Westinghouse Class 3

TECHNICAL MANUAL

FOR

INADEQUATE CORE COOLING

MONITOR-86

Watts Bar Units 1 and 2

Tennessee Valley Authority

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Volume I of III

WESTINGHOUSE ELECTRIC CORPORATION
Nuclear Instrumentation and Control Products Department
Pittsburgh, PA 15230

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SECTION 5
REMOTE DISPLAY INFORMATION

5.1 OVERVIEW

The ICCM-86 remote plasma display is a qualified microprocessor-based indication system used to relay core cooling information computed at the ICCM-86 main electronics cabinet to the control room operator. The display presents the following information: vessel level, pump status, System sensor readouts and status, and trending. The ICCM-86 System requires more than one graphic page to effectively convey all of its data to an operator. The data are shown in four different types of user-friendly graphics on a high-resolution plasma display board. In the event of an accident, the display, via the keypad, allows the operator to access the current plant status from one location and aids the operator in selecting an appropriate action.

Assembly, installation, and wiring drawings of the ICCM-86 System are provided in section 18.

5.2 PHYSICAL DESCRIPTION

The following paragraphs describe the physical characteristics of the modular plasma display.

5.2.1 Modular Plasma Display

The ICCM-86 modular plasma display houses its components in three enclosures: an electronics package, a stand-alone display, and an operator keypad.

The electronics package is a floor-mountable unit that measures 16.25 inches (412.75 mm) wide by 19.38 inches (492.25 mm) deep by 10.25 inches (260.35 mm) high. It is mounted to the floor with four .375-16 carbon steel bolts (ASTM-A307). The length of the bolts is plant specific. Six inches (152.40 mm) are required at the rear of the display for cable connections. Eighteen inches (457.20 mm) are required above the electronics package for servicing access.

The stand-alone display is a panel-mountable unit 12.88 inches (327.15 mm) wide by 9.88 inches (250.95 mm) high by 6 inches (152.40 mm) deep. The display is mounted

to the panel with four 10-32 x 1.00 stainless steel 303 screws (ASTM-A582). (Refer to Westinghouse drawing 2D32534 in section 18 for hole locations.) The display has a cutout requirement of 12.25 inches (311.15 mm) wide by 8.25 inches (209.55 mm) high. A 6-inch (152.40 mm) clearance is required at the rear of the stand-alone display for cable connections.

The operator keypad is also a panel-mountable unit. It measures 2.80 inches (71.1 mm) wide by 6.00 inches (152.4 mm) high by 4.06 inches (103.12 mm) deep. The unit is mounted to the panel with two jacking screws that are located at the top and bottom of the keypad. A cutout of 2.42 inches (61.47 mm) wide by 5.62 inches (142.75 mm) high is required for the unit. Also, the keypad requires 6 inches (152.40 mm) of cable access space at its rear.

5.3 FUNCTIONAL DESCRIPTION

The ICCM-86 plasma display is functionally separated into three parts: input, processing, and output. The input portion consists of the operator keypad and the RS-422 datalink interface to the ICCM-86 cabinet performed by the display peripheral interface board. The processing section is performed by the set of multibus boards in the unit: the Intel iSBC-86/05A, the Intel iSBC-544A, and the Micro Memory Inc. MM-8500CC/128. Finally, the output functions of the plasma display unit are handled by the display interface board and the Electroplasma plasma display.

5.3.1 ICCM-86 Modular Plasma Display Keypad

The operator keypad for the ICCM-86 modular plasma display is a vertical four-button arrangement linked to the electronics package by a five pair t.s.p. (twisted shielded pair) cable. Designed in cooperation with human factors engineering, the stand-alone keypad provides a remote means for the operator to access the necessary information concerning thermocouple monitoring, reactor vessel level, and System diagnostics. A description of each of the display pages available to the operator and instructions on accessing each are given later in this section.

5.4 REQUIREMENTS, CHARACTERISTICS, AND LIMITATIONS

The following paragraphs give information necessary in the operation of the modular remote plasma displays.

5.4.1 Power Requirements

The power requirements for the modular plasma display are separated into the power required by each piece.

Electronics package – 200 watts, supplied by a 120 V (+/– 10 percent) 60 Hz (+/– 5 percent) ac bus

Stand-alone display – 18 watts supplied by a 120 V (+/– 10 percent) 60 Hz (+/– 5 percent) ac bus (This represents only the power needed by the fan. All Electroplasma display power requirements are supplied from the electronics package.)

Operator keypad – 0 watts (All keypad power requirements are supplied by the electronics package.)

5.4.2 Interconnect Cable Lengths

Interconnection cabling between the electronics package and the stand-alone display must be less than 100 feet (30 m) in length because of the high frequency of data transmission between the two devices.

Interconnect cabling between the keypad and electronics package can be up to 250 feet (75 m), if necessary.

5.4.3 Installation Procedure

The following paragraphs outline the procedures necessary in mounting these three components of the modular plasma display: electronics package, stand-alone display, and operator keypad. Specific procedures for each piece will be described in a separate paragraph.

First, the electronics package should be floor mounted with four .375-16 diameter bolts. Note that the material for these is specified as type ASTM-A307 carbon steel on the outline/installation drawing found in section 18. (Refer to outline/installation drawing 2D32533 in section 18 for hole spacing required on the electronics package base.)

To mount the stand-alone display package, merely slide the unit into its prescribed cutout, then insert four 10-32 type 303 stainless steel screws into the panel. If the holes in the panel are not tapped, place the four lockwashers and hex nuts on the back side of the panel and tighten until snug. The cutout dimensions for the stand-alone display are given in paragraph 5.2 and on the outline/installation drawing 2D32534 located in section 18.

To mount the operator keypad, remove both mounting brackets from the keypad chassis and slide the keypad into the panel from the front. Mount the brackets back to the keypad chassis with the 6-32 screws. Reinsert the two jacking screws with locking nuts into the mounting brackets and tighten against the panel. Next, lock the jacking screws in place with the hex nuts. (Refer to drawing 2D32535 in section 18 for cutout dimensions of the keypad.)

Install the interconnecting cabling per Westinghouse drawing 5360C78 located in section 18.

5.4.4 External Connections

External connections for the ICCM-86 plasma display consist of the power and datalink connections.

The power for the ICCM-86 electronics package and stand-alone display should be taken from a 1E regulated 120 V bus. Connections for this power are provided through the Burndy Connectors P2 and P8 (P/N G6F10-4SNH). (P2 is the ac connector for the train A and train B remote displays.) These connections should be as follows:

Pin	Signal
A	Ac high
B	Ac ground
C	Ac low

The datalink connections to the ICCM-86 cabinet are to be made to the P1 connector (P/N G6F14-92SNH) for the train A and train B remote displays in the following manner:

Pin	Signal
A	Data low
B	Shield
C	Data high

Please refer to the ICCM-86 System external connection drawing in section 18 for more information.

5.5 CIRCUIT BOARDS

5.5.1 CPU Board

The central processing unit (CPU) board is an iSBC-86/05A single board computer from Intel. It is a 16-bit multibus compatible board which includes an 8086-2 microprocessor, an 8087 math co-processor, 8K of random-access memory (RAM), 256K bytes of read-only memory (ROM), 24 programmable input/output (I/O) lines, three programmable interval timers, a programmable interrupt controller, and one programmable serial I/O port.

The CPU board communicates with the System boards via the Intel iSBC multibus and is found in the A1 slot of the card cage.

Although the CPU board is an Intel iSBC product, it has been modified and qualified by Westinghouse for use in specific applications by Westinghouse customers. The A1 board configuration drawing (1772E77) is provided in section 18.

5.5.2 CMOS RAM Board

The Micro Memory MM-8500CC/128 is a 128K byte nonvolatile CMOS random-access memory (RAM) board which is multibus compatible. It has onboard nickel-cadmium batteries for data retention while the main power to the board is off. It also has a

built-in programmable real-time clock and calendar. The current configuration of the board is populated with RAM chips which provide 128K of System RAM memory.

This MM-8500CC/128 board communicates with the Intel iSBC-86/05A board through the multibus. It is located in slot A2 of the card cage. The A2 board configuration drawing (1776E02) is provided in section 18.

5.5.3 Communications Board

The Intel iSBC-544A intelligent communications controller board is a multibus compatible communications board which includes an 8085A microprocessor for onboard processing, four programmable synchronous and asynchronous serial I/O channels with RS-232C buffering, one parallel I/O port, seven programmable timers, eight programmable priority interrupts, 8K bytes of read-only memory, and a maximum of 16K bytes of random-access memory. This board works in conjunction with a master CPU board in the System which allows all outside communications to take place on this board and relieves this function from the master CPU board.

This board communicates with the Intel iSBC-86/05A board through the multibus and is located in slot A3 of the card cage. In this particular system the board uses one serial I/O channel for receiving an RS-232C input from the display peripheral interface board (A4). The A3 board configuration drawing (1772E76) is located in section 18.

5.5.4 Display Peripheral Interface Board

The display peripheral interface board performs all utility functions required to interface the separate components of the ICCM-86 plasma display unit. Located in the A4 slot of the card cage, it serves as an RS-422 to RS-232C converter so that the datalink signal from the cabinet is compatible with the Intel iSBC-544A communications board. It serves as a keypad interface by instructing the CPU board to display the appropriate display page. Also, it provides a deadman timer for the CPU. An onboard green LED indicates that the CPU is running properly. An onboard red LED will light when the CPU has timed out. Finally, the board transmits the signals sent from the CPU board (A1) and destined for the plasma display via the display interface board (A5).

The board is designed and built by Westinghouse. It is multibus compatible and has been qualified and tested to meet all customer requirements.

5.5.5 Plasma Display

The plasma display is the attractive feature of the ICCM-86 remote display module. A 4.25 inch by 8.50 inch (108 mm by 216 mm) flat panel presents alphanumeric and graphics information to the control room operator. Supplied by Electroplasma Incorporated, its design has been modified to meet packaging requirements and Westinghouse qualification standards.

Functionally, the display takes the serial RS-422 data from the display interface board, processes it, and refreshes the information presented on the screen. New information is presented every 2 seconds as long as the processor is running. In case of a processor failure, the display is not blanked. An onboard nonvolatile memory allows it to retain the data shown at the time of the processor failure.

5.5.6 Display Interface Board

The display interface board (A5) is responsible for controlling the interface between the plasma display and the electronics. It performs the following operations for the System:

- Changes the data signals to the display from transistor-transistor levels (TTL) to RS-422 levels for greater transmission capabilities.
- Controls the display brightness and its read/write capabilities.

The display interface board is supplied by Electroplasma, but has been modified (per drawing 2D31911 provided in section 18) by Westinghouse to meet System packaging and qualification requirements.

5.5.7 High-Voltage Power Supply

The high-voltage power supply board (A6) is a Westinghouse design that supplies the plasma display power requirements. A compact design, the board provides the 135-volt and 55-volt sources, as well as the lower level voltages, with two Sprague power supply modules mounted on a 3.4 inch by 5.0 inch (86.4 mm by 127.0 mm)

printed circuit board. The board has been qualified to meet IEEE 323-1974 and IEEE 344-1975 standards.

5.5.8 Keypad Encoder/Driver Board

The keypad encoder/driver board mounted in the modular display keypad is a utility board designed and manufactured by Westinghouse. Packaged on a 1 inch (25.4 mm) by 2.75 inches (69.85 mm) printed circuit board, the encoder/driver accepts up to eight inputs from the operator keypad and encodes them for proper interpretation by the central processing unit (CPU). See figure 5-1 for a view of the modular display keypad. The board also generates a flag which informs the CPU that a button has been pushed. Each of the signals are then converted from transistor-transistor logic (TTL) level to RS-422 for long distance transmission. No localized power supply is required. The power for board operation is provided through the five pair cable which links the keypad to the electronics package.

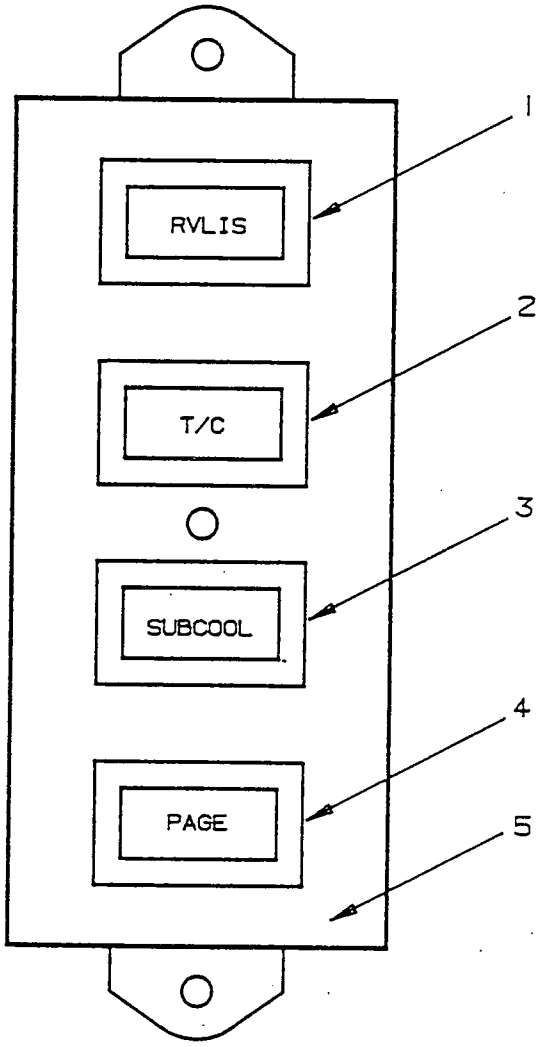
5.6 RECEIVING/UNPACKING

The remote displays are shipped packaged separately. Each package should be kept in the position indicated by the markings on the exterior of the packing material. Rough handling must be avoided, and each package must be inspected for damage upon delivery. All observable damage should be indicated on the carrier's delivery receipt to expedite any insurance claims against the carrier.

At the installation site, all packaged units should be moved from the transportation vehicle to the point of storage or installation by hand, hand truck, or similar method.

Shipment of the units from the factory to installation site is to be done in accordance with the uniform freight classification rules.

No special tools are required to open the packing cases. A hammer, nail puller, large screwdriver, adjustable-end wrench, and metal cutting shears are sufficient to open any packing case. The use of chisels, crowbars, and wrecking bars must be avoided since these tools may cause damage to the equipment when inserted into the case.



1. RVLIS DISPLAY SWITCH
2. T/C DISPLAY SWITCH
3. SUBCOOL DISPLAY SWITCH
4. PAGE SWITCH TO DIAGNOSTIC DISPLAY PAGE
5. OPERATOR KEYPAD

025-A-21990A-20

Figure 5-1 Four-Button Keypad Arrangement

The remote displays are packaged in corrugated cardboard. To remove the packing from the displays the following procedure must be followed.

(1) Remove or open the top of the crate.

(2) Remove the internal shipping blocks or bracing.

(3) Lift out the assembly.

(4) Remove the protective wrapping.

5.7 INSPECTION

Upon receipt, the condition of the packing material and System components should be noted. Any observable damage to any item should be indicated on the carrier's delivery receipt.

After unpacking all equipment, proceed with the inspection as follows:

(1) Examine the exterior of each item for dents, scratches, corrosion, dirt, and so forth.

(2) Examine the interior of each item as applicable and remove any foreign objects or packing material that may be present.

(3) Perform a visual and mechanical inspection to verify that there are no loose or damaged wires, wire harnesses, or wire interconnections. Also, confirm that all mechanical fasteners are in place and tight.

(4) Check that all printed circuit cards are properly seated with their mating connector(s) and plug(s).

(5) Inspect for missing or broken lenses or parts.

(6) Verify that the power supply fuses are in their respective fuse holders and are not broken or jammed.

(7) Operate all switches to ascertain that they are not broken or jammed.

(8) Ensure that all slide rails operate freely without binding.

5.8 STORAGE

All equipment should be stored in its original shipment packing, or suitable equivalent, until the time of final installation. Items should be maintained in the position indicated on their original packaging.

The storage facility should be a fire-resistant, weather-tight, rodent-proof, well-ventilated structure. It should NOT be subject to liquid seepage or flooding. Provisions should be made for minimizing dust within the building.

The overall general requirements for storage are that the storage be in accordance with ANSI N45.2.2.-1972, Level B.

The following environment must be maintained:

(1) The temperature must be between the limits of 40°F (5°C) and 120°F (50°C).

(2) The relative humidity must be between the limits of 15 and 95 percent.

5.9 PREOPERATIONAL CHECKOUT

Once the external connections of the display have been completed, the unit is ready for a preoperational checkout.

Before powering up the System, loosen the four captive screws at the front of the display and slide the electronics drawer out. Verify that all ribbon cables at the top of the card cage are seated properly. Also, check that no excessive amount of dirt or debris has entered the chassis. Slide the electronics back into the mounting case and tighten the four captive screws until snug. Next, verify that the fuse F1 at the rear of the electronics package is still intact. The fuse in the stand-alone display should also be checked before connecting power to the unit.

After this visual check, the display should be ready for use. If not already done, connect cables to P1, P2, and P8. Turn switch S1 on. The display should show an introductory page for the operator. Depressing any of the buttons should bring up another page. Resetting the unit via the white reset switch on the rear of the electronics package should return the introductory page to the display screen. Figure 5-2 shows the introductory page.

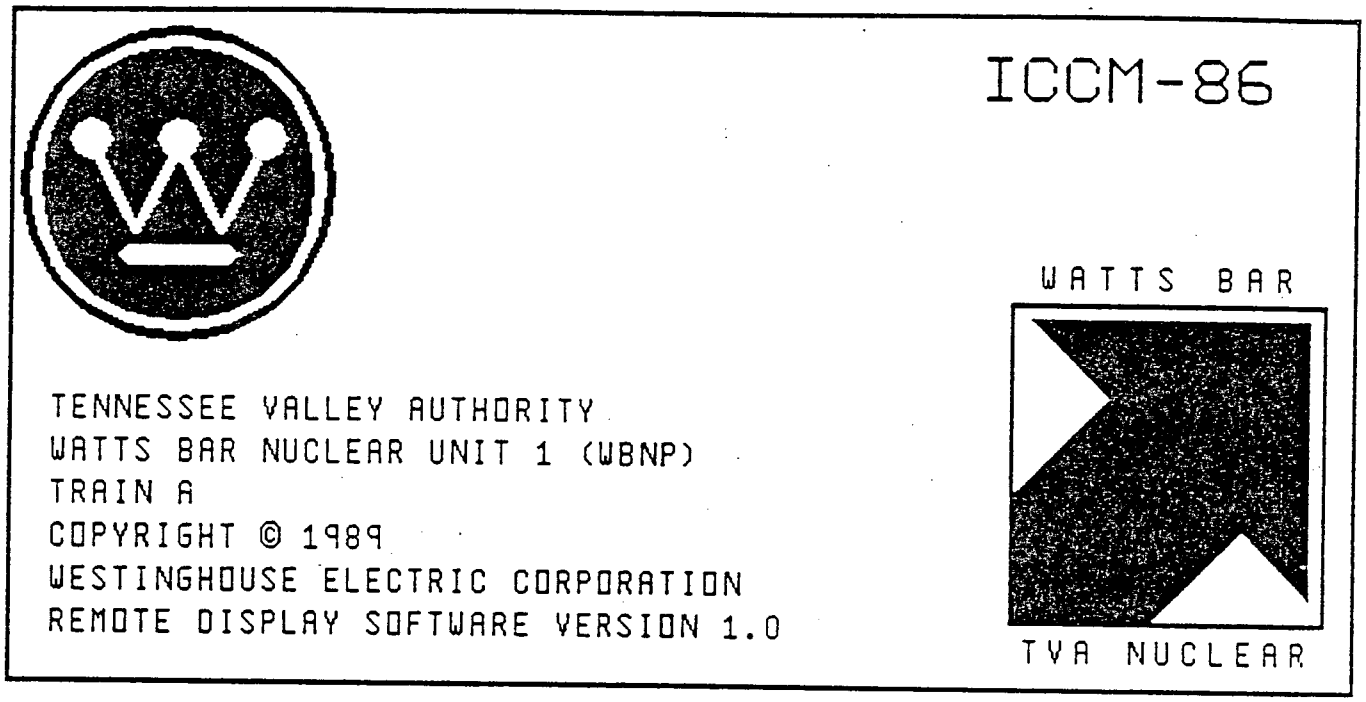


Figure 5-2 Typical Introductory Page

5.10 ICCM-86 DISPLAY PAGE DESCRIPTION

The ICCM-86 remote display consists of various graphic display pages which are divided into the following four different types:

- Reactor coolant system (RCS) level displays
- Thermocouple displays
- Subcooling displays
- Miscellaneous displays

The reactor coolant system (RCS) level display pages include the RCS level summary page, the RCS level sensor status page, the RCS level trend pages, and the RCS diagnostics page. The thermocouple displays include the T/C quadrant summary

page, the T/C map page, the individual T/C quadrant page, the T/C average temperature trend page, the auctioneered high core quadrant average temperature trend page, and the T/C diagnostics pages. The subcooling displays include the subcooling trend page, the heatup limit pressure-temperature curve page, the cooldown limit pressure-temperature curve page, and the subcooling diagnostics page. There are two other pages which are categorized as miscellaneous display pages and include the introductory page and the datalink failure page.

5.10.1 Display Page Access

Accessing the display pages requires using the four-button operator keypad. On the keypad are buttons labeled "RVLIS," "T/C," "SUBCOOL," and "PAGE." Figure 5-1 shows the ICCM-86 keypad button arrangement.

When the ICCM-86 remote plasma display is first powered up, the introductory page is displayed. Figure 5-2 is an example of the introductory page. Once any of the buttons on the operator keypad is pushed, this introductory page is erased and is replaced with one of the graphic display pages. To reaccess the introductory page, a hardware reset must be applied to the display unit.

Pushing the "RVLIS" button on the keypad allows the operator to access the vessel level section of the software. This action brings up the RVLIS summary page described later in this section. The other displays in the vessel level monitoring section can be accessed by pushing the "PAGE" button on the keypad. Pushing the "PAGE" button when the unit is displaying the RVLIS diagnostics page returns the operator to the RVLIS summary page. Pushing the "RVLIS" button at any time returns the operator to the RVLIS summary page. The display sequence for the vessel level monitoring section is as follows:

(1) RVLIS Summary Page

(2) RVLIS Static Head Trend Page

(3) RVLIS Dynamic Head Trend Page

(4) RVLIS Sensor Display Page

(5) RVLIS Diagnostics Page

Pushing the "T/C" button on the keypad allows the operator to access the thermocouple monitoring section of the software. This action brings up the T/C map page described later in this section. The other displays in the thermocouple monitoring section can be accessed by pushing the "PAGE" button on the keypad. Pushing the "PAGE" button when the unit is displaying the T/C diagnostics page returns the user to the T/C map page. Pushing the "T/C" button at any time returns the operator immediately to the T/C map page. The display sequence for the thermocouple monitoring section is as follows:

(1) Incore T/C Map Page

(2) T/C Quadrant Summary Page

(3) Individual T/C Quadrant Page

(4) T/C Average Temperature Trend Page

(5) Auctioneered High Core Quadrant Average Temperature Trend Page

(6) T/C Diagnostics Page 1

(7) T/C Diagnostics Page 2

When the "SUBCOOL" button is pressed, the subcooling trend page is displayed. The other subcooling pages are accessed as previously described. The display sequence is as follows:

(1) Subcooling Trend Page

(2) Heatup Limit P-T Curve Page

(3) Cooldown Limit P-T Curve Page

(4) Subcooling Diagnostics Page

5.10.2 Miscellaneous Pages

Two pages of the plasma display graphics cannot be grouped into the functional monitoring areas and cannot be accessed by the operator. These are the introductory page and the datalink failure page.

5.10.2.1 Introductory Page

When the remote display is first powered up, an introductory page appears which contains the logos of both the utility and Westinghouse. In addition, the page identifies the plant and version number for which the software is applicable and the instrumentation train orientation. Figure 5-2 shows a typical introductory page.

5.10.2.2 Datalink Failure Page

In the event of a datalink failure between the ICCM-86 main electronics cabinet and the ICCM-86 System remote plasma display unit, a software monitor blanks the previously requested page and presents "DATALINK FAILURE" in bold letters on the screen. A typical display of the datalink failure page is shown in figure 5-3.

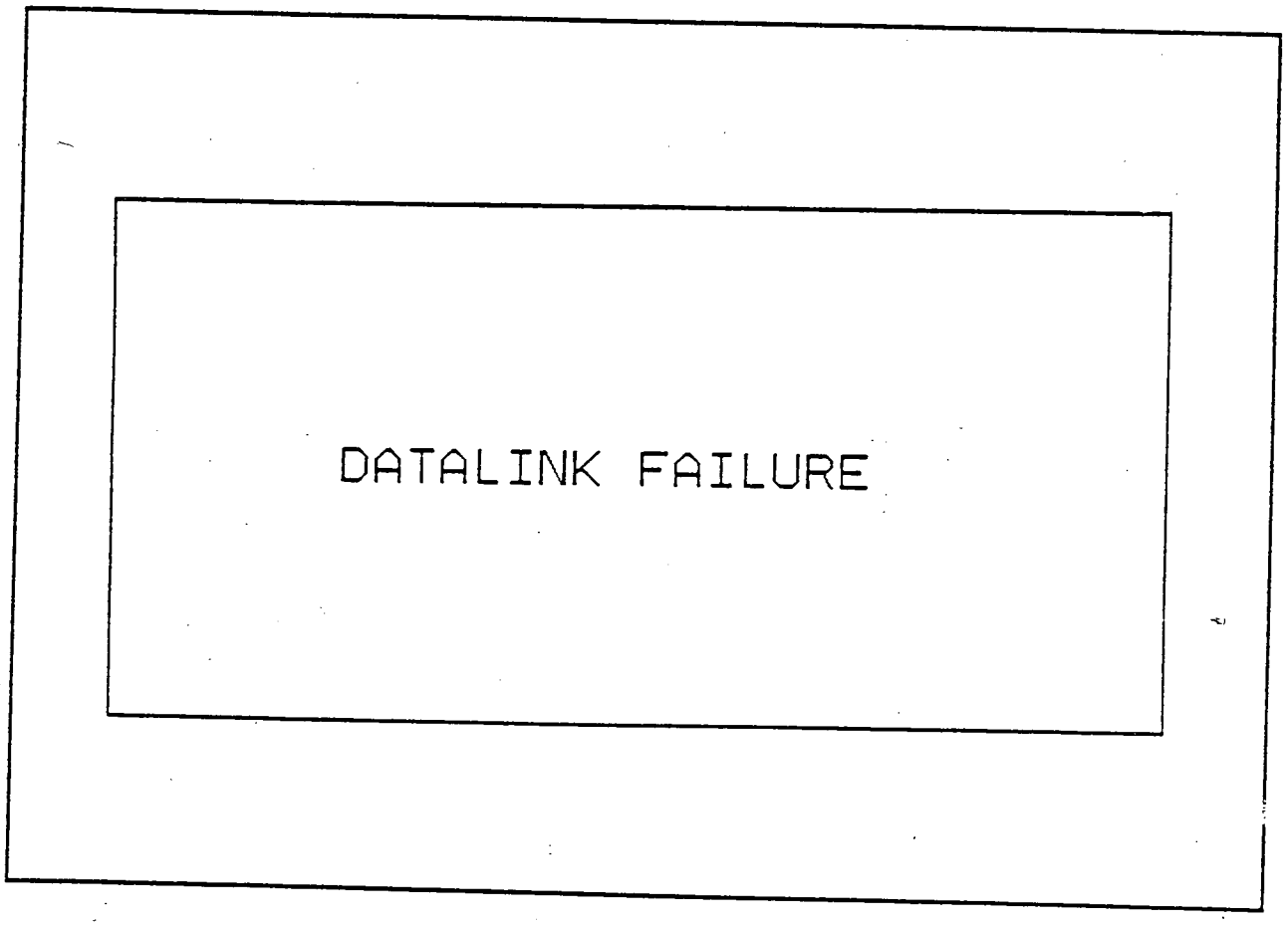


Figure 5-3 Typical Datalink Failure Display Page

The display software monitor allows 10 seconds before displaying this message. The previously requested page returns once the datalink is reestablished.

A datalink failure can be caused by the following:

- The ICCM-86 System main electronics cabinet is powered down.
- The ICCM-86 System main electronics cabinet has a malfunction associated with the display datalink while the cabinet is in the online mode.
- The ICCM-86 System main electronics cabinet is in a cold self-calibration mode (cold start).
- The ICCM-86 System main electronics cabinet is in the offline mode (offline menus).

5.10.3 Vessel Level Monitoring

This group of display pages allows an operator to monitor coolant levels in the reactor vessel. Five pages are necessary and are as follows:

- RVLIS Summary Page
- RVLIS Static Head Trend Page
- RVLIS Dynamic Head Trend Page
- RVLIS Sensor Display Page
- RVLIS Diagnostics Page

These pages are explained in detail in the following paragraphs.

5.10.3.1 RCS Level Summary Display Page

The RCS level display pages allow an operator to monitor levels readings in the hot leg and the reactor vessel. The following five pages are necessary and are described in the following sections:

- RCS Level Summary

- RCS Static Head Level Trend
- RCS Dynamic Head Level Trend
- RCS Level Sensor Status
- RCS Diagnostics

As illustrated in figures 5-4 and 5-5, the RCS level summary page has a vertical simulated meter for indicating either the static or dynamic vessel level range, a graphic representation of either the reactor vessel or a reactor coolant pump (RCP), and a vertical listing of other System parameters. These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System, and do not necessarily represent an exact replica of the display page that actually appears on the screen.

This display page layout will depict viewing left to right:

- A representative layout of the reactor vessel or a reactor coolant pump (RCP)
- The static or dynamic range meter
- The listing of System parameters

The static/dynamic range meter is scaled from zero to 100 percent. A pointer inside the vertical meter scale indicates the current level reading. A pointer and numeric value outside the meter indicate the critical vessel level setpoint. Above the static/dynamic range meter is the rounded whole number value for the current level reading. The heading "Static Range" or "Dynamic Range," depending on the current conditions of the reactor, will also appear above the scaled meter.

A calculated analog input point quality code of BAD associated with vessel head level will cause the word BAD QUALITY to be vertically displayed inside the static/dynamic range meter. The level indicator will default to an offscale low position and any numeric values associated with vessel head level will be replaced with the value XXXB. The "B" will appear in reverse video.

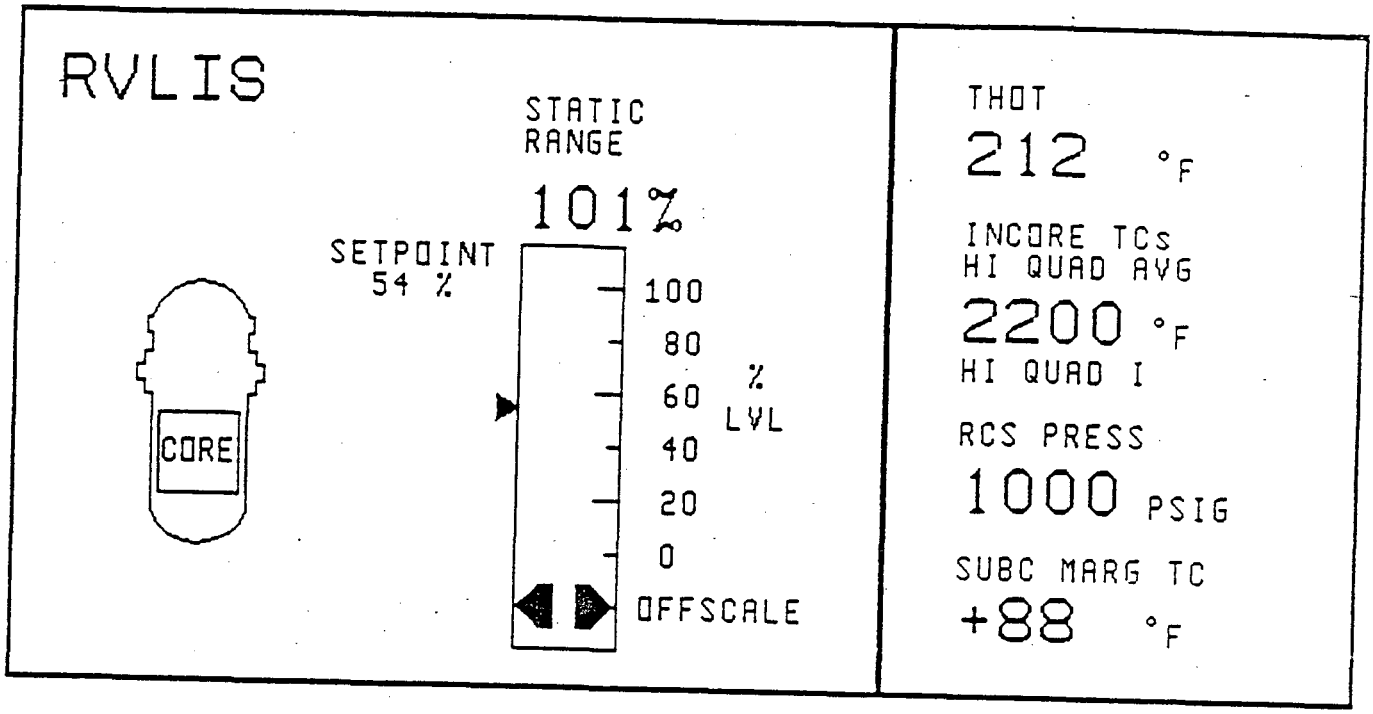


Figure 5-4 Typical RCS Static Level Summary Display Page

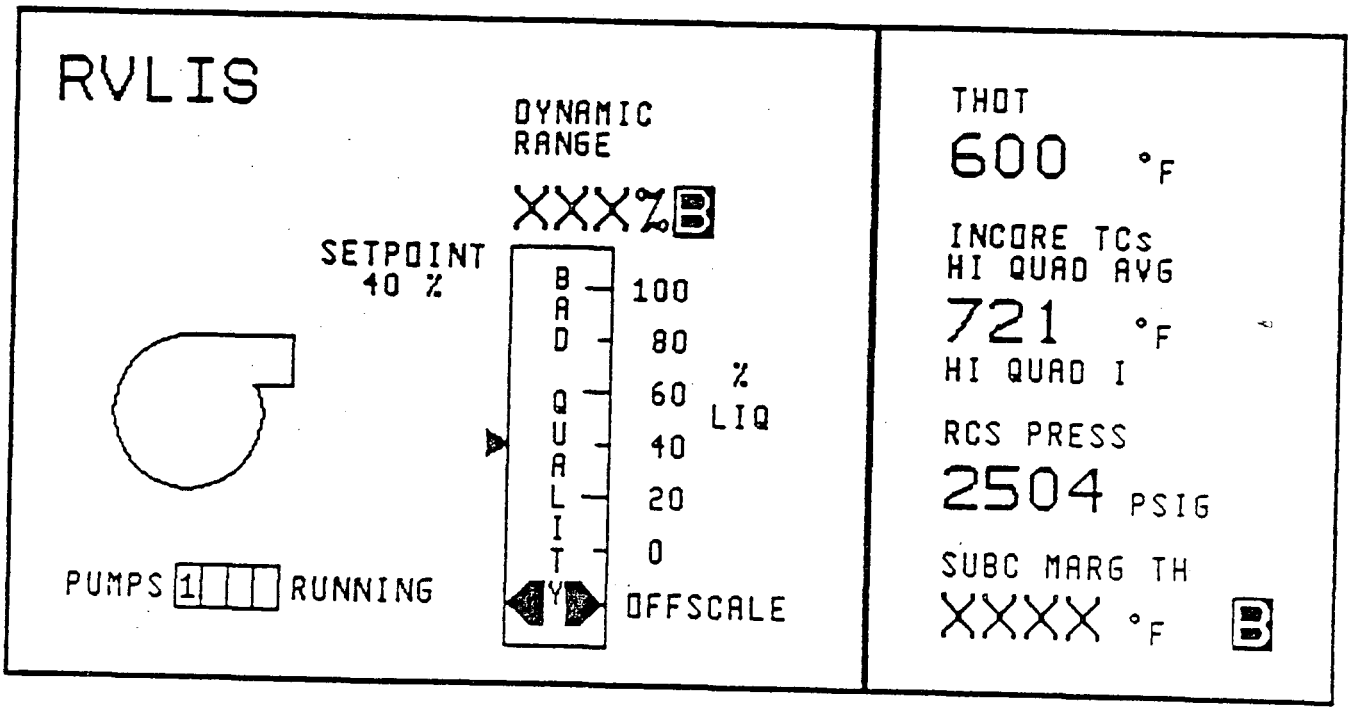


Figure 5-5 Typical RCS Dynamic Level Summary Display Page

If the current level percentage is "Offscale," either high or low, the pointer inside of the range meter will default to the position labeled "OFFSCALE." A quality code of "POOR" will then be assigned to level readings.

A calculated analog input point quality code of POOR associated with vessel head level will cause a reverse video "P" to follow any numeric values associated with vessel head level.

During dynamic operations, the status of the RCPs will be displayed in a block representation identified by a "PUMPS RUNNING" descriptor. If a pump is running, the number of that pump (1,2,3, or 4) will appear in the appropriate box within the block. If a pump is not running, the box will appear empty. If an RCP goes BAD, then a reverse video upper case "B" will appear in the appropriate block.

Whenever an RCP is in the start-up or coastdown mode, the display will indicate both the mode and pump number involved. The message "RVLIS INACCURATE" will also be displayed during either of these modes. A quality code of "Poor" will be assigned to RVLIS level during the startup or coastdown period.

In addition to the RVLIS on this page, the current rounded whole number values for INCORE TCs HI QUAD AVG, HI QUAD, THOT, RCS PRESS, and SUBC MARG (TC or TH) are given on the right-hand side of this display page. If the value for SUBC MARG (TC or TH) turns less than some critical setpoint, then its respective value will be displayed in reverse video.

If a calculated analog input point quality code of BAD or SUSPECT (without a manually entered value) is assigned to any of these values, then a reverse video "B" or "S," respectively, will be displayed next to the new value of X's, for a "BAD" quality code, or D's, for a "SUSPECT" quality code.

If a quality code of SUSPECT (with a manually entered value) is assigned to any of these values, then a reverse video "S" will be displayed next to the current numeric value.

If a calculated analog input point quality code of POOR is assigned to any of these values, then a reverse video "P" will be displayed next to the current numeric value.

5.10.3.2 RCS Level Trend Display Pages

The RCS level trend display pages (figure 5-6 and figure 5-7) maintain a record of RCS level conditions for a 30-minute period. The RCS level trending pages update every 20 seconds. These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System and do not necessarily represent exact replicas of the display pages that actually appear on the screen.

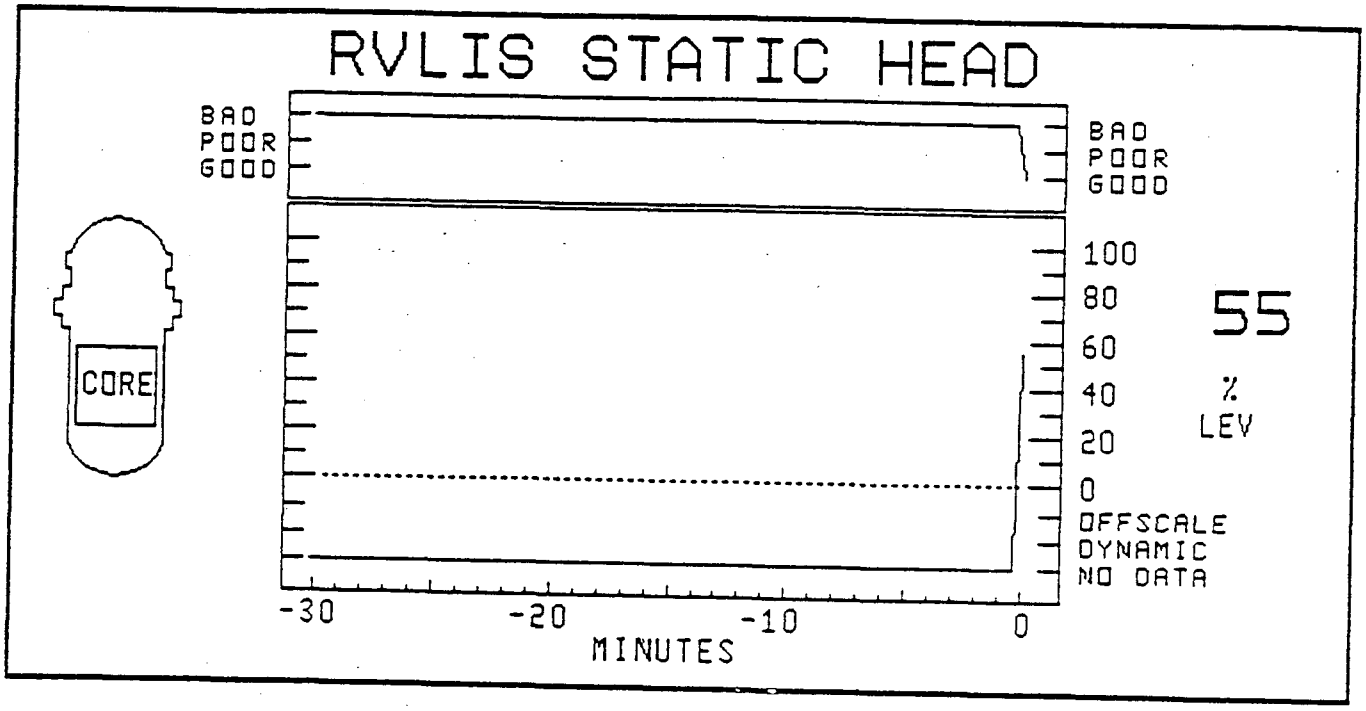


Figure 5-6 Typical RCS Static Level Trend Display Page

The first trending display page (figure 5-6) contains two trending line graphs which are associated with the "static" head vessel level inside the reactor. The graph can be easily distinguished by both the title "RVLIS STATIC HEAD," which appears at the top of the display, and the graphic representation of a reactor vessel which appears at the left side of the display.

The upper portion of the page contains the quality code trending graph which trends the calculated analog input point quality code for static head vessel level. The graph is labeled from top to bottom with the following quality codes: BAD, POOR, GOOD.

The lower portion of the page contains the data trending graph which trends the percentage of vessel level in the reactor. This graph is vertically labeled from zero to 100 percent and horizontally labeled from -30 to zero minutes (present). The rounded whole number value for static head vessel level is displayed to the right of this graph.

If the condition of the reactor vessel switches from a static to dynamic state, the trending line of the data trending graph will continuously move towards a low off-scale point labeled "DYNAMIC." If a static state returns, then the trending line will continuously move towards the appropriate percentage level.

A calculated analog input point quality code of BAD associated with static head vessel level will cause the data trend to draw a continuous line to a "NO DATA" indicator below the bottom of the scale. A reverse video "B" will be displayed next to the new level percentage value of X's, for a "BAD" quality code. The quality trend will trend along its BAD position on the graph.

If the current level percentage is "Offscale," either high or low, then the data trend will trend along the position labeled "OFFSCALE." A quality code of "POOR" will then be assigned to level readings.

A calculated analog input point quality code of POOR associated with vessel level will cause a reverse video "P" to be displayed next to the current numeric level percentage value. The quality trend will trend along its POOR position.

The second trending display page (figure 5-7) contains two trending line graphs which are associated with the vessel "dynamic" head inside the reactor. The graph can be easily distinguished by both the title "RVLIS DYNAMIC HEAD," which appears at the top of the display, and the graphic representation of a reactor coolant pump (RCP) which appears at the left side of the display.

The upper portion of the page contains the quality code trending graph which trends the calculated analog input point quality code for vessel dynamic head. The graph is labeled from top to bottom with the following quality codes: BAD, POOR, GOOD.

The lower portion of the page contains the data trending graph which trends the percentage of vessel liquid content in the reactor. This graph is vertically labeled

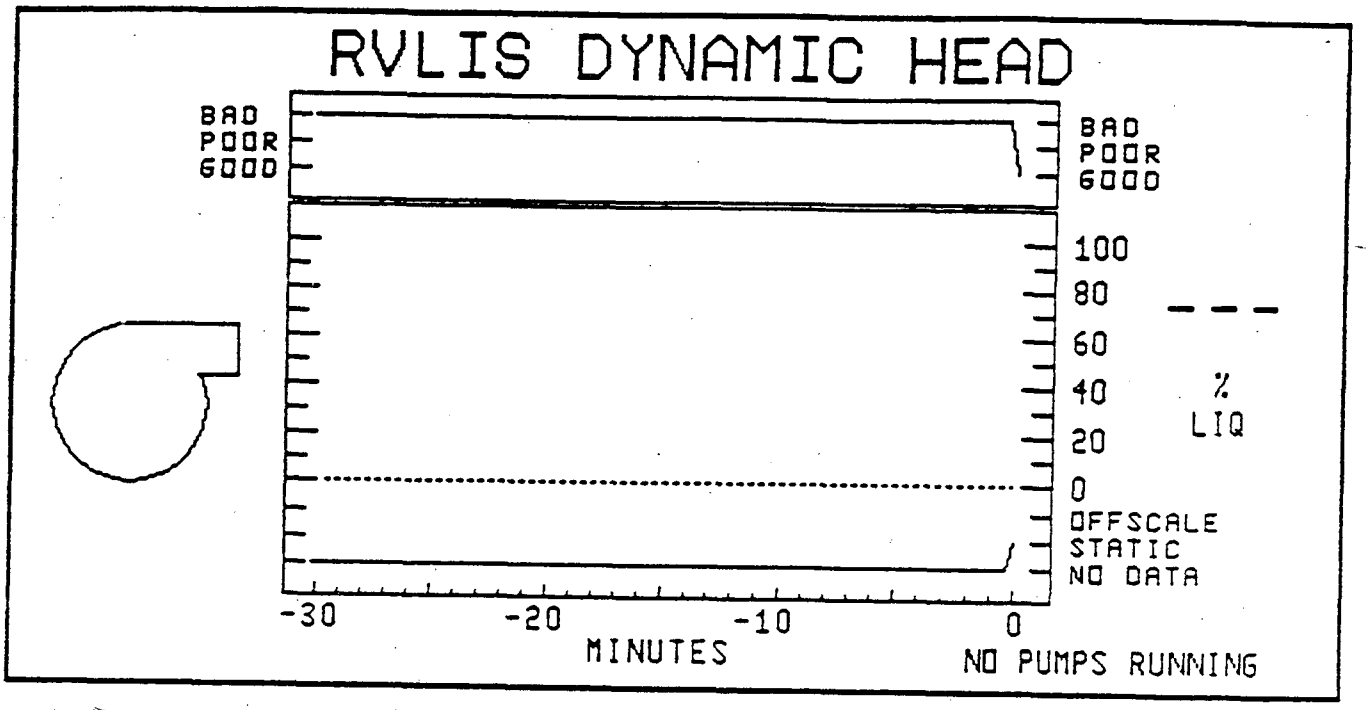


Figure 5-7 Typical RCS Dynamic Head Trend Display Page

from zero to 100 percent and horizontally labeled from -30 to zero minutes (present). The rounded whole number value for vessel liquid content is displayed to the right of this graph.

If the condition of the reactor vessel switches from a dynamic to static state, the trending line of the data trending graph will continuously move towards a low offscale point labeled "STATIC." If a dynamic state returns, then the trending line will continuously move towards the appropriate percentage level.

A calculated analog input point quality code of BAD associated with vessel dynamic head will cause the data trend to draw a continuous line to a "NO DATA" indicator below the bottom of the scale. A reverse video "B" will be displayed next to the new level percentage value of X's for a "BAD" quality code. The quality trend will trend along its BAD position on the graph.

If the current level percentage is "Offscale," either high or low, then the data trend will trend along the position labeled "OFFSCALE." A quality code of "POOR" will then be assigned to level readings.

A calculated analog input point quality code of POOR associated with vessel dynamic head will cause a reverse video "P" to be displayed next to the current numeric level percentage value. The quality trend will trend along its POOR position.

(The following paragraphs apply to both RVLIS trend pages.)

When the reactor vessel is in a dynamic state, the status of the RCPs will be displayed in a block representation identified by a "PUMPS RUNNING" descriptor. If a pump is running, the number of that pump (1,2,3, or 4) will appear in the appropriate box within the block. If a pump is not running, the box will appear empty. If an RCP goes BAD, then a reverse video upper case "B" will appear in the appropriate block.

Whenever a RCP is in the startup or coastdown mode, the display will indicate both the mode and the message "RVLIS INACCURATE."

In the event of a datalink failure, the trending line graphs are driven to their "NO DATA" positions once the datalink returns.

5.10.3.3 Sensor Status Display Pages

The RCS level sensor status display pages (figures 5-8 and 5-9) show a brief layout of the RCS level system. A representation of the reactor vessel is given along with the location of the compensation RTDs, the hydraulic isolators, and the RCS level D/P transmitters. These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System, and do not necessarily represent exact replicas of the display pages that actually appear on the screen.

If a sensor malfunction event occurs, a message is displayed next to the sensor describing its condition. A listing of the sensors and messages associated with each is given in tables 5-1 and 5-2.

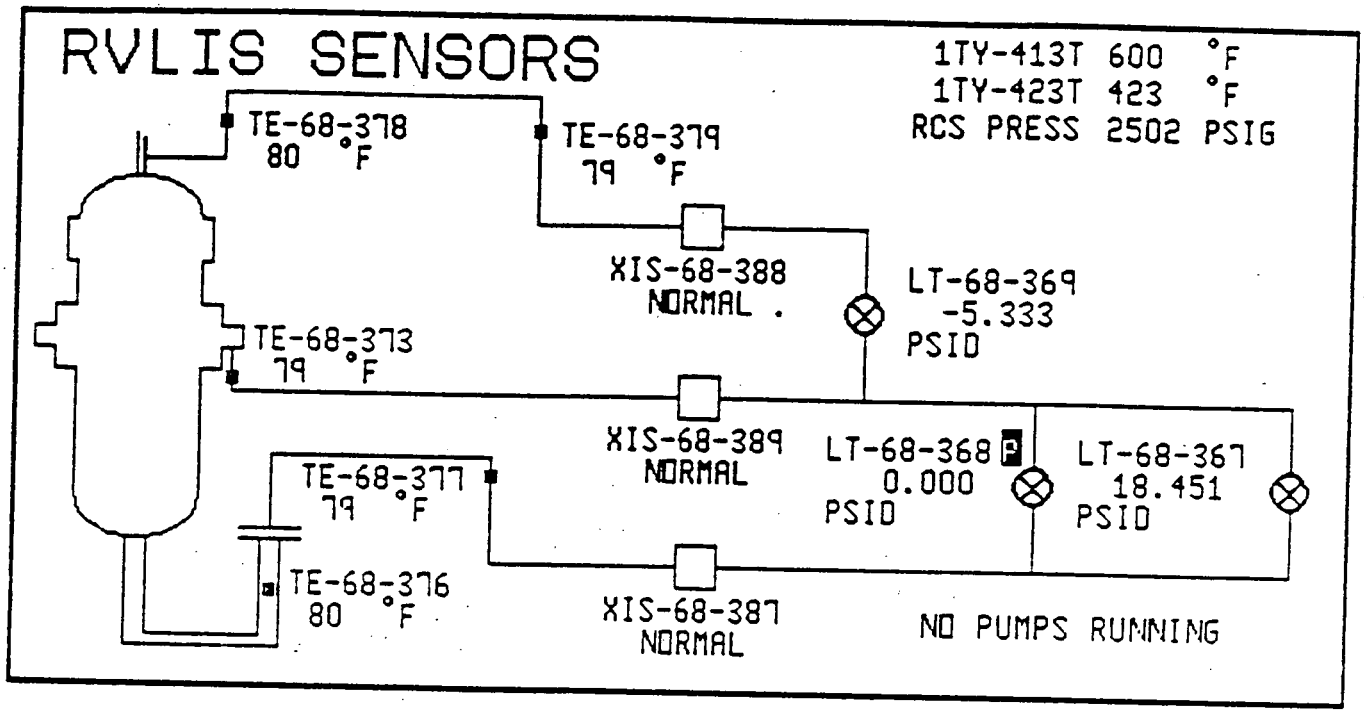


Figure 5-8 Typical Sensor Status Display Page, Unit 1 (Train A)

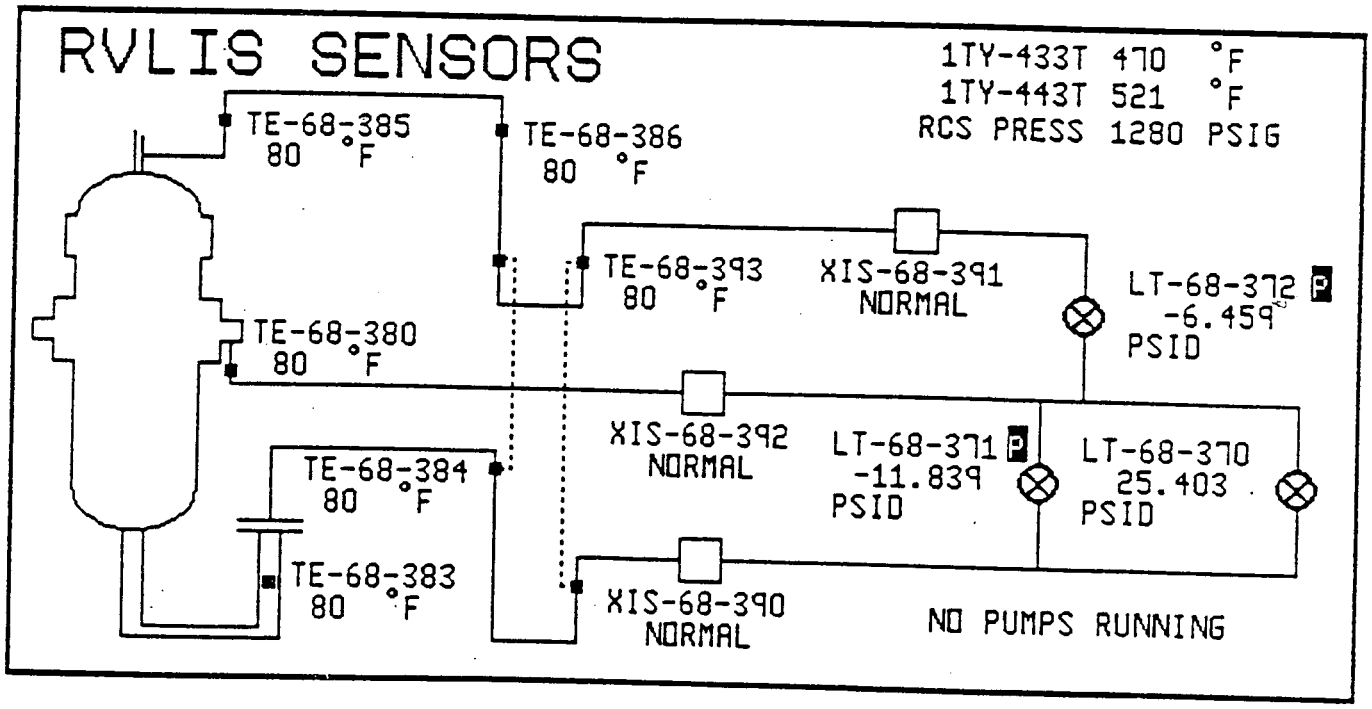


Figure 5-9 Typical Sensor Status Display Page, Unit 1 (Train B)

TABLE 5-1

REACTOR VESSEL LEVEL SENSORS AND MESSAGES – TRAIN A

SENSOR	LABEL	CONDITION
Hydraulic Isolators (XIS-68-387, XIS-68-388, XIS-68-389)	NORMAL OFFSCALE	Normal Limit switch activated

TABLE 5-2

REACTOR VESSEL LEVEL SENSORS AND MESSAGES – TRAIN B

SENSOR	LABEL	CONDITION
Hydraulic Isolators (XIS-68-390, XIS-68-391, XIS-68-392)	NORMAL OFFSCALE	Normal Limit switch activated

Also included on this display page are the rounded whole number values for THot 1, THot 2, and RCS PRESS.

If a calculated analog input point quality code of BAD or SUSPECT (without a manually entered value) is assigned to any of these values, then a reverse video "B" or "S," respectively, will be displayed next to the new value of X's, for a "BAD" quality code, or D's, for a "SUSPECT" quality code.

If a quality code of SUSPECT (with a manually entered value) is assigned to any of these values, then a reverse video "S" will be displayed next to the current numeric value.

A calculated analog input point quality code of POOR assigned to any of these values will cause a reverse video "P" to be displayed next to the current numeric value.

The status of the RCPs will be displayed on this page in a block representation identified by a "PUMPS RUNNING" descriptor. If a pump is running, the number of that pump (1,2,3, or 4) will appear in the appropriate box within the block. If a

pump is not running, the box will appear empty. If an RCP goes BAD, then a reverse video upper case "B" will appear in the appropriate block.

Whenever an RCP is in the startup or coastdown mode, the display will indicate both the mode and pump number involved. The message "RVLIS INACCURATE" will also be displayed during either of these modes.

5.10.3.4 Vessel Level Diagnostics Page

The vessel level diagnostics page handles the vessel level portion of the ICCM-86 System. This page displays diagnostic information for the RVLIS inputs and outputs.

At the bottom of the display page is an area reserved for diagnostic information messages. The time and message number appear at the top of the display page. The time and message number will update every 2 seconds if the datalink is working properly. Figure 5-10 shows a vessel level diagnostics page. This graphic example is a representative example of the display that appears. However, it should be noted that the numerical values shown are arbitrary numbers used solely to generate the example. The numerical values are a dynamic element and will change.

5.10.4 Core Exit T/C Monitoring

This group of display pages allows an operator to monitor core temperatures inside the reactor vessel. Seven pages are necessary and are as follows:

- Incore T/C Map Page
- T/C Quadrant Summary Page
- Individual T/C Quadrant Page
- T/C Average Temperature Trend Page
- Auctioneered High Core Quadrant Average Temperature Trend Page
- T/C Diagnostics Page 1
- T/C Diagnostics Page 2

```
VESSEL LEVEL DIAGNOSTIC PAGE          TIME 12:46:39          MESSAGE 100

LT-68-369      -5.334   30  00   UPPER RANGE     73.025  34  00
LT-68-368       0.000   60  80   LOWER RANGE     70.000  64  00
LT-68-367      18.424   30  00   DYNAMIC HEAD    85.229  34  00
TE-68-373      79.426   30  00
TE-68-376      80.393   30  00   RVLIS LEVEL     73.025  34  00
TE-68-377      80.435   30  00
TE-68-378      80.250   30  00
TE-68-379      79.401   30  00   PEN 1:   RVLIS LEVEL       73.025
1PY-406A     2504.473   30  00   PEN 2:   RVLIS LEVEL       73.025
                                  PEN 3:   RVLIS LEVEL       73.025
THOT           600.485   34  00
1TY-413T       600.485   30  00
1TY-423T       423.224   30  00                          RCP-1    00  00
1TY-411C        93.072   30  00                          RCP-2    00  00
                                                         RCP-3    00  00
                                                         RCP-4    00  00
                                  MALFUNCTION  00     XIS-68-387  00  00
DIAGNOSTIC INFORMATION            XIS-68-388  00  00
⊠                                 XIS-68-389  00  00
```

Figure 5-10 Typical RCS Level Diagnostics Display Page

5.10.4.1 T/C Map Display Pages

The core map display pages (figures 5-11 and 5-12) give a train-oriented view of the core exit thermocouple layouts (CETC). These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System, and do not necessarily represent exact replicas of the display pages that actually appear on the screen. The rounded whole number value of each CETC is shown in its assigned core location.

If a CETC value becomes greater than or equal to some critical setpoint, then it will be displayed in reverse video.

If a calculated analog input point quality code of BAD or SUSPECT (without a manually entered value) is assigned to any of these values, then a reverse video "B"

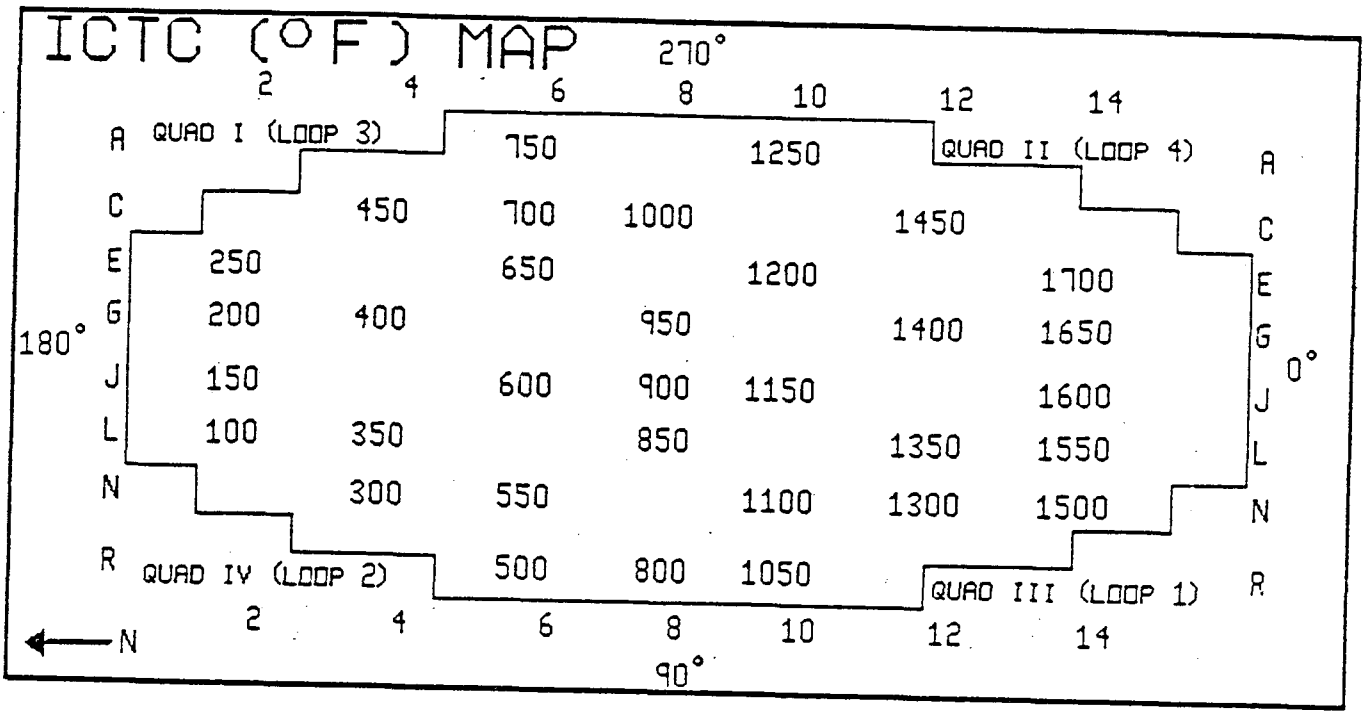


Figure 5-11 Typical Core Map Display Page, Unit 1

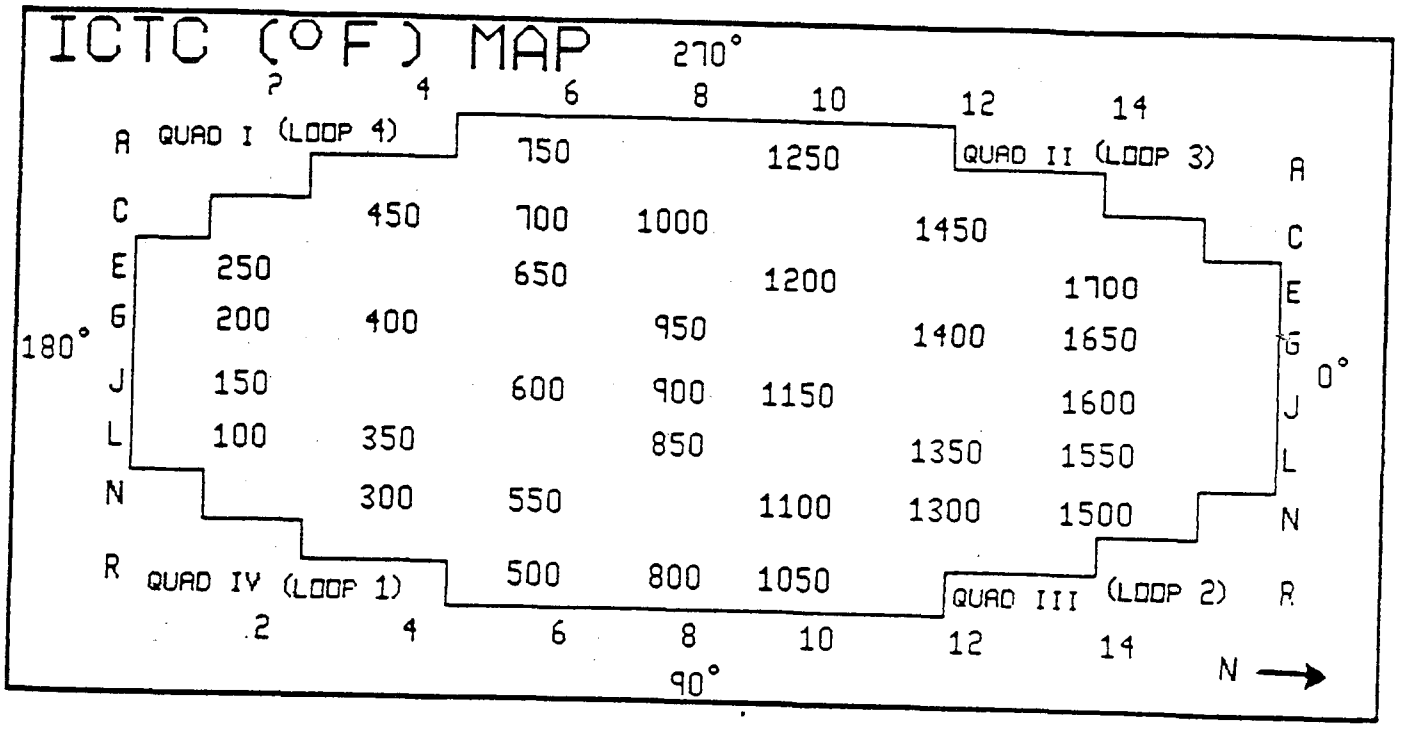


Figure 5-12 Typical Core Map Display Page, Unit 2

or "S," respectively, will be displayed next to the new value of X's, for a "BAD" quality code, or D's, for a "SUSPECT" quality code.

If a quality code of SUSPECT (with a manually entered value) is assigned to any of these values, then a reverse video "S" will be displayed next to the current numeric value.

A calculated analog input point quality code of POOR assigned to any of these values will cause a reverse video "P" to be displayed next to the current numeric value.

5.10.4.2 Incore T/C Quadrant Summary Display Pages

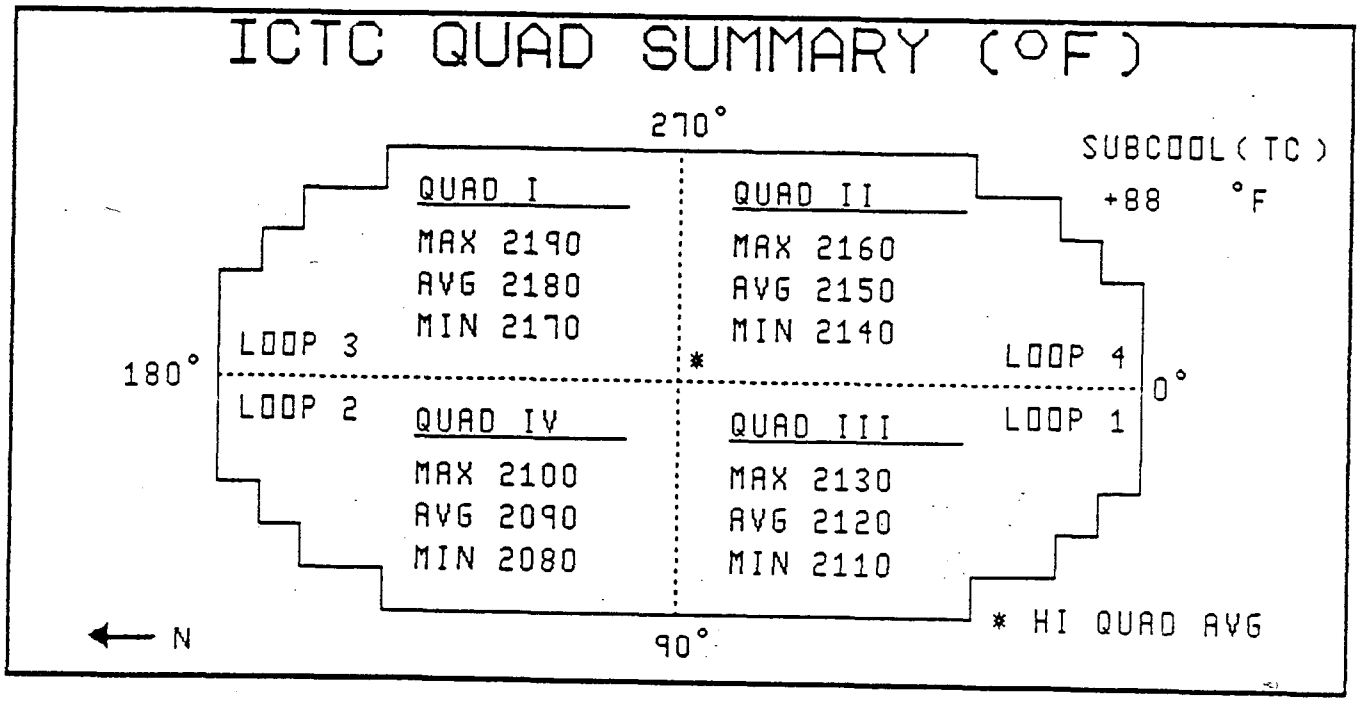


Figure 5-13 Typical ICTC Quadrant Summary Display Page, Unit 1

The incore T/C quadrant summary pages are shown in figures 5-13 and 5-14. These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System, and do not necessarily represent exact replicas of the display pages that actually appear on the screen. In a train-oriented view of the reactor vessel, the T/C quadrant summary page displays the rounded whole number values for each quadrant's minimum and maximum thermocouples. The average T/C temperature will also be displayed for each of the four quadrants. An asterisk will

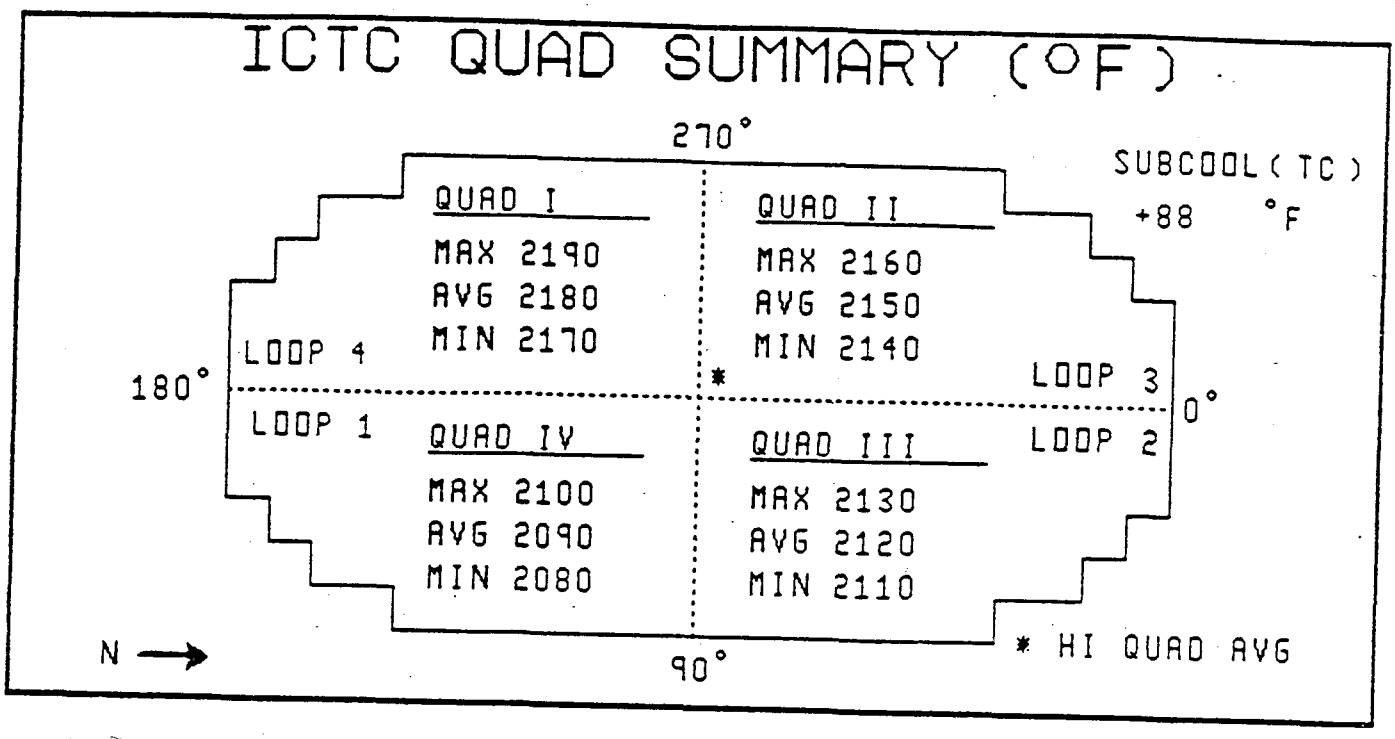


Figure 5-14 Typical ICTC Quadrant Summary Display Page, Unit 2

appear in the quadrant with the high auctioneered average temperature and the note, * HI QUAD AVG, will appear in the lower right-hand corner of the page. The corresponding loop numbers will appear in each quadrant's displayed section.

In addition to the T/C values being displayed, the rounded whole number value for SUBCOOL (T/C or TH) will also appear in the upper right-hand corner of the page. If the subcooling value becomes less than an entered setpoint, its respective value will be displayed in reverse video.

If a calculated analog input point quality code of BAD is assigned to any average quadrant value, then a reverse video "B" will be displayed next to the new value of X's for a "BAD" quality code.

If a quality code of POOR is assigned to any average quadrant value, then a reverse video "P" will be displayed next to the current numeric value.

If there are no "GOOD" thermocouples in any one quadrant, then the MAX and MIN values for that quadrant will be 0000 and 9999 respectively.

5.10.4.3 Individual T/C Quadrant Display Page

INDIVIDUAL INCORE T/CS BY QUAD

QUAD I		QUAD II		QUAD III		QUAD IV	
LOC	°F	LOC	°F	LOC	°F	LOC	°F
A06	750	A10	1250	J08	900	J02	150
				J10	1150	J06	600
C04	450	C08	1000	J14	1600	J08	900
C06	700	C12	1450				
C08	1000			L08	850	L02	100
				L12	1350	L04	350
E02	250	E10	1200	L14	1550	L08	850
E06	650	E14	1700	N10	1100	N04	300
				N12	1300	N06	550
G02	200	G08	950	N14	1500		
G04	400	G12	1400	R08	800	R06	500
G08	950	G14	1650	R10	1050	R08	800

Figure 5-15 Typical Individual T/C Quadrant Display Page

The individual T/C quadrant page is shown in figure 5-15. This graphic example is presented only to familiarize the operator with the mechanics of the ICCM-86 System, and does not necessarily represent an exact replica of the display page that actually appears on the screen. The individual T/C quadrant page displays both the rounded whole number value and the thermocouple location coordinate for each T/C inside the reactor vessel. The display page is set up in a column format which is easily identifiable by its quadrant heading.

If a calculated analog input point quality code of BAD or SUSPECT (without a manually entered value) is assigned to any T/C value, then a reverse video "B" or "S," respectively, will be displayed next to the new value of X's, for "BAD" quality, or D's, for "SUSPECT" quality.

If a quality code of SUSPECT (with a manually entered value) is assigned to any of these values, then a reverse video "S" will be displayed next to the current numeric value.

If a quality code of POOR is assigned to any T/C value, then a reverse video "P" will be displayed next to that current numeric value.

If a thermocouple becomes greater than or equal to some critical setpoint, then its value will be displayed in reverse video.

5.10.4.4 Incore Thermocouple Trend Display Page

The incore thermocouple (ICTC) average temperature trend display page shows two trending line graphs. The lower graph trends the INCORE TCs AVG temperature value for the preceding 30-minute period over the temperature range of 0 - 2500 degrees Fahrenheit (figure 5-16). The trending line graph updates once every 20 seconds. If the INCORE T/Cs AVG value is greater than 2500 degrees Fahrenheit, the trending line will update at the "OFFSCALE" position on the graph. In the event of a datalink failure, the trending line graph is driven to the "NO DATA" position when the datalink returns. In addition to the trending graph, the current rounded whole number value for the INCORE TCs AVG is given on the right side of this display page.

The upper graph trends the calculated analog input point quality code for the INCORE TCs AVG temperature. The graph is labeled from top to bottom with the following quality codes: BAD, POOR, GOOD.

A calculated analog input point quality code of BAD associated with the INCORE TCs AVG temperature will cause the data trend (lower graph) to draw a continuous line to the "NO DATA" indicator below the bottom of the scale. A reverse video "B" will be displayed next to the new average temperature value of X's for a "BAD" quality code. The quality trend (upper graph) will trend along its BAD position on the graph.

A calculated analog input point quality code of POOR associated with INCORE TCs AVG temperature will cause a reverse video "P" to be displayed next to the current average temperature value. The quality trend will trend along its POOR position.

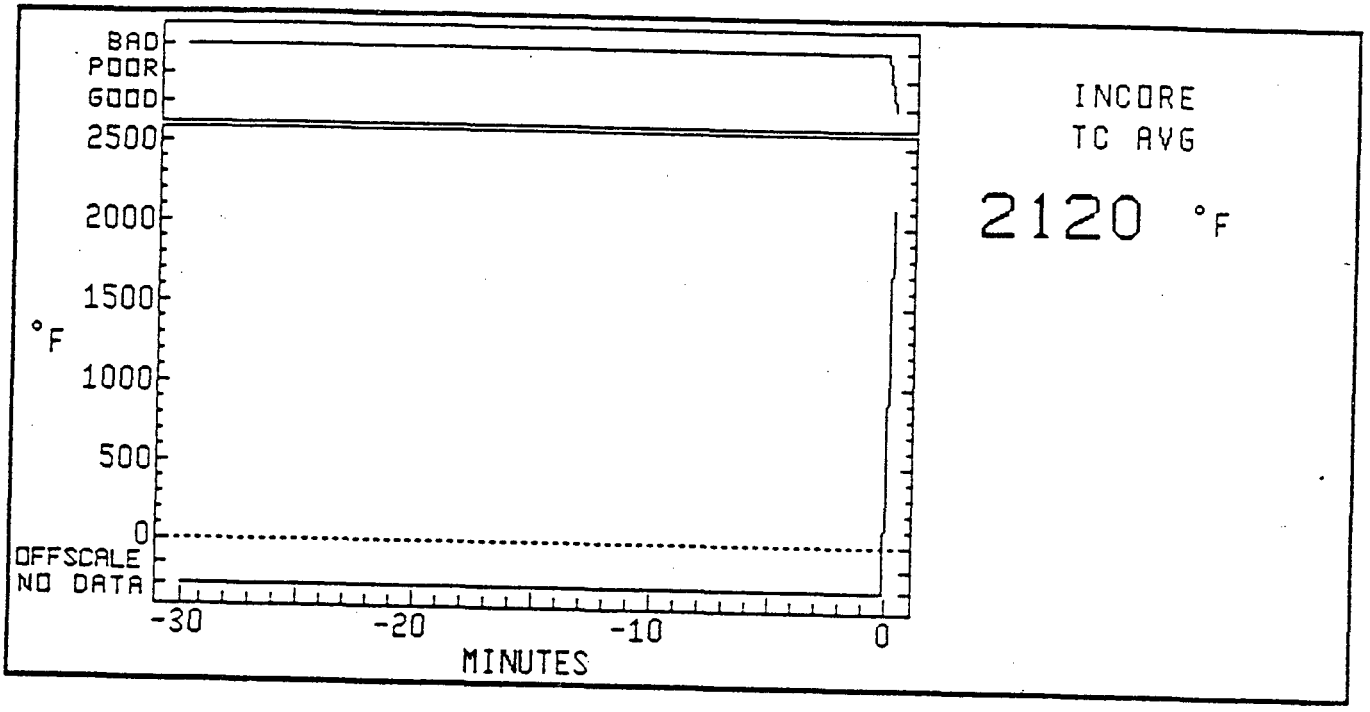


Figure 5-16 Typical ICTC Average Temperature Trend Display Page

5.10.4.5 Auctioneered High T/C Trend Display Page

The auctioneered high incore T/C (ICTC) temperature trend display page shows two trending line graphs. The lower graph trends the INCORE TCs HI QUAD AVG temperature value for the preceding 30-minute period over the temperature range of 0 - 2500 °F (figure 5-17). The trending line graph updates once every 20 seconds. If the INCORE TCs HI QUAD AVG value is greater than 2500 °F, then the trending line will update at the "OFFSCALE" position on the graph. In the event of a datalink failure, the trending line graph is driven to the 0 °F position when the datalink returns. In addition to the trending graph, the current rounded whole number value for the INCORE TCs HI QUAD AVG is given on the right-hand side of this display page along with the designated number of the high quadrant.

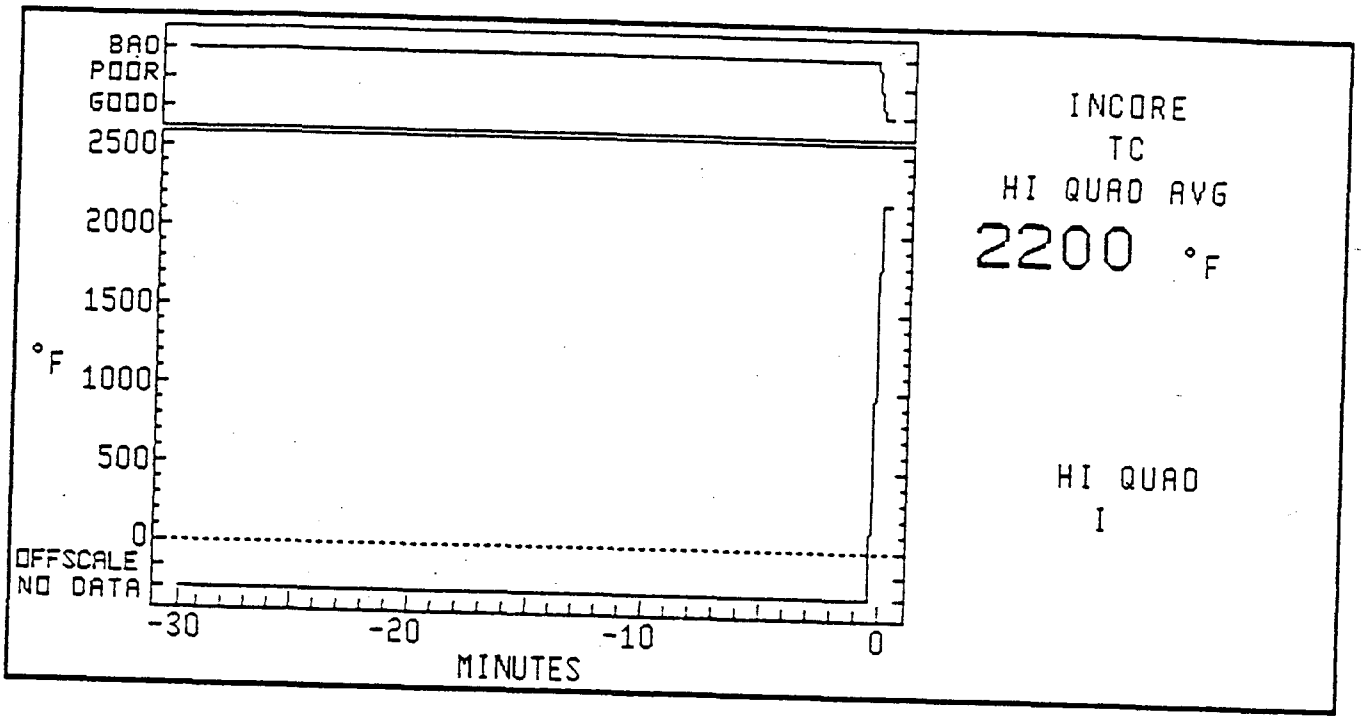


Figure 5-17 Typical Auctioneered High ICTC Temperature Trend Display Page

The upper graph trends the calculated analog input point quality code for the INCORE TCs HI QUAD AVG temperature. The graph is labeled from top to bottom with the following quality codes: BAD, POOR, GOOD.

A calculated analog input point quality code of BAD associated with the INCORE TCs AVG temperature will cause the data trend (lower graph) to draw a continuous line to a "NO DATA" position below the bottom of the scale. A reverse video "B" will be displayed next to the defaulted average temperature value of X's for a "BAD" quality code. The quality trend (upper graph) will trend along its BAD position on the graph.

A calculated analog input point quality code of POOR associated with INCORE TCs AVG temperature will cause a reverse video "P" to be displayed next to the current average temperature value. The quality trend will trend along its POOR position.

5.10.4.6 Thermocouple Diagnostics Pages

The thermocouple diagnostics pages display diagnostic information for the thermocouple monitoring inputs and outputs.

At the bottom left of thermocouple diagnostics pages is an area reserved for diagnostic information messages. The time and information message number appear at the top of the display pages. The time and message number will update every 2 seconds if the datalink is working properly. Figures 5-18 and 5-19 show typical examples of thermocouple diagnostics pages. These graphic examples are representative examples of the displays that appear. However, it should be noted that the numerical values shown are arbitrary numbers used solely to generate the examples. The numerical values are a dynamic element and will change.

```
THERMOCOUPLE DIAGNOSTIC PAGE 1          TIME 03:15:29          MESSAGE 57

L02  100.000  30 00   A06  750.000  30 00   G12 1400.000  30 00
J02  150.000  30 00   R08  800.000  30 00   C12 1450.000  30 00
G02  200.000  30 00   L08  850.000  30 00   N14 1500.000  30 00
E02  250.000  30 00   J08  900.000  30 00   L14 1550.000  30 00
N04  300.000  30 00   G08  950.000  30 00   J14 1600.000  30 00
L04  350.000  30 00   C08 1000.000  30 00   G14 1650.000  30 00
G04  400.000  30 00   R10 1050.000  30 00   E14 1700.000  30 00
C04  450.000  30 00   N10 1100.000  30 00
R06  500.000  30 00   J10 1150.000  30 00
N06  550.000  30 00   E10 1200.000  30 00
J06  600.000  30 00   A10 1250.000  30 00
E06  650.000  30 00   N12 1300.000  30 00
C06  700.000  30 00   L12 1350.000  30 00

                      HIGH T/C    00      RJB RTD1      505.000  30 00
                                          RJB RTD2      605.000  30 00
                                          RJB RTD3      705.000  30 00
DIAGNOSTIC INFORMATION                    MAX QUAD AVG 2200.000  34 00
⊠
```

Figure 5-18 Typical Thermocouple Diagnostics Display Page 1

THERMOCOUPLE DIAGNOSTIC PAGE 2 TIME 15:16:39 MESSAGE 61

MAX I	567.417	30	00	L02	567.417	G08	908.195
AVG I	390.319	34	00	J02	390.319	C08	906.191
MIN I	738.118	30	00	G02	738.118	R10	163.323
MAX II	300.421	30	00	E02	300.421	N10	164.402
AVG II	457.388	34	00	N04	457.388	J10	164.151
MIN II	456.049	30	00	L04	456.049	E10	979.350
MAX III	456.250	30	00	G04	456.250	A10	211.321
AVG III	456.451	34	00	C04	456.451	N12	417.376
MIN III	456.381	30	00	R06	456.381	L12	152.457
MAX IV	456.049	30	00	N06	456.049	G12	484.280
AVG IV	455.450	34	00	J06	455.450	C12	483.482
MIN IV	456.381	30	00	E06	456.381	N14	172.110
THOT	456.177	34	00	C06	455.119	L14	173.443
TC HOT	455.119	34	00	A06	456.177	J14	173.443
				R08	456.250	E14	305.101
HIGH T/C	00			L08	458.122	E14	503.471
				J08	456.250		

DIAGNOSTIC INFORMATION

Figure 5-19 Typical Thermocouple Diagnostics Display Page 2

5.10.5 Subcooling Monitor

This group of display pages allows an operator to monitor the saturation temperature for the current RCS pressure and the temperature margin to saturation based on the CETCs. Four pages are necessary and are as follows:

- Subcooling Trend Page
- Heatup Limit Curve Page
- Cooldown Limit Curve Page
- Subcooling Diagnostics Page

5.10.5.1 Subcooling Trend Display Page

The subcooling trend display page shows two trending line graphs. The lower graph trends the SUBCOOL MARGIN (TC or TH) value for the preceding 30-minute period over the temperature range of -200 °F to 200 °F (figure 5-20). The trending line graph updates once every 20 seconds. In the event of a datalink failure, the trending line graph is driven to the "NO DATA" position when the datalink returns.

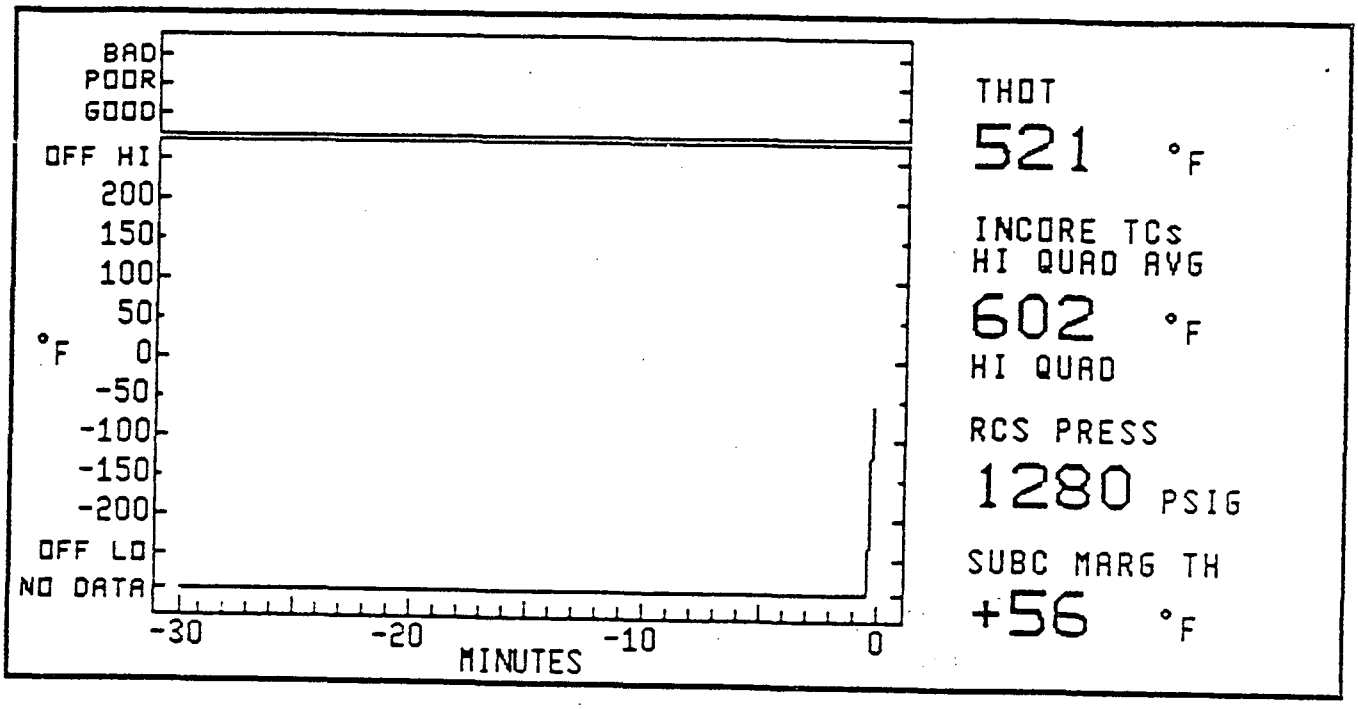


Figure 5-20 Typical Subcooling Trend Display Page

The upper graph trends the calculated analog input point quality code for the SUBCOOL MARGIN (TC or TH) value. The graph is labeled from top to bottom with the following quality codes: BAD, POOR, GOOD.

In addition to the trending graphs on this page, the current rounded whole number values for INCORE TCs HI QUAD AVG, HI QUAD, THOT, RCS PRESS, and SUBC MARG (TC or TH) are given on the right-hand side of this display page. If the value for SUBC

MARG (TC or TH) becomes less than an entered setpoint, its respective value will be displayed in reverse video.

A calculated analog input point quality code of BAD associated with the SUBC MARG (TC or TH) value will cause the data trend (lower graph) to draw a continuous line to a "NO DATA" position below the bottom of the scale. A reverse video "B" will be displayed next to the defaulted parameter values of X's for a "BAD" quality code. The quality trend (upper graph) will trend along its BAD position on the graph.

A calculated analog input point quality code of POOR associated with SUBC MARG (TC or TH) value will cause a reverse video "P" to be displayed next to the current parameter value. The quality trend will trend along its POOR position.

5.10.5.2 Subcooling Curve Display Pages

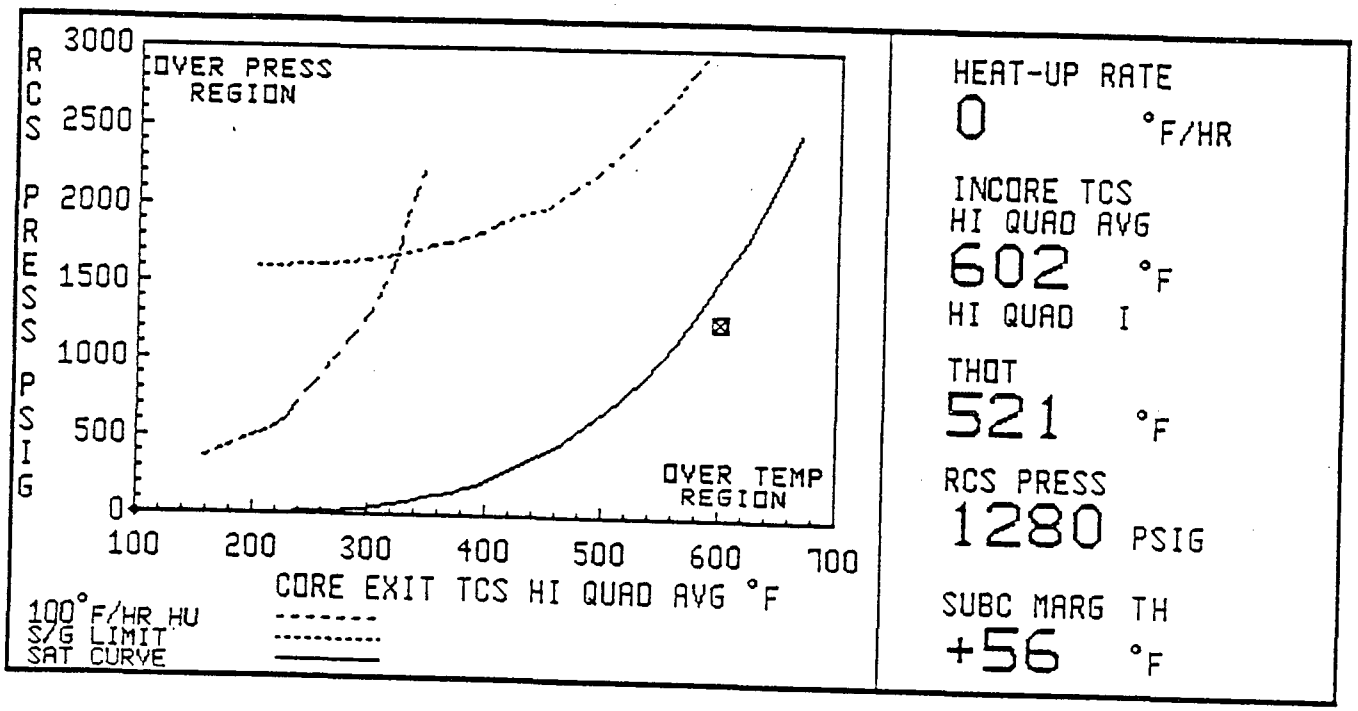


Figure 5-21 Typical Subcooling Heatup Curve Display Page

The subcooling curve pages (figure 5-21 and 5-22) show the subcooling graphs of the RCS. These graphic examples are presented only to familiarize the operator with the mechanics of the ICCM-86 System, and do not necessarily represent exact replicas of the display pages that actually appear on the screen. The vertical axis is the range of

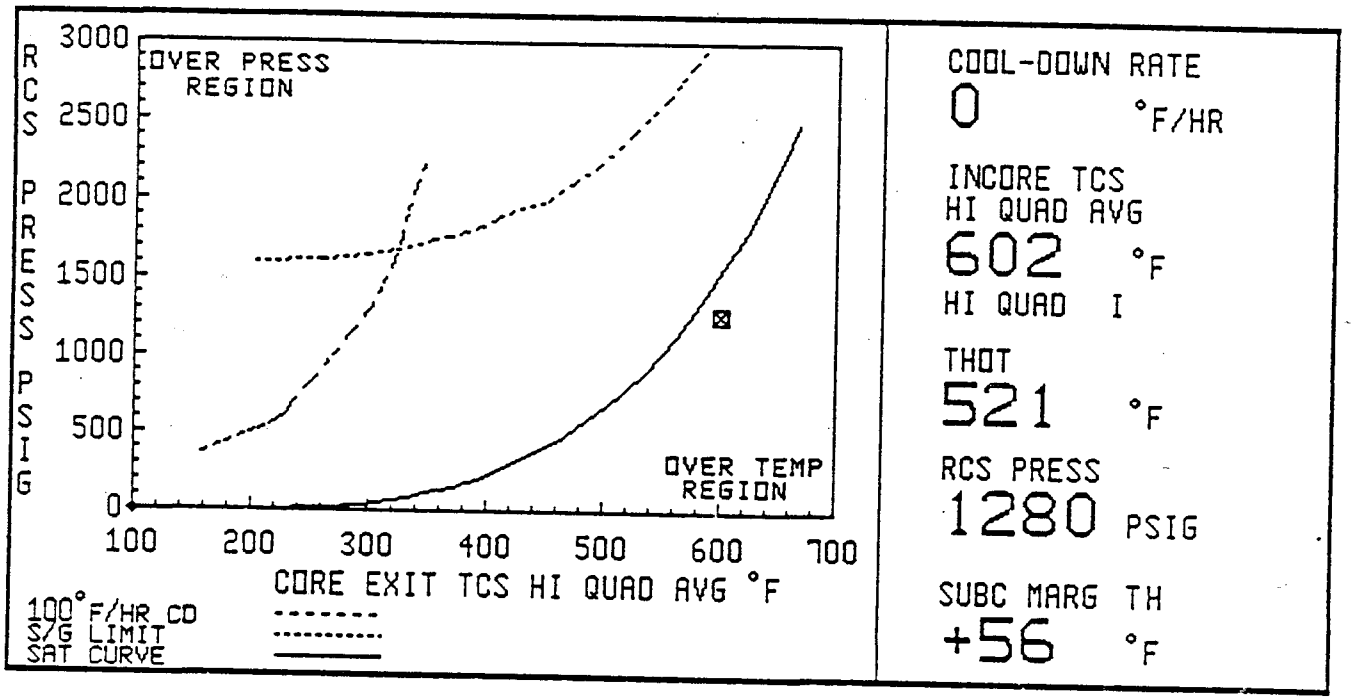


Figure 5-22 Typical Subcooling Cooldown Curve Display Page

RCS PRESS from zero to 3000 psig. The horizontal axis is the range of CORE EXIT TCs HI QUAD AVG from 100 to 700 degrees Fahrenheit. The current coolant condition is shown with a square-shaped figure on this graph. A trending representation is given by a series of six smaller diamond figures overlaid by and possibly trailing the square-shaped figure representing the current coolant condition. Each diamond-shaped figure represents a time period of 5 minutes for a total trending period of 30 minutes.

The heatup subcooling display graph (figure 5-21) also includes the following curves:

- S/G LIMIT
- 100°F/HR HU
- SAT CURVE

The cooldown subcooling display graph (figure 5-22) also includes the following curves:

- S/G LIMIT
- 100°F/HR CD
- SAT CURVE

In addition to the subcooling on these pages, the current rounded whole number values for INCORE TCs HI QUAD AVG, HI QUAD, THOT, RCS PRESS, SUBC MARG (TC or TH) and HEATUP RATE (for the heatup curve display page) or COOLDOWN RATE (for the cooldown curve display page) are given on the right-hand side of these display pages. If the value for SUBC MARG (TC or TH) becomes less than an entered setpoint, its respective value will be displayed in reverse video. Quality coding will be implemented as discussed previously.

5.10.5.3 Subcooling Diagnostics Page

The subcooling diagnostics page handles the subcooling portion of the ICCM-86 System. This page displays diagnostic information for the subcooling inputs and outputs.

At the bottom of the display page is an area reserved for diagnostic information messages. The time and message number appear at the top of the display page. The time and message number will update every 2 seconds if the datalink is working properly. Figure 5-23 shows a subcooling diagnostics page. This graphic example is a representative example of the display that appears. However, it should be noted that the numerical values shown are arbitrary numbers used solely to generate the example. The numerical values are a dynamic element and will change.

5.10.6 System Diagnostics

The diagnostics pages are used to display the information sent over the datalink from the ICCM-86 main electronics cabinet. This information includes analog inputs, calculated analog inputs, labeled analog inputs, analog outputs, digital outputs, digital inputs, time message number, and diagnostic information messages.

```
SUBCOOL DIAGNOSTIC PAGE                    TIME 13:55:23          MESSAGE 225
SUBC MARG       54.004    34 00      TC HOT       978.049    34 00
MARGIN (TH)     54.004    34 00      THOT         600.079    34 00
MARGIN (TC)    -35.000    04 00
HEATUP RATE      0.000    04 00
COOLDN RATE      0.087    34 00

                         LOW MARGIN 00

DIAGNOSTIC INFORMATION
⊠
```

Figure 5-23 Typical Subcooling Diagnostics Display Page

Analog inputs and calculated analog inputs are represented by their identification label followed by their floating point real number value (fixed to three decimal places) and two sets of characters that represent the sensor status and the sensor data quality. The first set of two characters represents the analog input point limit status and the analog input point scan status. The second set of characters represents the analog input point error status and the analog input point quality code. These two sets of characters are defined later in this section.

Labeled analog inputs and analog outputs are represented by their identification label followed by their floating point real number value (fixed to three decimal places).

Digital outputs are represented by their identification label followed by a set of two characters representing the sensor value as shown below:

Digital Output	Value
True	FF
False	00

Digital inputs are represented by their identification label followed by two sets of characters. The first set of two characters represents the digital input point value status and the digital input point scan status. The second set of two characters represents the digital input point error status and the digital input point quality code. These two sets of characters are defined later in this section.

The time is expressed in the form "XX:YY:ZZ" where the hours (in military time) are XX, the minutes are YY, and the seconds are ZZ.

The message number has a range from 0 to 255. This number increases by 1 with each new datalink message. A message number equal to 0 is not displayed but appears as a blank field. The message number rolls over to 0 when the previous message number is 255.

The diagnostic information messages that may be displayed on a diagnostic page notify an operator of a possible error in the ICCM-86 System main electronics cabinet ROM (read-only memory), RAM (random-access memory), or NVRAM (nonvolatile random-access memory). These diagnostic information messages are defined in paragraph 5.10.7.

5.10.7 Diagnostic Character Sets

The information presented in the following paragraphs describes the error codes referenced in paragraph 5.10.6, System Diagnostics.

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2
NUREG-0737, ITEM II.F.2

LIST OF COMMITMENTS

1. The Westinghouse Inadequate Core Cooling Monitor 86 (ICCM-86) and associated hardware will be installed before initial fuel loading of the respective units.

2. Preoperational testing will be performed on the Inadequate Core Cooling (ICC) System before initial fuel loading of the respective units.

3. Preliminary calibration and scaling of the ICC System will be performed before initial fuel loading of the respective units.

4. Final calibration and scaling for the ICC System will be performed before initial criticality of the respective units.