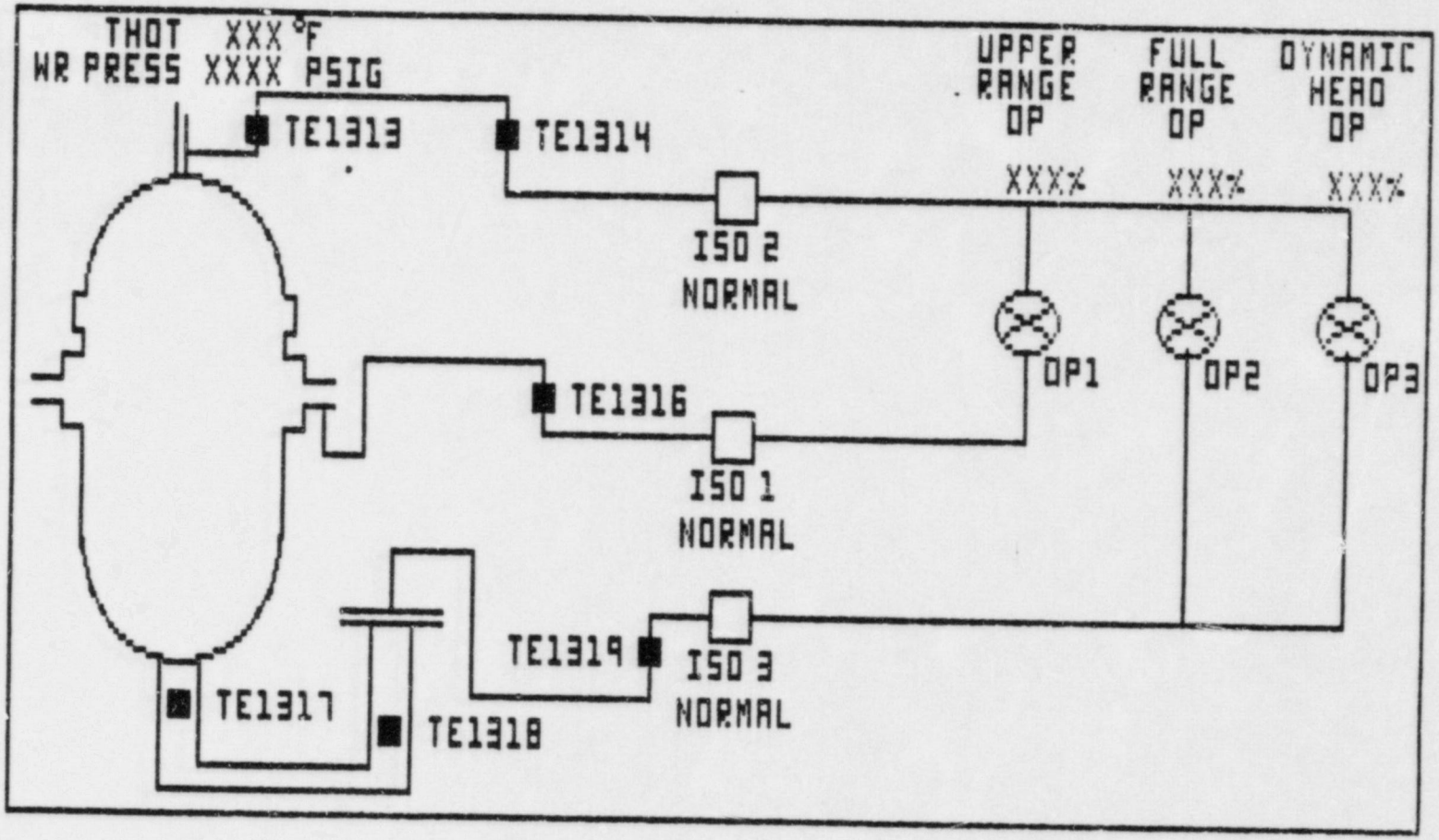
BEAVER VALLEY POWER STATION-UNIT *
ICC MONITORING SYSTEM
EXTERNAL CONNECTION DIAGRAM
DWG. NO. ICC-668-1



VESSEL LEVEL PAGE 1 (WITH RCP(S) ON)

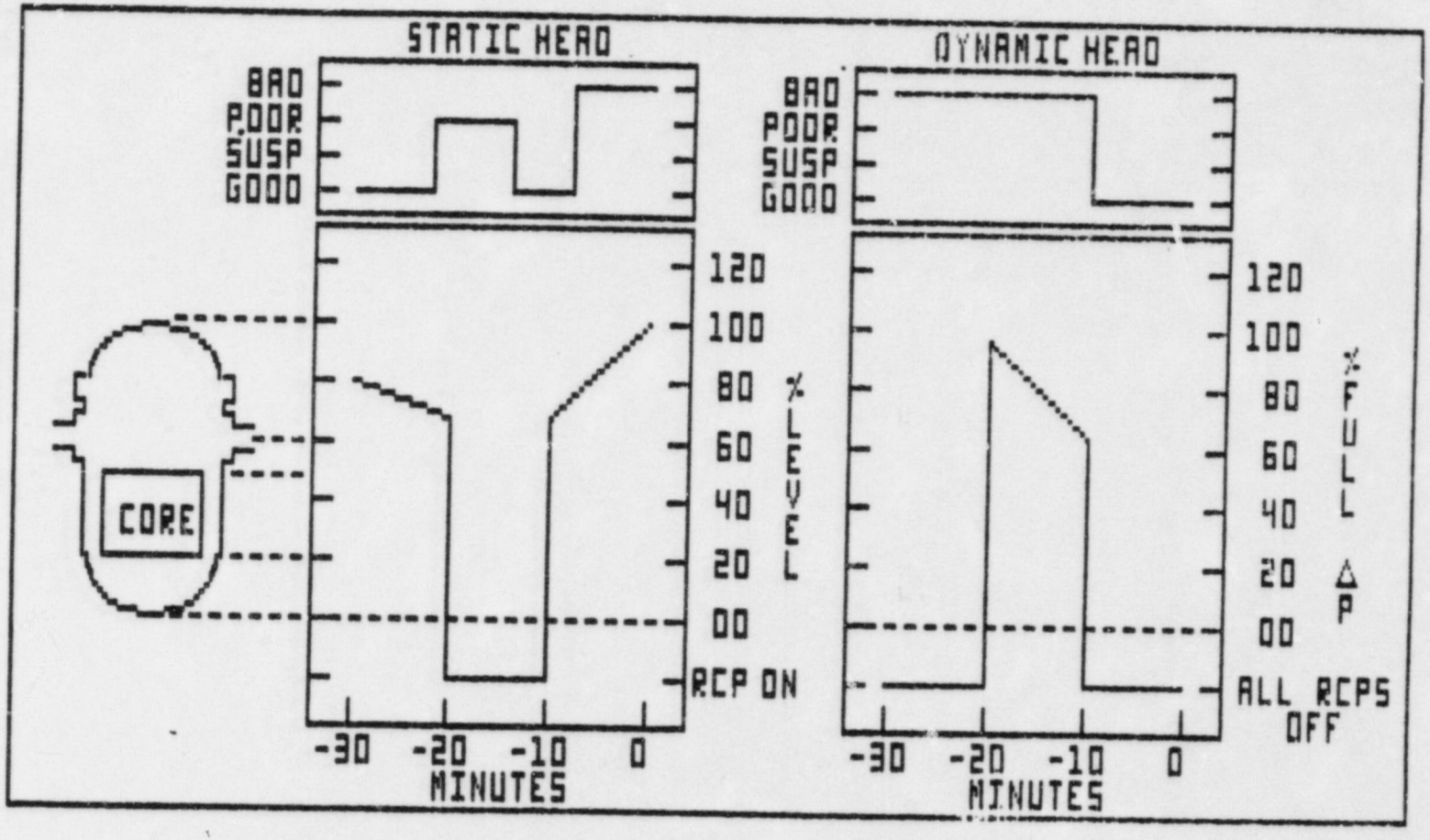


VESSEL LEVEL PAGE1 (WITH RCP's OFF)



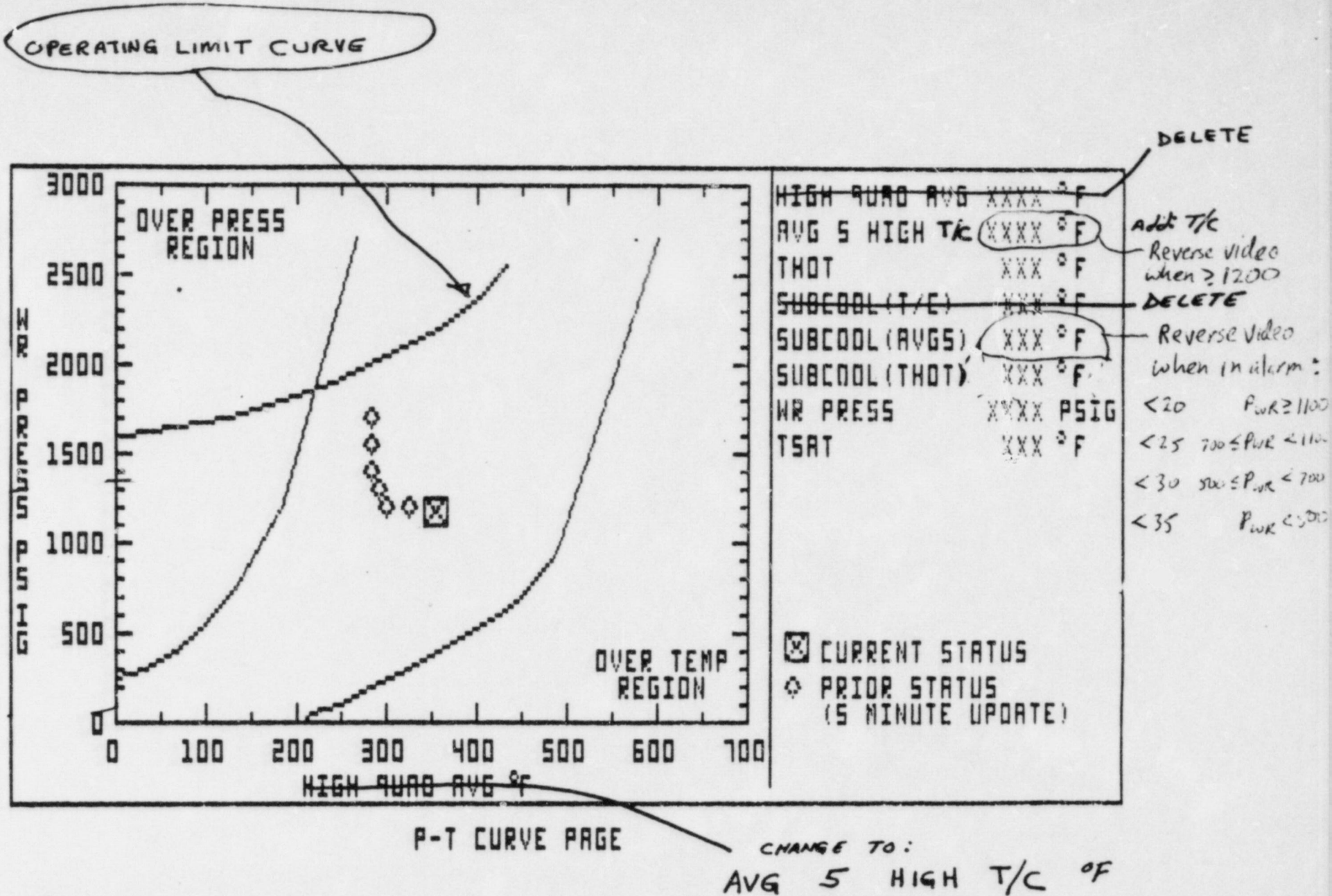
RVLIS SENSOR LAYOUT PAGE

VESSEL LEVEL PAGE 2



RVLIS TREND PAGE

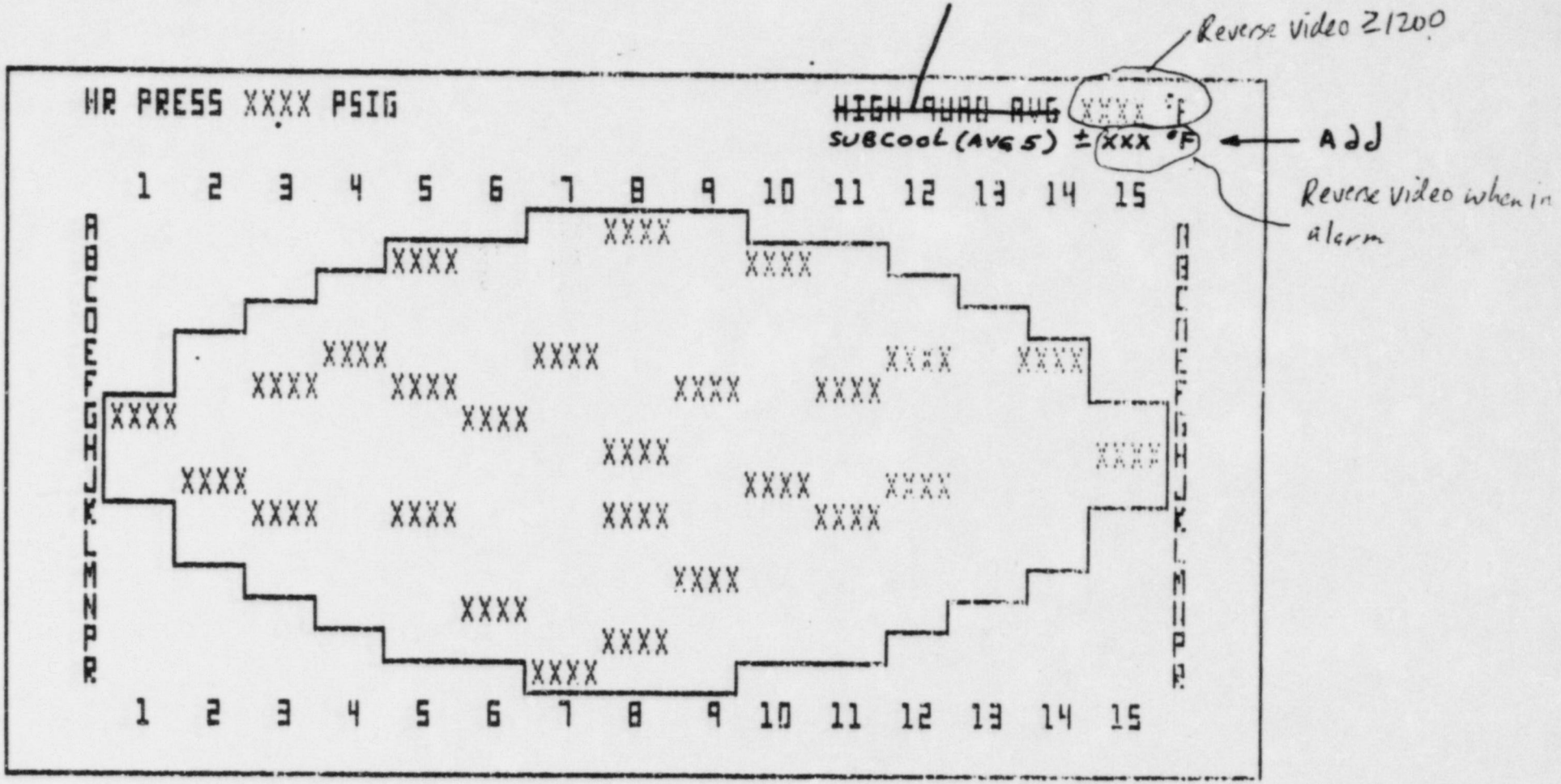
VESSEL LEVEL PAGE 3


OPERATING LIMIT CURVE
DELETE
3000
2500
2000
1500
1000
500
0
WR PRESS PSIG
OVER PRESS REGION
OVER TEMP REGION
0
100
200
300
400
500
600
700
HIGH QUAD AVG °F
HIGH QUAD AVG XXXX °F
AVG 5 HIGH T/C XXXX °F
THOT XXX °F
SUBCOOL (T/C) XXX °F
SUBCOOL (AVG5) XXX °F
SUBCOOL (THOT) XXX °F
WR PRESS XXXX PSIG
TSAT XXX °F
Add T/C
Reverse video when ≥ 1200
DELETE
Reverse video when in alarm:
<20 PWR ≥ 1100
<25 700 ≤ PWR < 1100
<30 500 ≤ PWR < 700
<35 PWR < 500
CURRENT STATUS
PRIOR STATUS
(5 MINUTE UPDATE)
P-T CURVE PAGE
CHANGE TO:
AVG 5 HIGH T/C °F

T/C PAGE 1

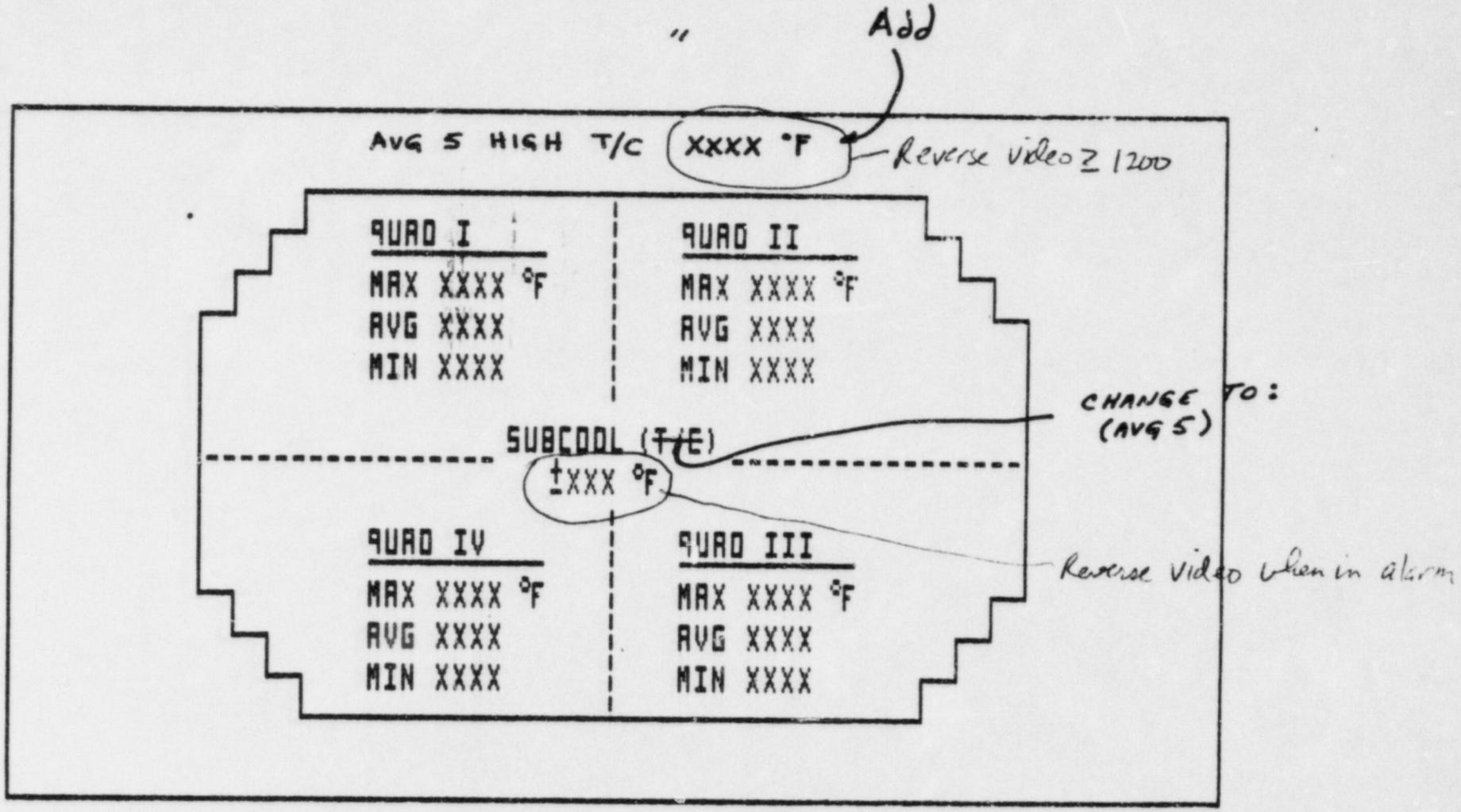
CHANGE TO:

AVG 5 HIGH T/C



T/C CORE MAP PAGE

T/C PAGE 2.



T/C QUADRANT SUMMARY PAGE

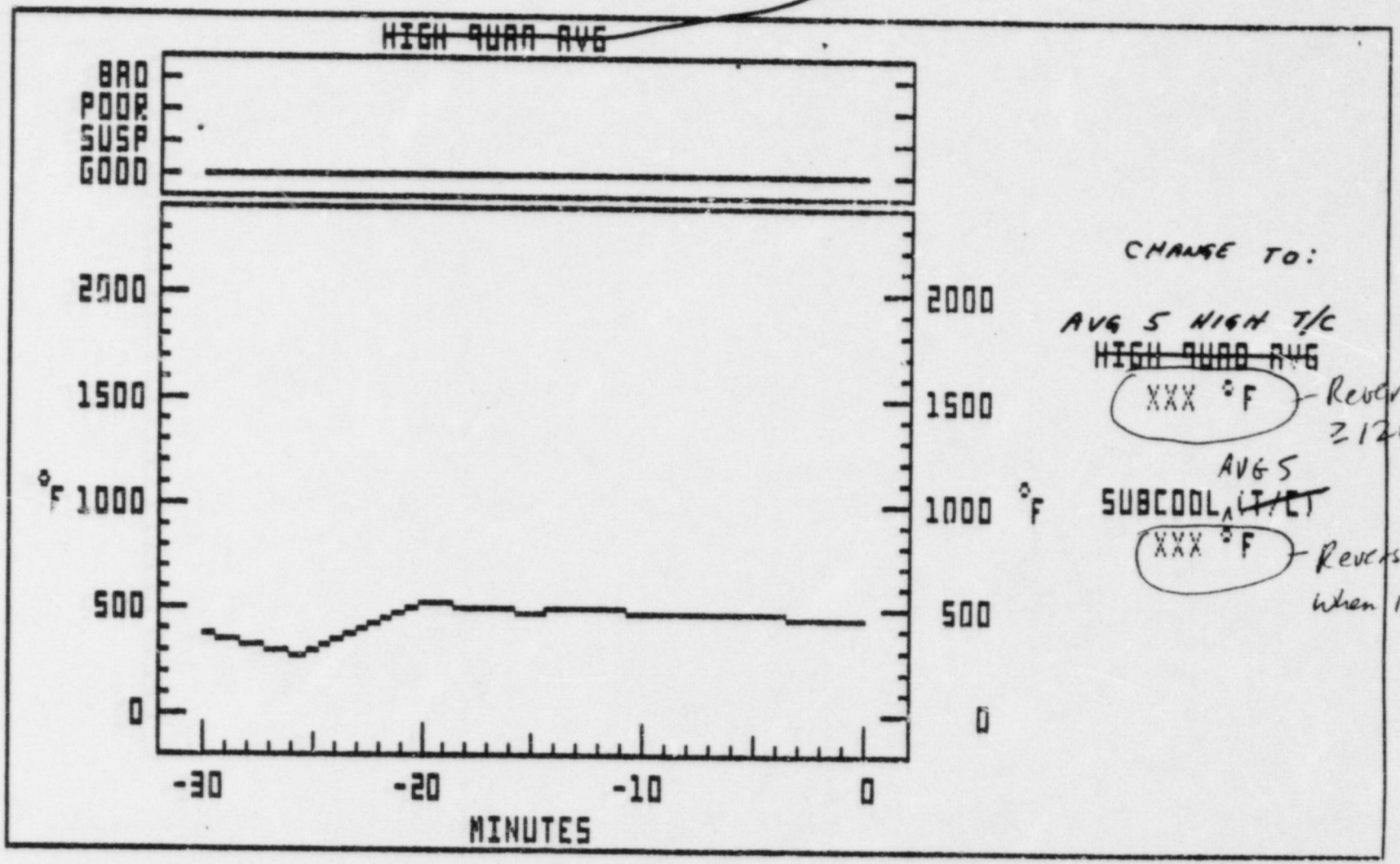
QUAD I			QUAD II		
LOC	SENSOR	°F	LOC	SENSOR	°F
A08	TE-01	XXXX	E12	TE-06	XXXX
			E14	TE-07	XXXX
B05	TE-02	XXXX			
B10	TE-03	XXXX	F11	TE-11	XXXX
E07	TE-05	XXXX	H15	TE-15	XXXX
F09	TE-10	XXXX	J10	TE-17	XXXX
			J12	TE-18	XXXX
			K11	TE-22	XXXX

T/C PAGE 4

QUAD III			QUAD IV		
LOC	SENSOR	°F	LOC	SENSOR	°F
H08	TE-14	XXXX	E04	TE-04	XXXX
K08	TE-21	XXXX	F03	TE-08	XXXX
			F05	TE-09	XXXX
M09	TE-23	XXXX			
			G01	TE-12	XXXX
N06	TE-24	XXXX	G06	TE-13	XXXX
P08	TE-25	XXXX	J02	TE-16	XXXX
R07	TE-26	XXXX	K03	TE-19	XXXX
			K05	TE-20	XXXX

CHANGE TO:

AVG 5 HIGH T/C



CHANGE TO:

AVG 5 HIGH T/C

~~HIGH QUAD AVG~~

XXX °F — Reverse video ≥ 1200

AVG 5

SUBCOOL ~~LT/LT~~

XXX °F — Reverse video when in alarm

T/C PAGE 6

THERMOCOUPLE DIAGNOSTIC PAGE 1 TIME 14:21:58 MESSAGE 013

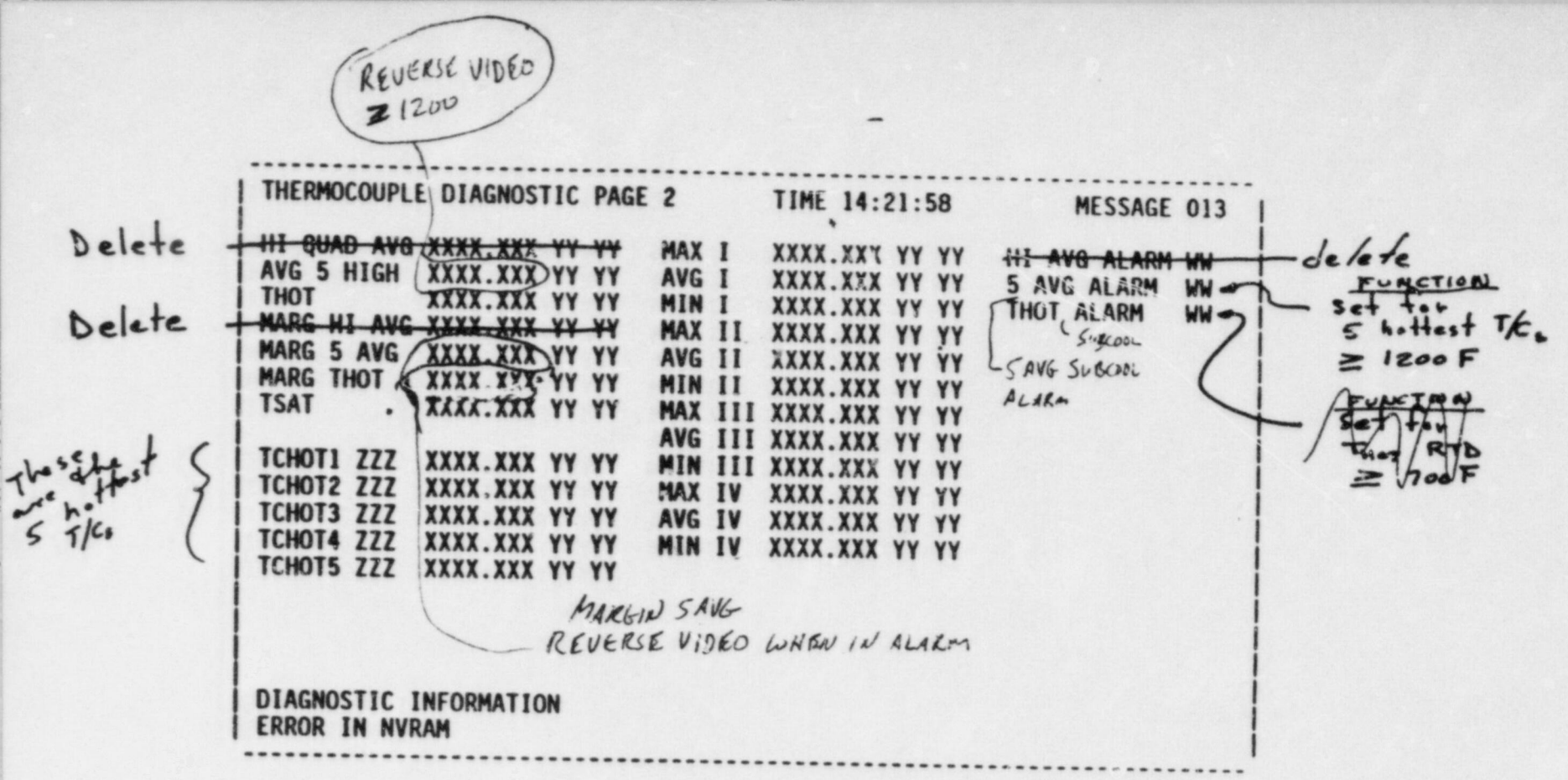
TE-01	XXXX.XXX YY YY	TE-14	XXXX.XXX YY YY	RJB1	XXX.XXX YY YY
TE-02	XXXX.XXX YY YY	TE-15	XXXX.XXX YY YY	RJB2	XXX.XXX YY YY
TE-03	XXXX.XXX YY YY	TE-16	XXXX.XXX YY YY	RJB3	XXX.XXX YY YY
TE-04	XXXX.XXX YY YY	TE-17	XXXX.XXX YY YY		
TE-05	XXXX.XXX YY YY	TE-18	XXXX.XXX YY YY		
TE-06	XXXX.XXX YY YY	TE-19	XXXX.XXX YY YY		
TE-07	XXXX.XXX YY YY	TE-20	XXXX.XXX YY YY		
TE-08	XXXX.XXX YY YY	TE-21	XXXX.XXX YY YY		
TE-09	XXXX.XXX YY YY	TE-22	XXXX.XXX YY YY		
TE-10	XXXX.XXX YY YY	TE-23	XXXX.XXX YY YY		
TE-11	XXXX.XXX YY YY	TE-24	XXXX.XXX YY YY		
TE-12	XXXX.XXX YY YY	TE-25	XXXX.XXX YY YY		
TE-13	XXXX.XXX YY YY	TE-26	XXXX.XXX YY YY		

DIAGNOSTIC INFORMATION
ERROR IN RAM 1000 + 0000

NOTE:

XXXX.XXX = Engineering Units
YY = Diagnostic Characters

ERROR MESSAGE PAGE 1A

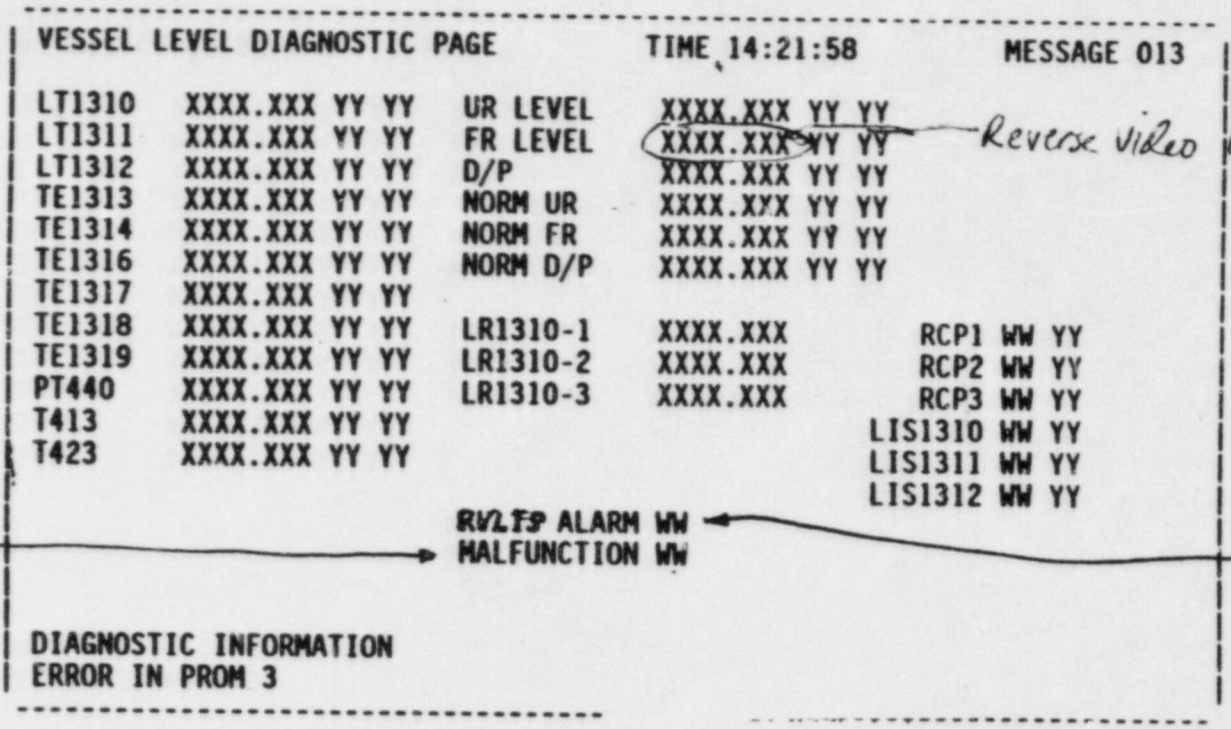


NOTE:

WW = Contact Status
XXXX.XXX = Engineering Units
YY = Diagnostic Characters
ZZZ = Thermocouple Location (i.e., A08)

ERROR MESSAGE PAGE 18

NOTE: Above setpoints are to be programable



Reverse Video when RVLIS Alarm

Alarm when CC system malfunctions

FUNCTION

Set alarm to actuate when 5 Hottest T/C's ≥ 700 °F and Full Range RVLIS ≤ 40% with no RCPs running.

NOTE:

WW = Contact Status
XXXX.XXX = Engineering Units
YY = Diagnostic Characters

ERROR MESSAGE PAGE 2

NOTE: Above setpoints are to be programable