Attachment 1

Duke Power Company

OCONEE NUCLEAR STATION

Response to Generic Letter 89-06

SPDS Checklist

This checklist is intended to aid licensees in determining the status of their SPDS. Bracketed, [ ], information refers to the section in NUREG-1342 where discussions on the specific question(s) may be found.

1.0 GENERAL DESCRIPTION

1.1 Plant Name: **OCONEE NUCLEAR STATION**

1.2 Who/What organization developed the original version of the SPDS software implemented at your site?

Utility (in-house)

1.3 If the SPDS software has undergone significant modification (i.e., more than 25 percent of software replaced or modified) since original implementation, list the organization performing the modification:

Utility (in-house)

1.4 What is the hardware host on which the current SPDS Software is implemented?

Honeywell 45000

1.5 How many total CPUs are accessible by SPDS software on the computer system described in the previous question?

One per Nuclear Unit

1.6 What is the approximate MIPS rating of all the CPUs counted above?

__1__ MIPS Note: Use a decimal fraction if less than 1.0

1.7; 1.8; 1.9 **DO NOT APPLY**

1.10 Are significant changes in hardware or software planned in the next two years?

Yes. These changes include modifications to meet the requirements of NUREG-0737, Supplement 1, taking into account the information provided in NUREG-1342, as well as enhancements to the present SPDS program.

Modifications

1. The color behavior of the Logic Diagram Displays is to be changed such that the lines and logic elements between the input statements and the CSF Status Blocks will change color depending upon the status of the input statements and if the logic elements are satisfied. If there is no alarm, the true input statements, satisfied logic elements, and connecting lines will be output in yellow. If there is an alarm, true input statements, satisfied logic elements, and connecting lines which input the alarm will be output to the screen in red. All true input statements, satisfied logic elements, and lines which do not input the alarm will be yellow. All false input statements, unsatisfied logic elements and lines will be green.

2. The OAC has available, in many cases, multiple inputs for the same parameter being used by the SPDS logic. Through the usage of OR GATE logic, one or more inputs from the same measured parameter will be made available to the SPDS. The OAC or SPDS will not automatically block a signal determined to be "bad" or invalid since notification of input failure is an important part of the SPDS function. Rather, the ability to "de-select" SPDS input points should be available manually as described below. When using the peek-point feature of the SPDS Logic Diagram Displays, the first point listed as entering the OR GATE should be the one displayed unless it has been locked out as described below or placed in scan lockout or contains an inserted value, in which case the second point providing input to the OR GATE will be displayed.

3. The Reactor Vessel Head Level and Reactor Coolant System Hot Leg Level indications input to the OAC from the Westinghouse RVLIS or ICCM Systems are to be integrated into the SPDS alarm logic for the following Critical Safety Functions:

   RCS INVENTORY
   INADEQUATE CORE COOLING
   HEAT SINK

4. The stack monitor is not currently included in the SPDS. However, changes will be made to include the stack monitor in the SPDS.

Enhancements

1. A utility within the SPDS to "de-select" points from inputting the SPDS Logic will be provided which will have the following features:

a. Prevent the point from inputting the logic entirely. If there is a redundant point, it would then provide the SPDS Logic as described above and no CSF Input Invalid Alarm should be generated. If there is no alternate point, then a CSF Input Invalid Alarm should be generated.

b. Provide a means of inserting a value for a point to the SPDS ONLY. The inserted value would not affect any other display or program. A summary of all points with inserted values and SPDS Input Lockout will be provided.

c. When a value for an SPDS Point is inserted, the option of setting a "trigger" to automatically return the point to normal SPDS input status will be provided.

d. If a point which inputs the SPDS Logic is in "SPDS Input Lockout" or "SPDS Inserted Value" and that point is put in "Scan Lockout" or "Inserted Value" using the existing system utility for those functions, that point will be automatically removed from "SPDS Input Lockout" or "SPDS Inserted Value". If an attempt is made to put that point in one of the SPDS Specific lockouts, the following message will be shown on the screen "Point already in system Scan Lockout" or "Point already in system Insert Value" (depending upon which operation is attempted).

e. These functions must be password protected.

2. The Alarm Typer print-out is to be changed such that when an SPDS Alarm is printed, the Point ID of the Logic Input Points will be printed directly under the alarm.

2.0 PARAMETER SELECTION

This section is divided into two parts: the safety functions, and the parameters used to depict each safety function.

2.1 Plant-specific Safety Functions [III.F.]

List the title of the plant-specific safety function(s) displayed on your SPDS that is (are) equivalent to the safety function in Supplement 1 to NUREG-0737.

	Supplement 1 To NUREG-0737 Safety Functions	Plant-Specific Safety Functions
2.1.1	Reactivity Control	Subcriticality
2.1.2	Core Cooling and Heat Removal	Heat Sink Inadequate Core Cooling

2.1.3	RCS Integrity	RCS Integrity RCS Inventory
2.1.4	Radioactivity Control	Containment Integrity RCS Integrity
2.1.5	Containment Conditions	Containment Integrity

2.2 Parameters Selected to Display Each Safety Function

The purpose of this section is to specify a list of parameters used to depict each of the five safety functions identified in Supplement 1 to NUREG-0737. Lists of parameters that have been found acceptable to NRC through previous SPDS post-implementation reviews have been provided. One list of parameters applies to pressurized water reactors in general, and the other list applies to boiling water reactors.

NOTE: Check any parameters that have been selected as an SPDS parameter. List any additional parameters under the relevant "Others" category. Include additional safety functions and parameters that are a part of your SPDS.

PRESSURIZED WATER REACTOR SPDS PARAMETER SELECTION CHECKLIST [III.F.1]

Supplement 1 to NUREG-0737 Safety Functions		Parameters
2.2.1	Reactivity Control (ONS: Subcriticality)	Source Range NI Flux Level Source Range NI Start-up Rate Intermediate Range NI Flux Level Intermediate Range NI SUR Power Range NI Level Control Rod Positions Asymmetric Rod indications RPS Channels RPS Manual Trip CRD Breakers
2.2.2	Reactor Core Cooling and Heat Removal from the Primary System (ONS: Heat Sink)	RCS Level and RV Head Level (Modifications are in progress to include these parameters) Subcooling Margin Hot Leg Temperature Cold Leg Temperature Core Exit Thermocouples

Steam Generator Levels
    Operating Range
    Extended Start-up Range
    Start-up Range
    Full Range
Steam Generator Pressures
RCS Average Temperature
RCS Hot Leg Temperatures
RCS Pressure
Condenser Vacuum
LPI Pump Status
RHR Flow
LPI Flow
ES Channels 1, 2, 3, & 4 Status
Specific LPI System valves
Hotwell Pump Status
Condensate Booster Pump Status
Condensate Flow
Thermal Reactor Power
Main FDW Pump Status
FDW Pump Discharge Pressure
FDW Pump Suction Pressure
FDW Control Valve dP
Emergency FDW Pump Status
EFDW Pump Cooling Water Flow
EFDW Pump Cooling Water Temperature
EFDW Pump Oil Temperature
Upper Surge Tank Level
HPI Pump Status
RC Pump Seal Supply Flow
RB Spray Flow
HPI Header Flows
LPSW Pump Status
LPSW Discharge Pressure
Selected LPSW Valve Positions
CCW Pump Status
Selected CCW System Valve Positions
    from all three Units

2.2.3 RCS Integrity

RCS Pressure
Cold Leg Temperatures
Steam Generator Operating Range Lvl
Steam Generator Outlet Pressures
Steam Generator Outlet Pressure
    Rate of Change
Containment Sump Level
(Modifications are in progress
to include sump level)
Steam Line Radiation Detectors

		Condensate Air Ejector Off-Gas Radiation Detector Pressurizer Level NDT Limits TSOR "C" HPI Pump Status RC Pump Status Selected HPI System Valves Position RCS Cooldown Rate Containment Radiation Monitors Stack Radiation Monitors (Modifications in progress to include in SPDS)
2.2.4	Radioactivity Control	Note: This is not an Oconee Critical Safety Function, but, the functionality and the parameters described for this safety function are contained within the ONS Containment Integrity and RCS Integrity Critical Safety Functions.
2.2.5	Containment Conditions (ONS: Containment Integrity)	Containment Pressure Containment Isolation Containment Hydrogen Concentration RB Spray Flow RB Cooling Unit Status LPSW System Status (input from HEAT SINK Logic) Containment Radiation Monitors
2.2.6	RCS Inventory	RB Emergency Sump Level BWST Level RCS Pressure Pressurizer Level HPI System Status (from HEAT SINK Logic) Letdown Storage Tank (LDST) Level HP and LP Valve Positions RCS Hot Leg Temperature
2.2.7	Inadequate Core Cooling	Core Exit Thermocouples Subcooling Margin Inputs from HEAT SINK Logic

2.3 **Detailed Parameter Questions** [III.f.1.e and III.f.2.e]

2.3.1 Are containment isolation demand signals input to SPDS (e.g., PWR Phase A/B Isolation Demand Signal or BWR - Group Isolation Demand Signals)?

Yes

2.3.2 Does the SPDS use actual containment isolation valve position as an input to monitor successful isolation?

Yes

3.0 **DISPLAY OF SAFETY FUNCTIONS** [III.F.]

3.1 Does the SPDS provide the status of all five (six at ONS) safety functions on one display page?

Yes

3.2 Are the individual parameters that support the safety functions grouped by safety function?

Yes

3.3 Is the status of all five (six at ONS) safety functions <u>always</u> displayed on the SPDS? [III.B.2]

Yes

4.0 **RELIABLE DISPLAY** [III.A.3 except as noted]

4.1 Is the SPDS hosted on the same computer system as the plant process computer?

Yes

4.2 List location of accessible (e.g., keyboards) devices capable of changing SPDS data.

Unit Control Board (UB1)
Control Room Desk
Computer Room

Note: SPDS Data is password protected

4.3 Are SPDS hardware availability data documented?

Yes

If Yes, what is the documented percent availability of the SPDS hardware over the past 12 months? NOTE: Availability should be based

on power operation, startup, hot standby, and hot shutdown only and not include other plant modes.

____ > 99% ____ Available

4.4 Are the SPDS computer points included in routine instrument loop surveillances? [III.A.3.a]

No

A review of the Oconee SPDS input parameters and the associated surveillance performed on these inputs is currently underway. Based on our research of all applicable databases, review of all I&E and Performance procedures, and discussion with station personnel preliminary indication are that all computer input points for the SPDS may not now be covered by the surveillance activities. We intend to include all SPDS computer points in routine instrument loop surveillances. However, additional reviews are necessary to identify those computer input points which may not be receiving routine surveillance. This review will be completed by October 16, 1989. At that time we will notify the NRC of the results of our findings and schedules for implementation of corrective actions to assure that all SPDS computer points are included in surveillance activities.

4.5 What percentage of software verification and validation has been completed?

100%

4.6 Have changes to the SPDS host computer and software been maintained under a formal Software/Hardware Change Request (or equivalent) system?

Yes, for seven years

4.7 How frequently does the SPDS display invalid or erroneous information?

Rare (less than 1% of the time)

4.8 How frequently have any of the critical safety functions been in a false alarm condition? [III.A.3.a]

Infrequent (1% - 5%)

4.9 Does the SPDS display valid parameter information during adverse containment conditions?

Yes

5.0 **HUMAN FACTORS** [III.E except as noted]

Human factors in the context of SPDS design includes the usefulness of the technical information displayed on the screen to users and their performance during emergency operations. Human factors also includes display design techniques, such as labeling, display layout, and control/display integration.

This section provides a sample of the kinds of questions to be asked to help determine the degree to which the SPDS design incorporates accepted human factors principles.

5.1 Who is the prime user of the SPDS?

Shift Supervisor
Unit Supervisor
Control Room Supervisor
Shift Engineer (STA)

5.2 Are all SPDS controls located at the SPDS workstation?

Yes

5.3 Is all SPDS related information physically displayed such that the information can clearly be read from the SPDS user's typical position? [III.A.1 and III.B.1]

Yes

5.4 How are SPDS displays accessed? [III.A.2]

Continuous display, no interaction possible	(Alarm CRT)
Keyboard, one or two keystroke function key	(Control Room)
Keyboard, greater than two keystrokes	(Computer Room)

Note: See the attached program description for more details (Attachment 2).

5.5 Does the SPDS consistently respond to user commands in less than 10 seconds? [III.A.2]

Yes

5.6 Does the SPDS sampling rate for parameters match the display update rate for those parameters? [III.A.2]

Yes

5.7 Are all parameter units of measure displayed on the SPDS consistent with the units of measure included in the emergency operating procedures?

Yes

5.8 Are all parameter labels and abbreviations consistent with the labels and abbreviations included in the emergency operating procedures?

Yes

5.9 Is any of the displayed information in a form that requires transformation or calculation?

No

5.10 Are the high and low level setpoints consistent with hard-wired parameter instrumentation and reactor protection system setpoints?

Yes

5.11 Does SPDS display high and low level setpoints?

Yes

5.12 Are the SPDS calculated values such as subcooling margin, consistent with calculated values on the plant process computer?

Yes

5.13 Are all parameter units of measure displayed on SPDS consistent with the hard wired instrumentation?

Yes

5.14 Are all parameter labels and abbreviations consistent with hard wired instrument labels and abbreviations?

Yes

5.15 Were the technical basis for software specifications verified with plant specific data (for example, heat-up and cool-down limits, variable steam generator setpoints and high and low level alarm setpoints)?

Yes

5.16 List LERs written as a result of SPDS software problems.

None

6.0 **TRAINING** [III.C.2 all questions]

6.1 Does simulator training include training in the use of the SPDS?

Yes

6.2 How long is formal classroom training for SPDS users?

More than 4 hours

6.3 Is there periodic requalification training for SPDS?

Yes, during every two year continuing training cycle via the normal simulator training for the Cycle and/or during classroom training.

6.4 When are SPDS users given training regarding the relationship of the parameters to the plant safety functions?

On the job or required reading
During Requalification Training
During an initial SPDS training program

7.0 **ELECTRICAL ISOLATION** [III C.1 all questions]

7.1 What isolation devices are currently used?

7.1.1 Analog Isolation Devices

The following isolation devices are employed to protect the safety systems from electrical and electronic interference.

DEVICE	MODEL NUMBER	PART OF ORIGINAL PLANT DESIGN PREVIOUS NRC ACCEPTANCE
Bailey System 880 Buffer Amplifier	6621670A1143	Yes
E-Max Optical Isolator	175D127-8	No*
E-Max Optical Isolator	175D127-4	No*
Westinghouse Inadequate Core Cooling Monitor-86	2D31856G01	No
E-Max Optical Isolator	175D127-5	No*
E-Max Optical Isolator	175D126-3	No*
Bailey System 880 Count Rate Amplifier	6622091L2	Yes
Bailey System 880 Rate of Change Amp	6622275A2C/L	Yes
Bailey System 880 Log Amplifier	6622280CL	Yes
Bailey System 880 Summing Amplifier	6625202A021	Yes

*Listed in NUREG 1342, Table 1 as an acceptable isolation device.

The Westinghouse ICCM-86 provides electrically isolated signals to the SPDS. The signals have a high accuracy, isolated, voltage to current converter which provides galvanic isolation and protection from transients and fault voltages which may occur during interfaces with computing systems and other process monitoring devices (Ref. OM-311.B - 0036). Outputs are individually fused.

7.1.2 Digital Isolation Devices

The following isolation devices are employed to provide coil to contact isolation and separation for digital input signals to the SPDS from safety systems.

DEVICE	MODEL NUMBER	PART OF ORIGINAL PLANT DESIGN PREVIOUS NRC ACCEPTANCE
Bailey System 880 Auxiliary Relay Module	6622510A1	Yes
Potter Brumfield, Relays	KRP&KRPA	Yes
Cutler-Hammer, Relays	D23	Yes
Bailey System 880 Auxiliary Relay "B" Module	661961A2	Yes
ITE/ABB 4KV Breakers	5HK-350	Yes

7.2 Original Installation and NRC Approval

The isolation devices are identified in Section 7.1.1 and 7.1.2 with respect to previous NRC approval. Original installation in this context is taken to mean "as part of the original plant design" which received NRC approval as part of the issuance of the plant operating license.

Attachment 2

Duke Power Company

Oconee Nuclear Station

Response to Generic Letter 89-06

Safety Parameter Display System

and

Supporting Displays

Program Description

Overview

The Safety Parameter Display System or SPDS consists of computer alarm logic, implemented on the Honeywell 45000 Operator Aid Computer (OAC), which receives inputs from a wide range of plant parameters. To make the SPDS useful to the Operator, the SPDS Alarm Logic has been formed to cover six separate areas referred to as Critical Safety Functions or CSFs. The CSFs have been further divided into four Alarm States, a No Alarm State and an Indeterminate Indication.

The six Critical Safety Functions are:

SUBCRITICALITY
INADEQUATE CORE COOLING
HEAT SINK
RCS INTEGRITY
CONTAINMENT INTEGRITY
RCS INVENTORY

The status of each CSF will be identified by individual color blocks arranged along the bottom of the Alarm CRT (this is a dedicated display located on UB2 in each Control Room). The possible CSF states and Block colors are:

NO ALARM	GREEN
INDETERMINATE	MAGENTA
ALARM LEVEL 1	WHITE
ALARM LEVEL 2	YELLOW
ALARM LEVEL 3	ORANGE (Checkered Red & Yellow Pattern)
ALARM LEVEL 4	RED

Each CSF will have a corresponding Color Block arranged along the bottom of the Alarm CRT from left to right in the same order as the listing above.

When the state of a CSF changes, the associated Alarm Block will change to the color dictated by the alarm logic, begin to flash, and the computer alarm bell will sound once. The CSF Alarm Block will flash until the computer alarm acknowledge button is pressed by the Operator. If the CSF status changes while its Alarm Block is flashing, the block will still change color and the alarm

bell will sound. In addition to the Alarm Block color change, the changed status of the CSF will be printed on the Alarm Printer in the Control Room.

The SPDS Alarm Logic has been designed such that it will produce no alarms during normal plant maneuvers. Thus if a valid SPDS Alarm is received, it will be accompanied by other alarms and and indications symptomatic of the transient being experienced. But, if an SPDS Alarm is received and the alarm source is not obvious due to other simultaneous alarms and plant indications, Support Displays are available to aid in determining the alarm source.

There are three types of Support Displays; the Overview Display (Graphic Display 31), the Fault Tree Diagrams and the Alarm Logic Diagrams. All of these display types are graphic displays on the Honeywell 45000 OAC and can be accessed through the Graphic Display Function of the OAC by all OAC terminals.

The Overview Display shows the status of all six CSFs and the displayed Alarm Blocks mimic the behavior of the Alarm Blocks on the Alarm CRT.

The Fault Tree Displays, as shown in the attached screen prints, provide a simplified view of the CSF utilizing CSF Statement Blocks. Each statement block represents a portion for the CSF Alarm Logic which can be either true or false, and each contains a statement which can be answered "YES" or "NO" by the computer. As each statement is answered "YES" or "NO", a path is traced to an Alarm Status Result.

On the right side of the display are the five Alarm Status Boxes for the displayed CSF Fault Tree. Along the bottom of the display are the Alarm Blocks for all the CSFs as on the Alarm CRT. When the computer traces a path through the CSF Statement Blocks to an Alarm Status Box, the path will be shown as a different color than the rest of the Fault Tree Diagram. If the path leads to the the No Alarm Box, the path and the box interior will be GREEN. The interior of all the other boxes will be blank, and the rest of the Fault Tree will be white.

If the path leads to an Alarm Box, such as the White (Level 1) Box, the path will be RED and the interior of the Alarm Box reached will be the appropriate alarm color. The interior of all other Alarm Boxes and the No Alarm Box will be blank, and the rest of the Fault Tree will be white.

In addition to the Fault Tree Diagrams, the Alarm Logic Diagrams, as shown in the attached screen prints, are available. The Alarm Logic Diagrams are slightly simplified displays of the actual driving SPDS Alarm Logic.

Each Logic Diagram consists of Parameter Alarm Statements, Parameter Conditional Statements, Logic Elements, CSF Alarm Status Boxes, and SPDS Alarm Blocks. The Parameter Alarm and Conditional Statements indicate the values at which the statement is true or false. If true, and Alarm Statement will change from Green to Red and a Conditional Statement will change from green to cyan (light blue). If a statement is false it will be green.

An example of each type of statement can be found on the HEAT SINK CENTRAL Logic Diagram. The statement "T-AVE > 150 DEGF" is a conditional statement and will turn cyan when the RCS Average Temperature is greater than 150^{o}F. The statement

"COND VAC < 7 INHG" is an alarm statement and will turn red when condenser vacuum is less than 7 inches of mercury.

On the right side of the display are the CSF Status Boxes as in the Fault Tree Display. Only the box corresponding to the highest level alarm will be lit-up, the rest being blank.

If one of the OAC inputs to the SPDS is determined to be invalid by the OAC, the corresponding input statement will turn magenta. Additionally, the Alarm Block will turn magenta and begin to flash until acknowledged. The CSF Status Boxes along the right side of the Fault Tree and Logic Diagram Displays will all be blank. If the remaining inputs to the affected portion of a CSF's Logic reach a state which indicate that an alarm condition exists, then the alarm status will be displayed as previously explained. The Alarm Block will turn magenta only when a CSF's input is invalid and no other alarm condition exists.

Between the Parameter Alarm and Conditional Statements and the CSF Status Boxes are the Logic Elements. The Logic Elements are always green.

As on the Fault Tree Displays, the SPDS Alarm Blocks are arranged along the bottom of each Logic Display and show the current alarm condition of each CSF. When an SPDS Alarm is received, these alarm blocks will change color and flash until acknowledged just as they do on the Alarm CRT. The Alarm Blocks shown on the Overview Display also exhibit the same behavior.

SPDS Support Display Usage

The SPDS Support Displays can be called to the OAC CRT Screen in one of several ways. If the user is at the STA Workstation located at the Control Room Desk, there are dedicated call up keys for each of the CSF Fault Tree Displays. At any other OAC Workstation, the SPDS Support Displays must be initially called to the screen using the OAC Graphic Display Function.

Through use of the OAC Graphic Display Function, the user can initially access a display through one of two methods. The first method is by pressing the Graphic Display Key and then entering the desired graphic display's number. When the Graphic Display Key is pressed, it calls a menu of all available displays to the screen. By paging through the menu, using the Menu Forward and Menu Backward Keys, the user can find the number of the display of interest. The second method is by pressing the Graphic Display Key and through the Graphic Display Menu, calling up Graphic Display 31 (the Overview Display). The Overview Display is a summary of the CSF Alarm Blocks (see the attached screen prints), it is also the means to access the rest of the SPDS Support Displays.

The Overview Display contains six "link-zoom" targets. These link-zoom targets are located with the displayed CSF Alarm Blocks. By placing the cursor anywhere within one of the CSF Alarm Blocks, either by using one of the TAB keys or one of the ARROW keys, and then pressing the EXECUTE Key, the users display will be "zoomed" to the "linked" display. Thus if the cursor is placed within the SUBCRITICALITY Alarm Block and the EXECUTE Key is pressed, the screen display will change from the Overview Display to the Fault Tree Diagram for SUBCRITICALITY.

The STA Keyboard, located next to the Control Room Desk, and the Loop A/B Keyboard, located on the UB1 Control Board, also have dedicated graphic call-up keys. The STA Keyboard has six dedicated keys, on for each CSF, which will instantly call up the Fault Diagram corresponding to the selected key when pressed. The Loop A/B Keyboard has a dedicated key for instant call-up of the Overview Display. Once the SPDS Support Displays have been reached, from what ever path, utilization of these displays is the same.

Once one of the SPDS Support Displays has been called to the screen, the user can page through all of the displays by using the PAGE FORWARD and PAGE BACKWARD Keys. All of the SPDS Support Displays, except for Graphic Display 31, are sequential, thus when paging through the displays, the user will go through them in a logical order. The attached screen prints are arranged in the same order the user would find when paging through the displays.

In addition to being able to page through the displays, each Fault Tree and Logic Diagram Display have been equipped with Link-zoom targets which allow the user to quickly go to any of the CSF Fault Tree Displays. Along the bottom of each Fault Tree and Logic Diagram Display are the six CSF Alarm Blocks. Not only do these Alarm Blocks display the alarm status of their respective CSFs, they are also Link-zoom targets as well. By placing the cursor within one of these blocks and pressing the EXECUTE Key, the Fault Tree Display associated with the selected block will be displayed on the CRT. This provides a much faster means to get from one display to the next than paging if it is not desired to view the displays in sequential order. In addition, many portions of the SPDS Alarm Logic refer to portions of logic associated with other CSFs and in the case of the HEAT SINK CSF the amount of logic present is to great to be displayed on one screen. In those cases, link-zoom targets have been provided to allow the user to quickly go from one logic segment to an associated logic segment. By placing the cursor next to the line in a Logic Diagram which refers to another segment of logic and pressing the EXECUTE Key, the associated Logic Diagram will be displayed. The newly displayed Logic Diagram will contain a link-zoom target which will return the user to the previously displayed screen.

Since there is not enough room to display values associated with each of the logic input statements on the Logic Diagram Displays, a "Peek-Point" function has been provided for the Logic Diagram Displays. By positioning the cursor next to a input statement and pressing the EXECUTE Key, the OAC analog or digital point feeding that input statement and its value will be displayed along the bottom of the CRT directly below the CSF Alarm Blocks. If more than one OAC point feeds a single input statement (such as the statement "SAFETY RODS NOT AT 100% WD" which has as an input all the control rod position indications for the rods within the four safety groups), then rather than attempt to display more than one point at the bottom of the screen, a new screen will be displayed containing all of the points of interest.

14:26:35 OCONEE STAGING SYSTEM 07/10/89

*4020 COMP OUT-OF-SERVICE YES

INVD	A0157	C STOR TK LVL		N FEET	5.49
LOW	CPS028	NC AMBT AIR TMP --A1023	-3.99	DEGF	35.00
HS-7	ANLBAD	ANALOG INPUTS BAD	43		5
HS-5	PWABAD	BAD PWA'S	6		1
OVFL	TEST7	PIU BOX #7 TEMP		N DEGF	
OVFL	A2004	RCS LR PRESS		N PSIG	

SUBCRIT ICC HEAT SINK RCS INTEG CONTAIN RCS INVEN

SPDS SUPPORTING DISPLAYS

A831

SUBCRITICALITY

INADEQUATE CORE COOLING

HEAT SINK

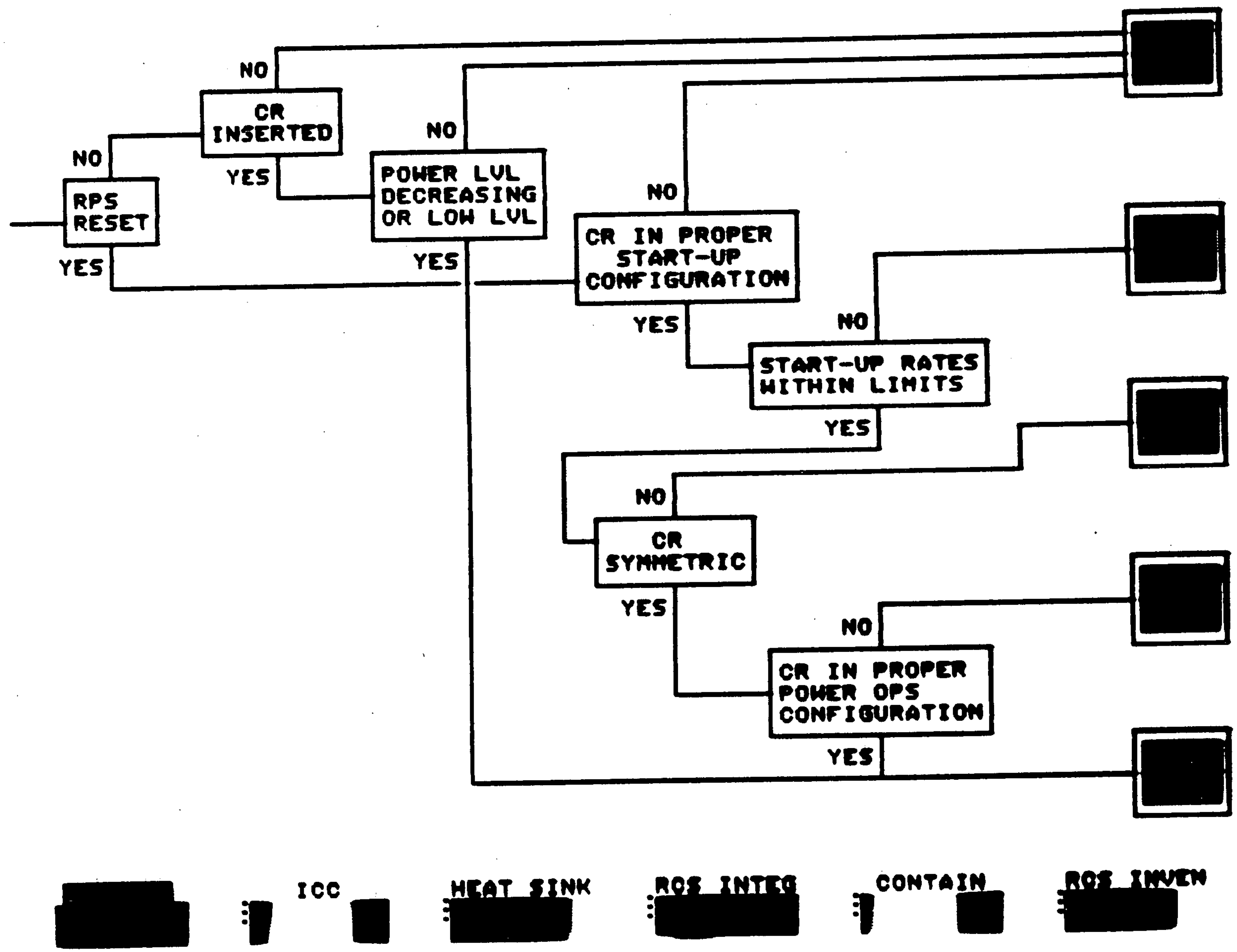
RCS INTEGRITY

CONTAINMENT INTEGRITY

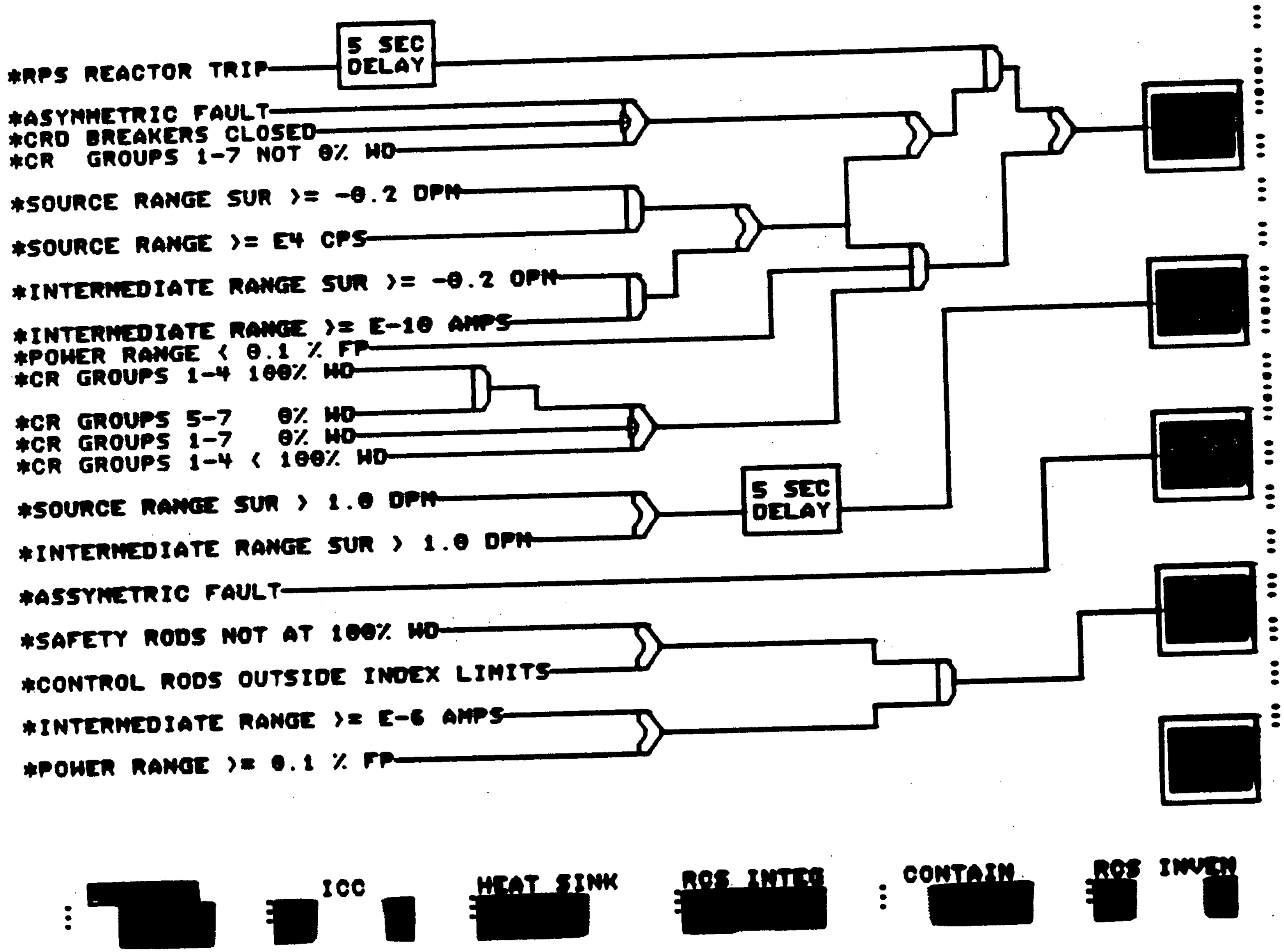
RCS INVENTORY

A201

SUBCRITICALITY



SUBCRITICALITY



CRD BREAKERS CLOSED

D2385	RP CRD DC BRKR CB1	INVD
D2386	RP CRD DC BRKR CB2	INVD
D2389	RP CRD AC BRKR UNIT 10	INVD
D2387	RP CRD DC BRKR CB3	INVD
D2388	RP CRD DC BRKR CB4	INVD
D2390	RP CRD AC BRKR UNIT 11	INVD

CR GROUP 1 THRU 7 % WITHDRAWN

GROUP 1	A0727	CR G5 POSN	PCT	INVD
	A0726	CR K5 POSN	PCT	INVD
	A0741	CR E7 POSN	PCT	INVD
	A0738	CR M7 POSN	PCT	INVD
	A0754	CR E9 POSN	PCT	INVD
	A0751	CR M9 POSN	PCT	INVD
	A0766	CR G11 POSN	PCT	INVD
	A0765	CR K11 POSN	PCT	INVD
GROUP 2	A0718	CR E3 POSN	PCT	INVD
	A0715	CR M3 POSN	PCT	INVD
	A0729	CR C5 POSN	PCT	INVD
	A0724	CR O5 POSN	PCT	INVD
	A0768	CR C11 POSN	PCT	INVD
	A0763	CR O11 POSN	PCT	INVD
	A0777	CR E13 POSN	PCT	INVD
	A0774	CR M13 POSN	PCT	INVD
GROUP 3	A0747	CR F8 POSN	PCT	INVD
	A0740	CR G7 POSN	PCT	INVD
	A0739	CR K7 POSN	PCT	INVD
	A0759	CR H10 POSN	PCT	INVD
	A0745	CR L8 POSN	PCT	INVD
	A0753	CR G9 POSN	PCT	INVD
	A0752	CR K9 POSN	PCT	INVD
	A0733	CR H6 POSN	PCT	INVD
GROUP 4	A0714	CR F2 POSN	PCT	INVD
	A0712	CR L2 POSN	PCT	INVD
	A0736	CR B6 POSN	PCT	INVD
	A0730	CR P6 POSN	PCT	INVD
	A0746	CR H8 POSN	PCT	INVD
	A0762	CR B10 POSN	PCT	INVD
	A0756	CR P10 POSN	PCT	INVD
	A0780	CR F14 POSN	PCT	INVD
	A0778	CR L14 POSN	PCT	INVD
GROUP 5	A0057	CR GROUP 5 POSN	PCT	INVD
GROUP 6	A0058	CR GROUP 6 POSN	PCT	INVD
GROUP 7	A0059	CR GROUP 7 POSN	PCT	INVD

RPS REACTOR TRIP CH. A & B

CH. A	D2355	RP CH A FLO/FLUX	INVD
	D2382	RP CH A RCP/FLUX	INVD
	D2356	RP CH A LO PRESS	INVD
	D2377	RP CH A PSI/TEMP	INVD
	D2372	RP CH A HI PRESS	INVD
	D1251	RP CH A	INVD
	D1246	RP A SD BYP PRESS	INVD
	D1451	RP A HI RB PRESS	INVD
	D2368	RP CH A HI TEMP	INVD
	D2391	RP NI 5 HI FLUX	INVD
	D2150	RP TURB CH A	INVD
	D2154	RP CH A TURB TRIP	INVD
	D2347	RP FWPT CH A	INVD
	D2140	RP CH A FWPT TRIP	INVD
	D2364	RP CH A TRIP	INVD
CH. B	D2429	RP CH B FLO/FLUX	INVD
	D2381	RP CH B RCP/FLUX	INVD
	D2357	RP CH B LO PRESS	INVD
	D2378	RP CH B PSI/TEMP	INVD
	D2373	RP CH B HI PRESS	INVD
	D1252	RP CH B	INVD
	D1248	RP B SD BYP PRESS	INVD
	D1452	RP B HI RB PRESS	INVD
	D2369	RP CH B HI TEMP	INVD
	D2392	RP NI 6 HI FLUX	INVD
	D2151	RP TURB CH B	INVD
	D2155	RP CH B TURB TRIP	INVD
	D2348	RP FWPT CH B	INVD
	D2141	RP CH B FWPT TRIP	INVD
	D2365	RP CH B TRIP	INVD

RPS REACTOR TRIP CH. C & D

D

CH. C	D2430	RP CH C FLO/FLUX	INVD
	D2383	RP CH C RCP/FLUX	INVD
	D2358	RP CH C LO PRESS	INVD
	D2379	RP CH C PSI/TEMP	INVD
	D2374	RP CH C HI PRESS	INVD
	D1253	RP CH C	INVD
	D1249	RP C SD BYP PRESS	INVD
	D1453	RP C HI RB PRESS	INVD
	D2370	RP CH C HI TEMP	INVD
	D2393	RP NI 7 HI FLUX	INVD
	D2152	RP TURB CH C	INVD
	D2156	RP CH C TURB TRIP	INVD
	D2349	RP FWPT CH C	INVD
	D2142	RP CH C FWPT TRIP	INVD
	D2366	RP CH C TRIP	INVD
CH.D	D2431	RP CH D FLO/FLUX	INVD
	D2384	RP CH D RCP/FLUX	INVD
	D2359	RP CH D LO PRESS	INVD
	D2380	RP CH D PSI/TEMP	INVD
	D2376	RP CH D HI PRESS	INVD
	D1254	RP CH D	INVD
	D1250	RP D SD BYP PRESS	INVD
	D1454	RP D HI RB PRESS	INVD
	D2371	RP CH D HI TEMP	INVD
	D2394	RP NI 8 HI FLUX	INVD
	D2153	RP TURB CH D	INVD
	D2157	RP CH D TURB TRIP	INVD
	D2350	RP FWPT CH D	INVD
	D2143	RP CH D FWPT TRIP	INVD
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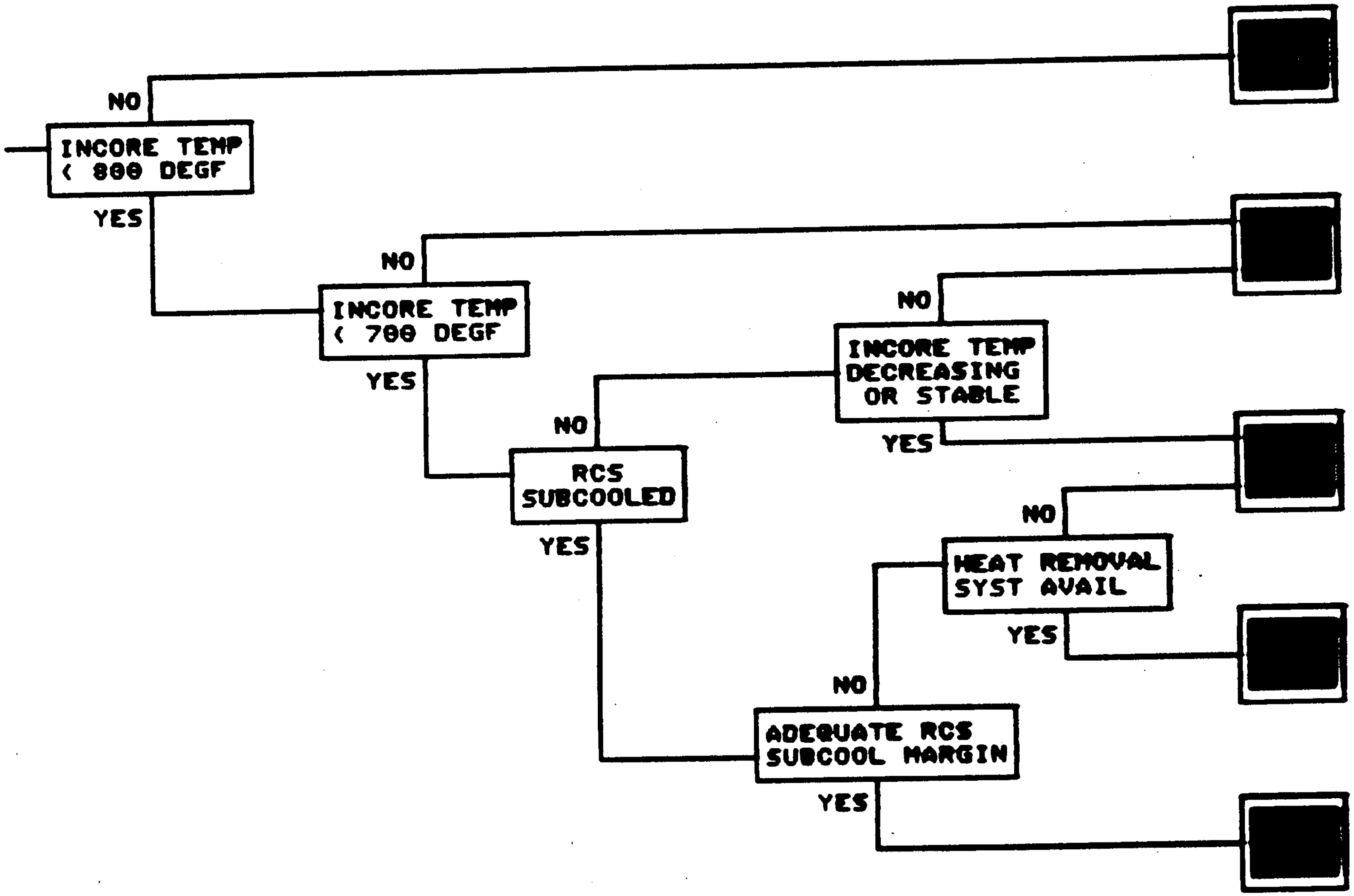
INADEQUATE CORE COOLING

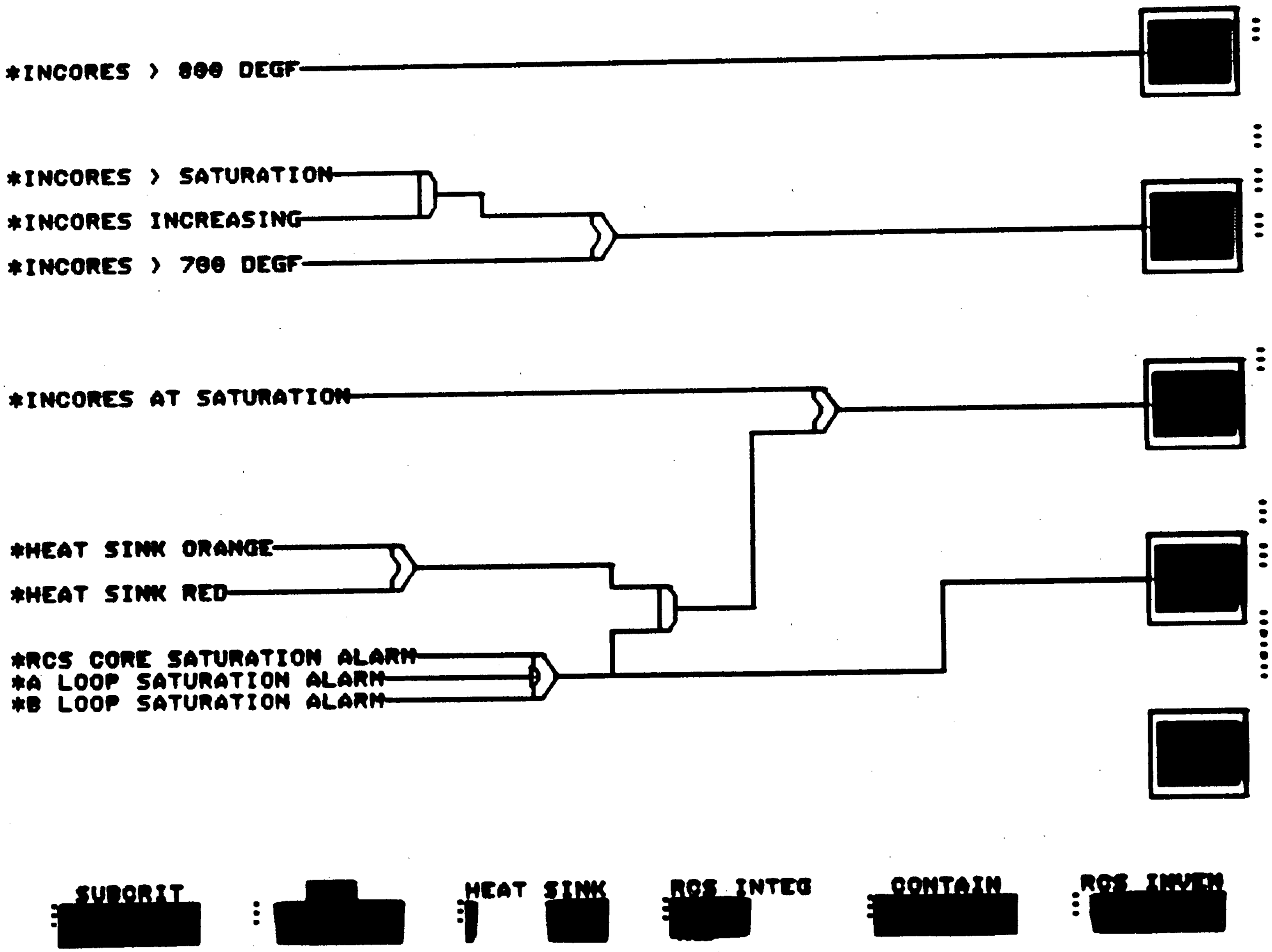
A206



SUBCRIT HEAT SINK RCS INTEG CONTAIN RCS INVEN

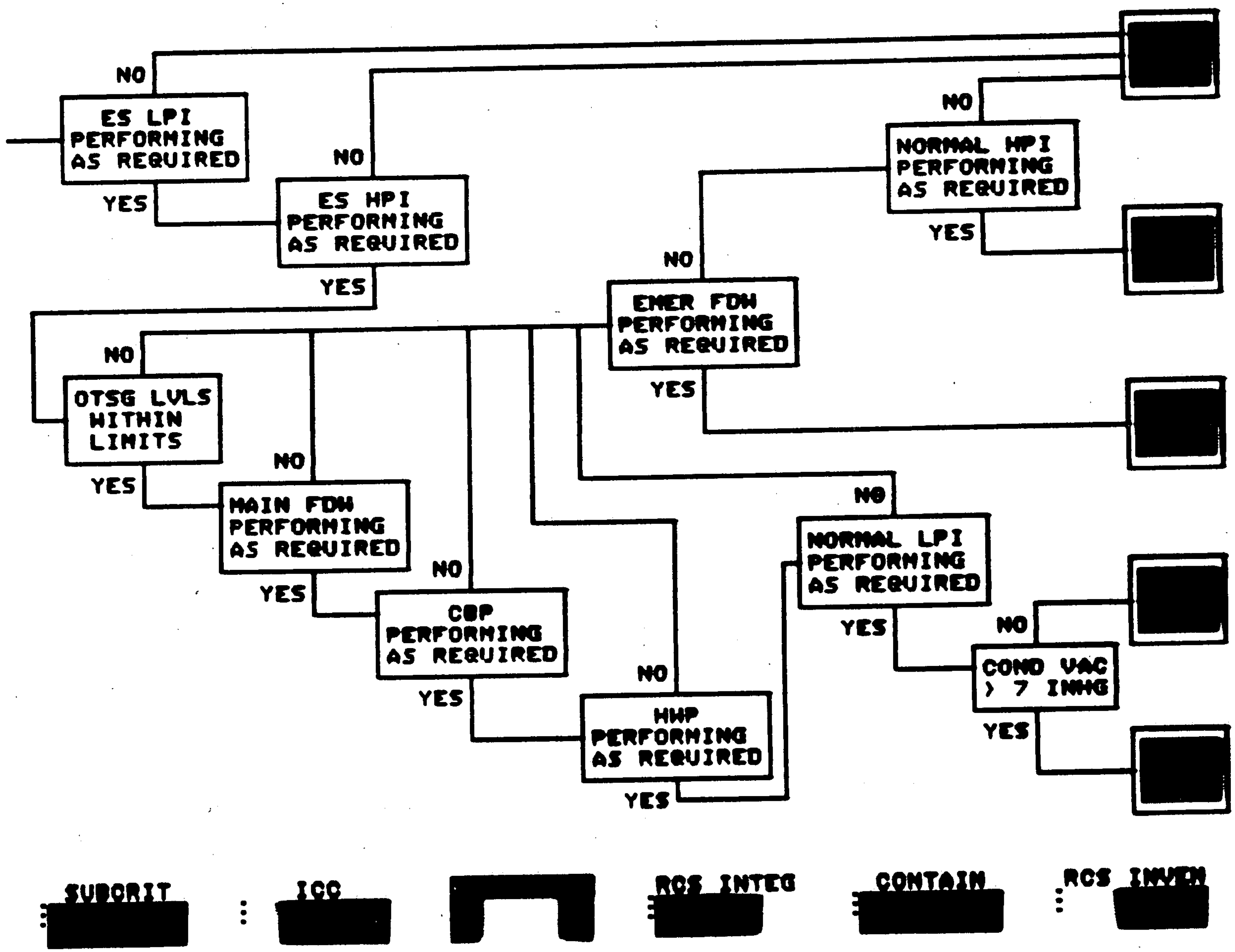
INADEQUATE CORE COOLING

A207



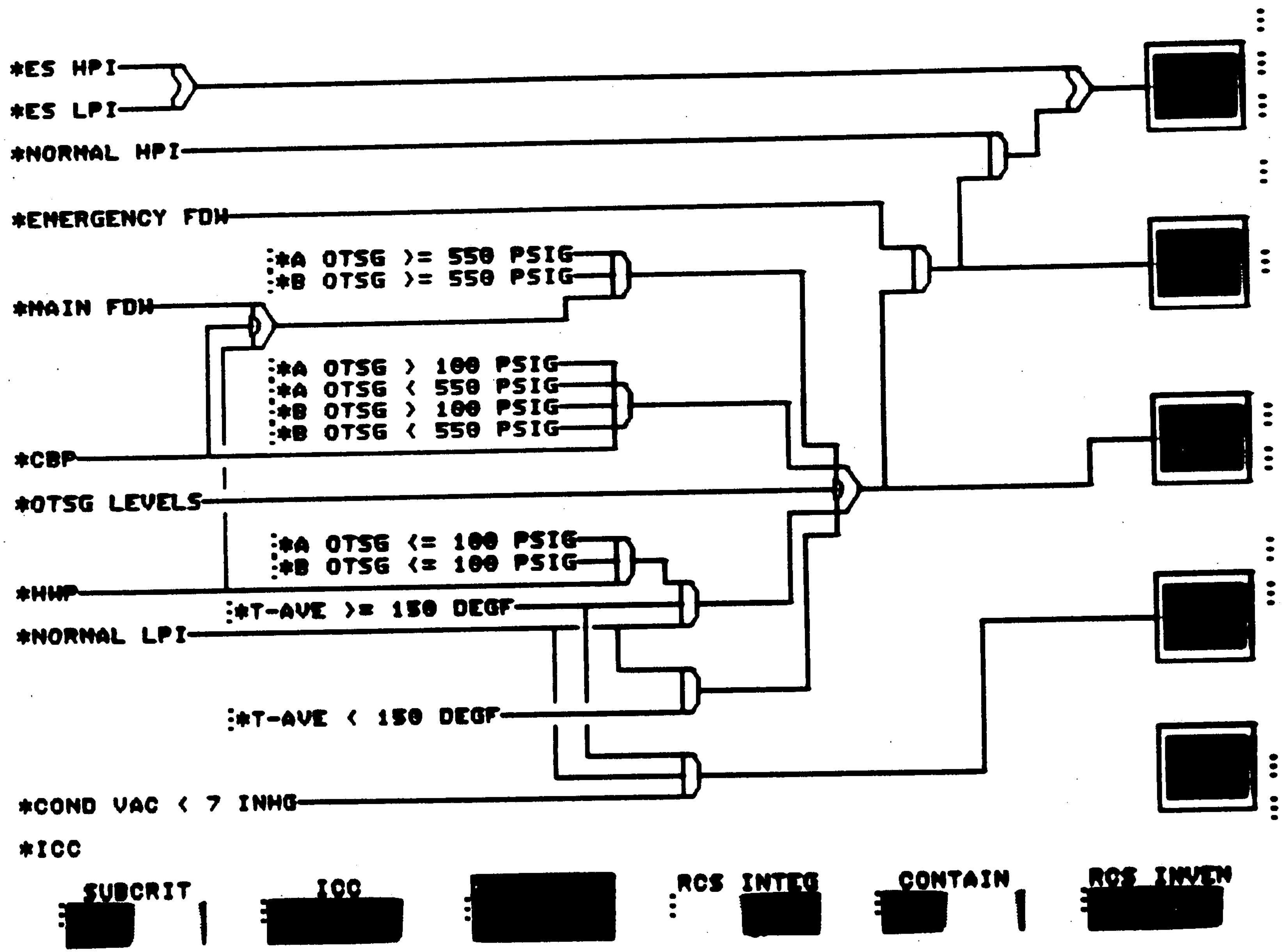
HEAT SINK

A211



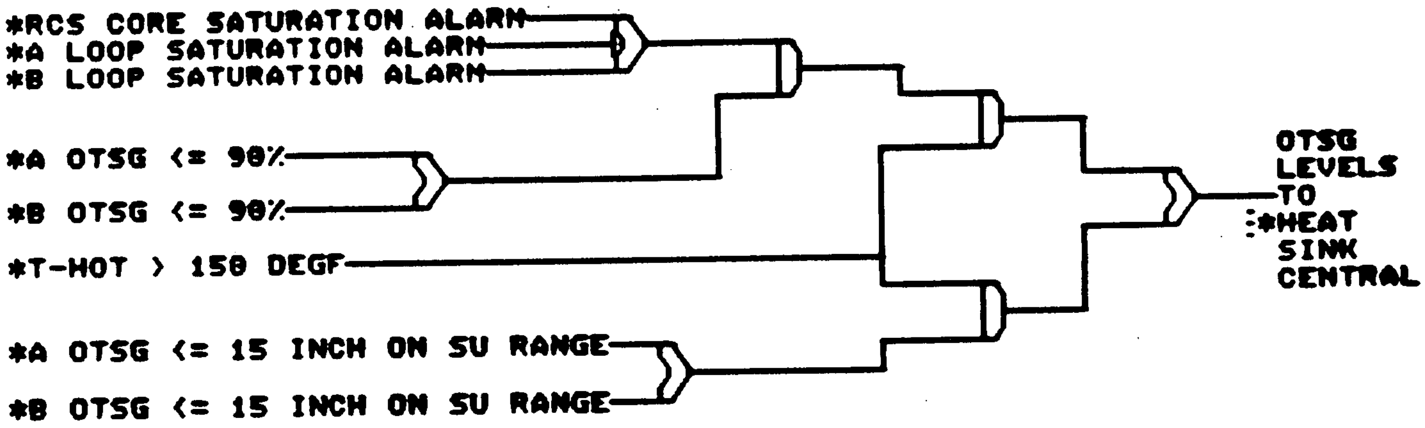
HEAT SINK CENTRAL

A212



A213

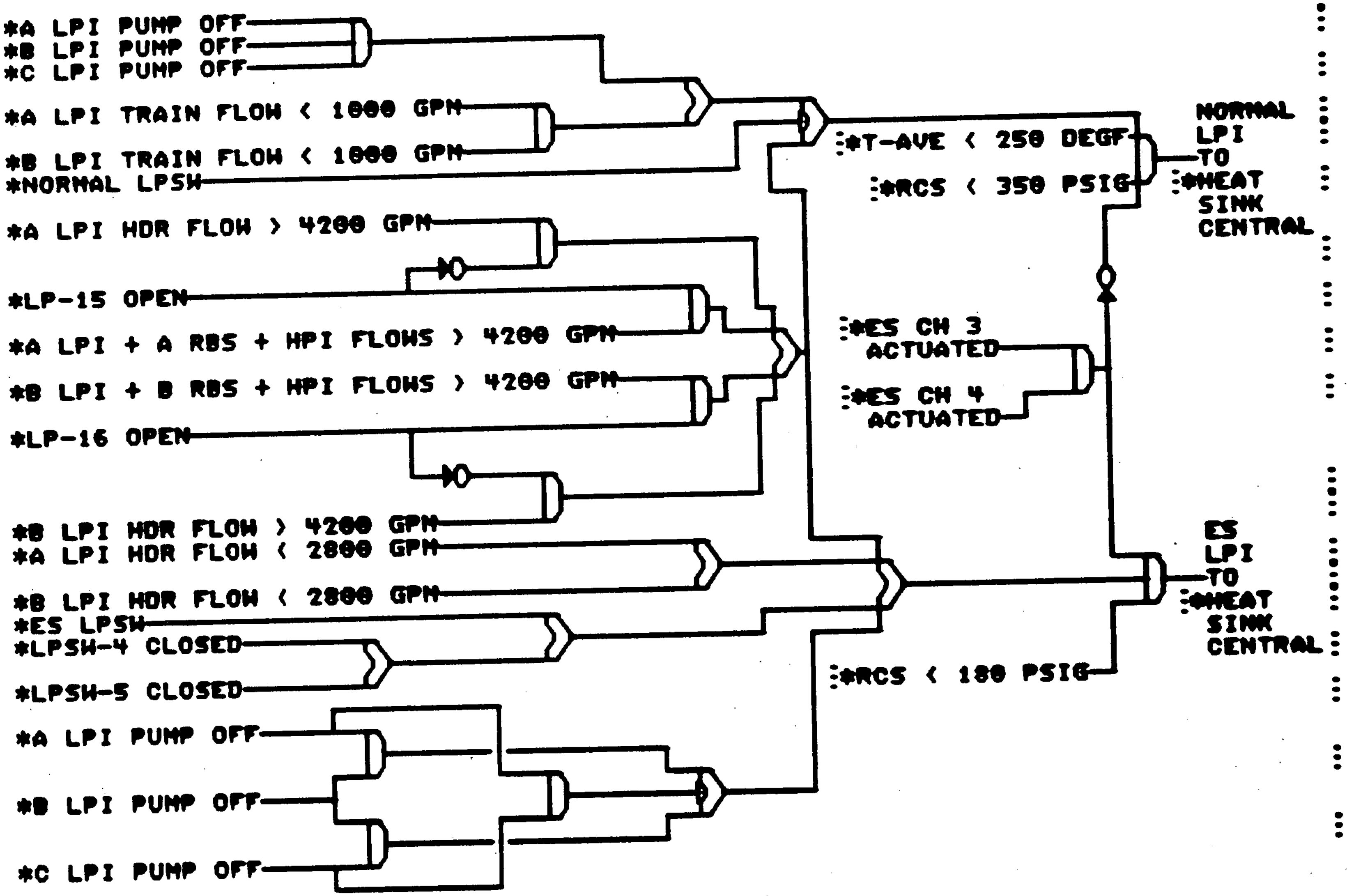
HEAT SINK OTSG LEVEL



SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

A214

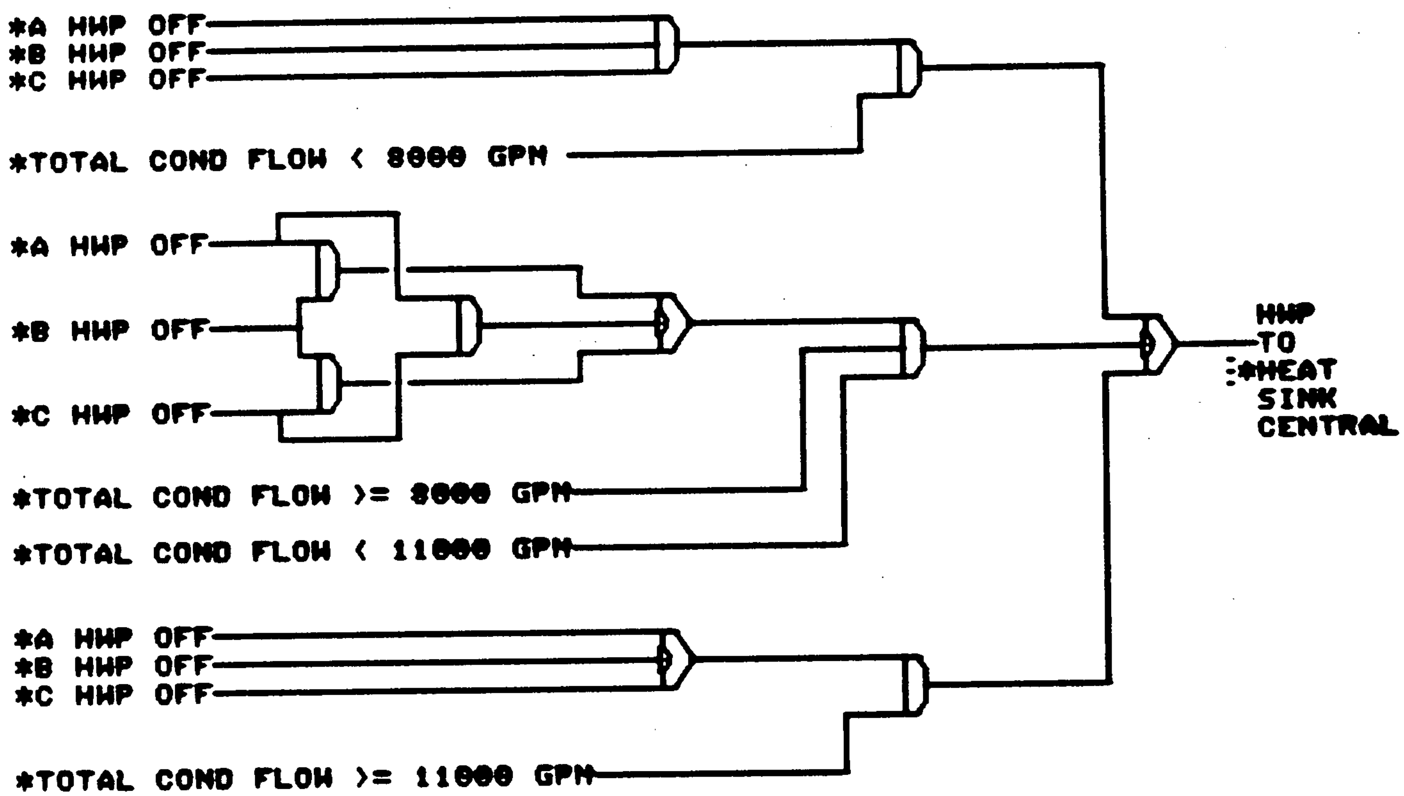
HEAT SINK LPI



SUBCRIT [redacted] ICC [redacted] [redacted] RCS INTEG [redacted] CONTAIN [redacted] RCS INVEN [redacted]

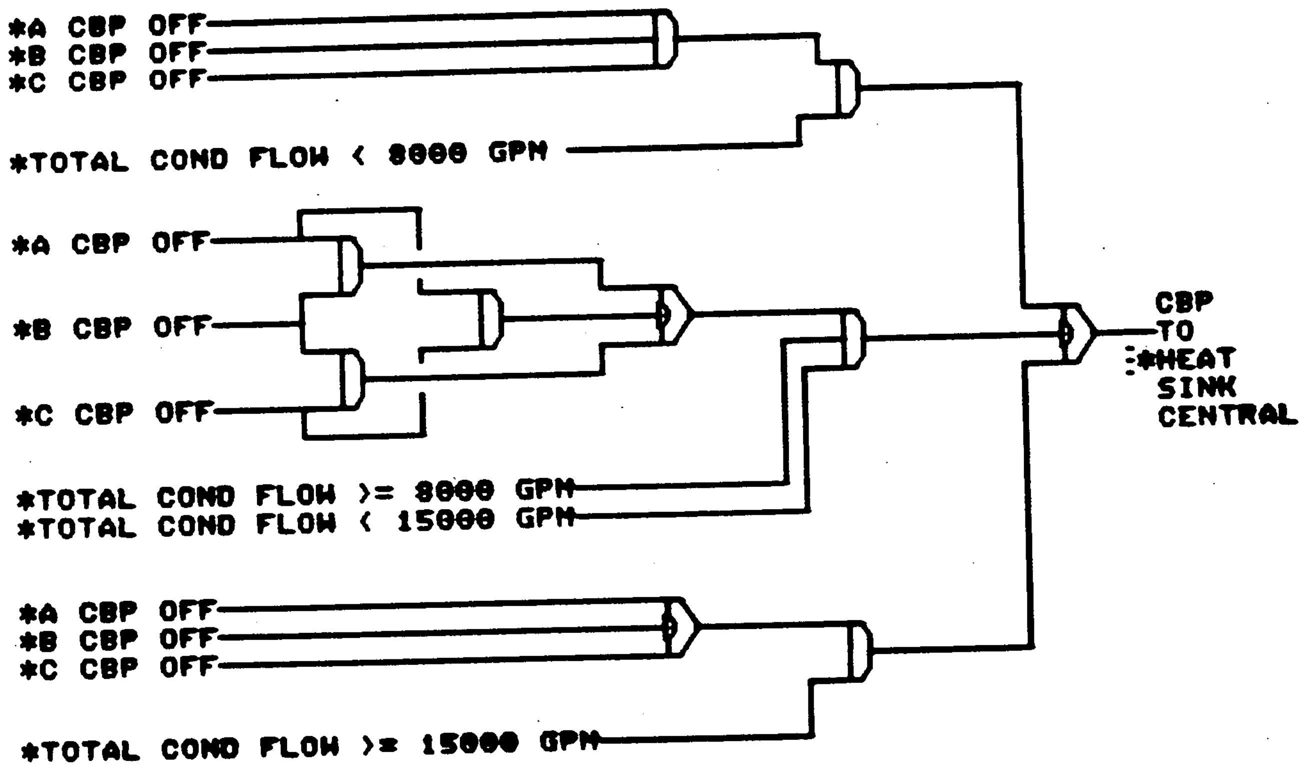
A215

HEAT SINK HWP



SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

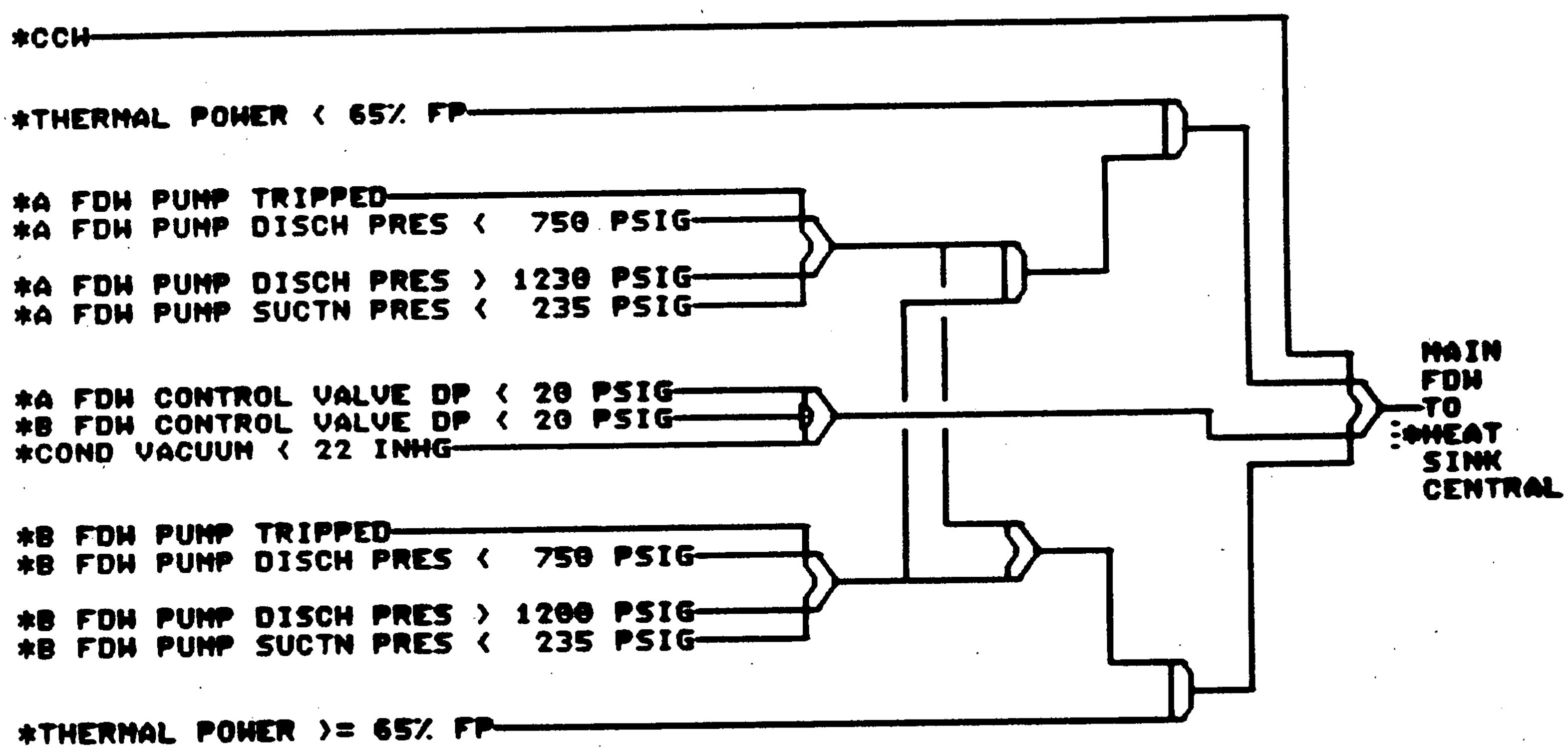
HEAT SINK CBP



SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

A217

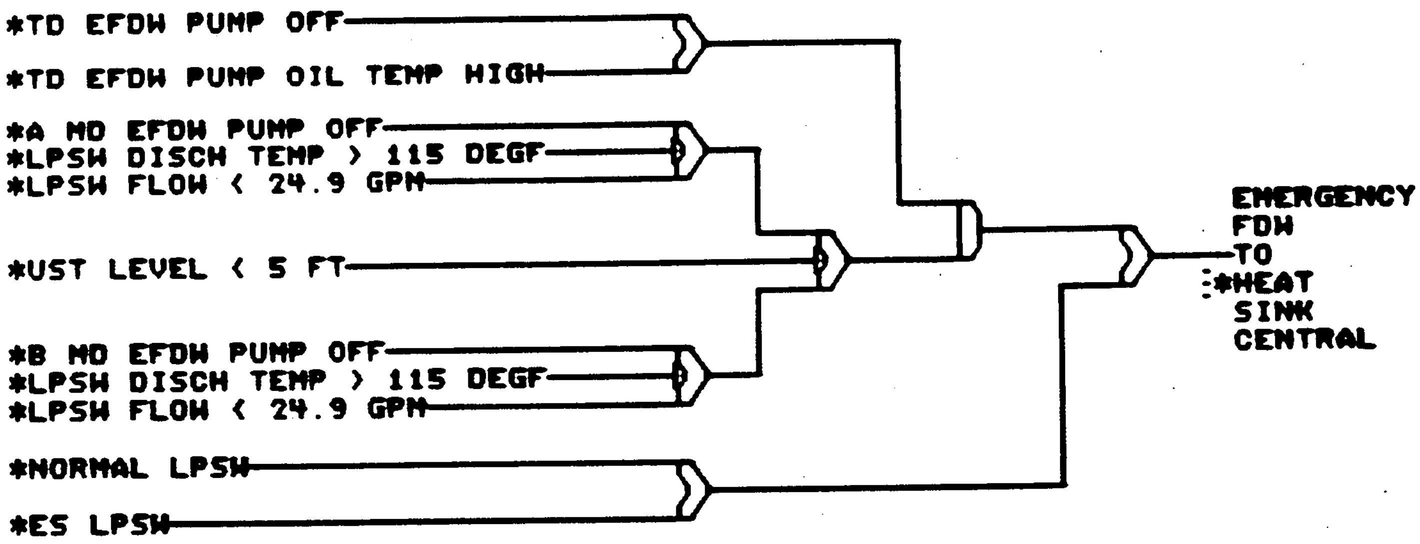
HEAT SINK MAIN FDW



SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

HEAT SINK EMERGENCY FDW

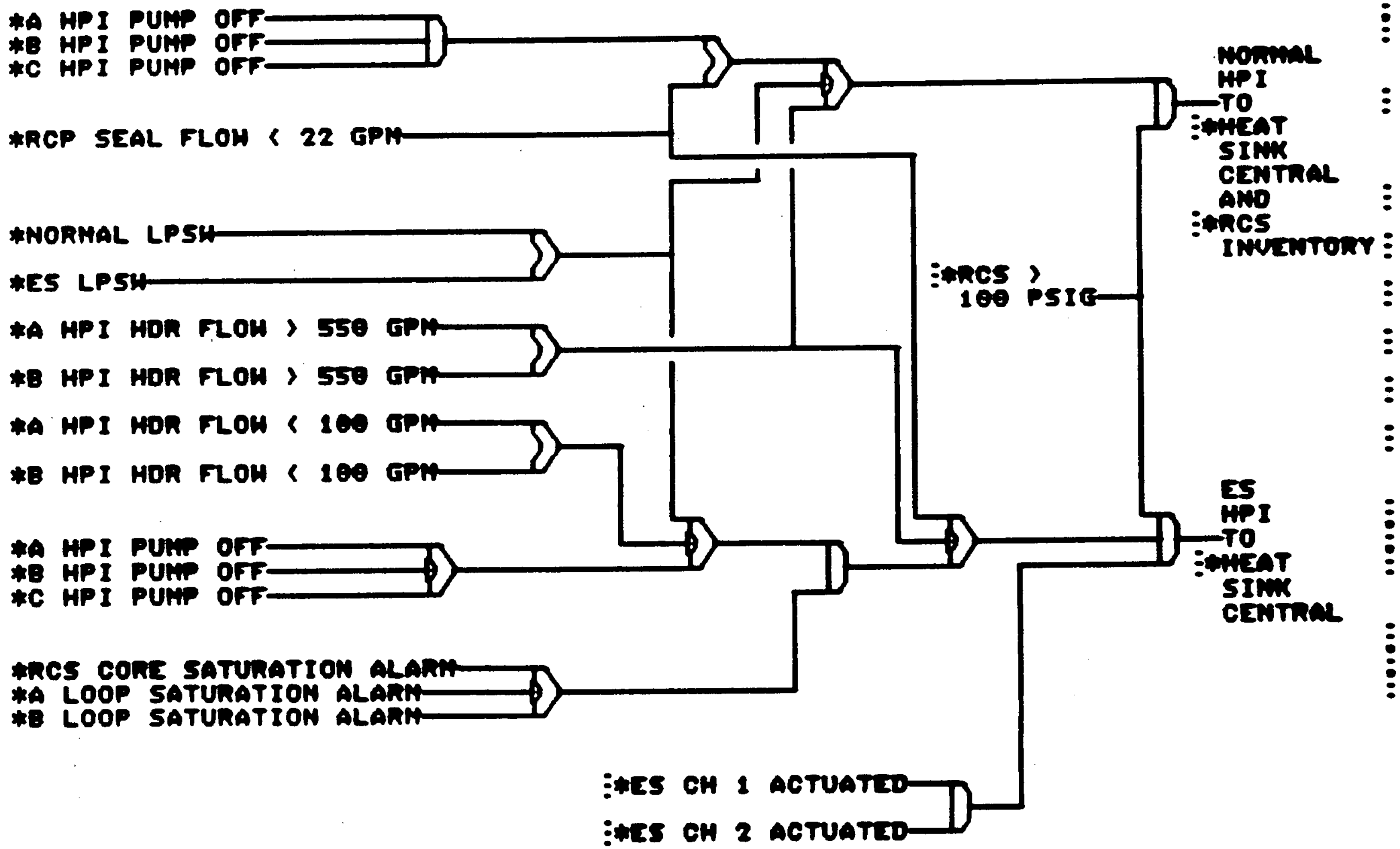
A219



SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

HEAT SINK HPI

A219

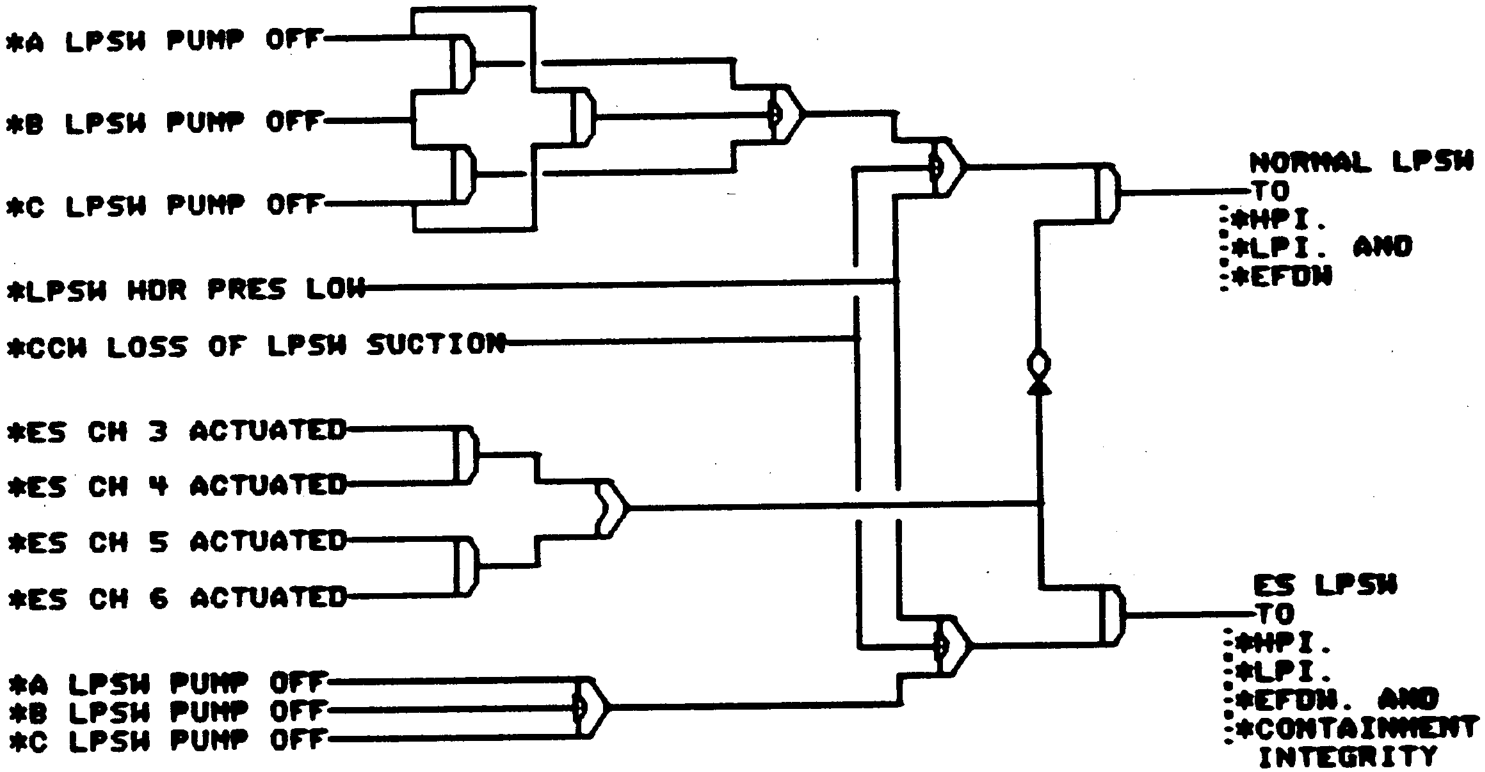


SUBCRIT ICC RCS INTEG CONTAIN RCS INVEN

D

HEAT SINK LPSW

A220

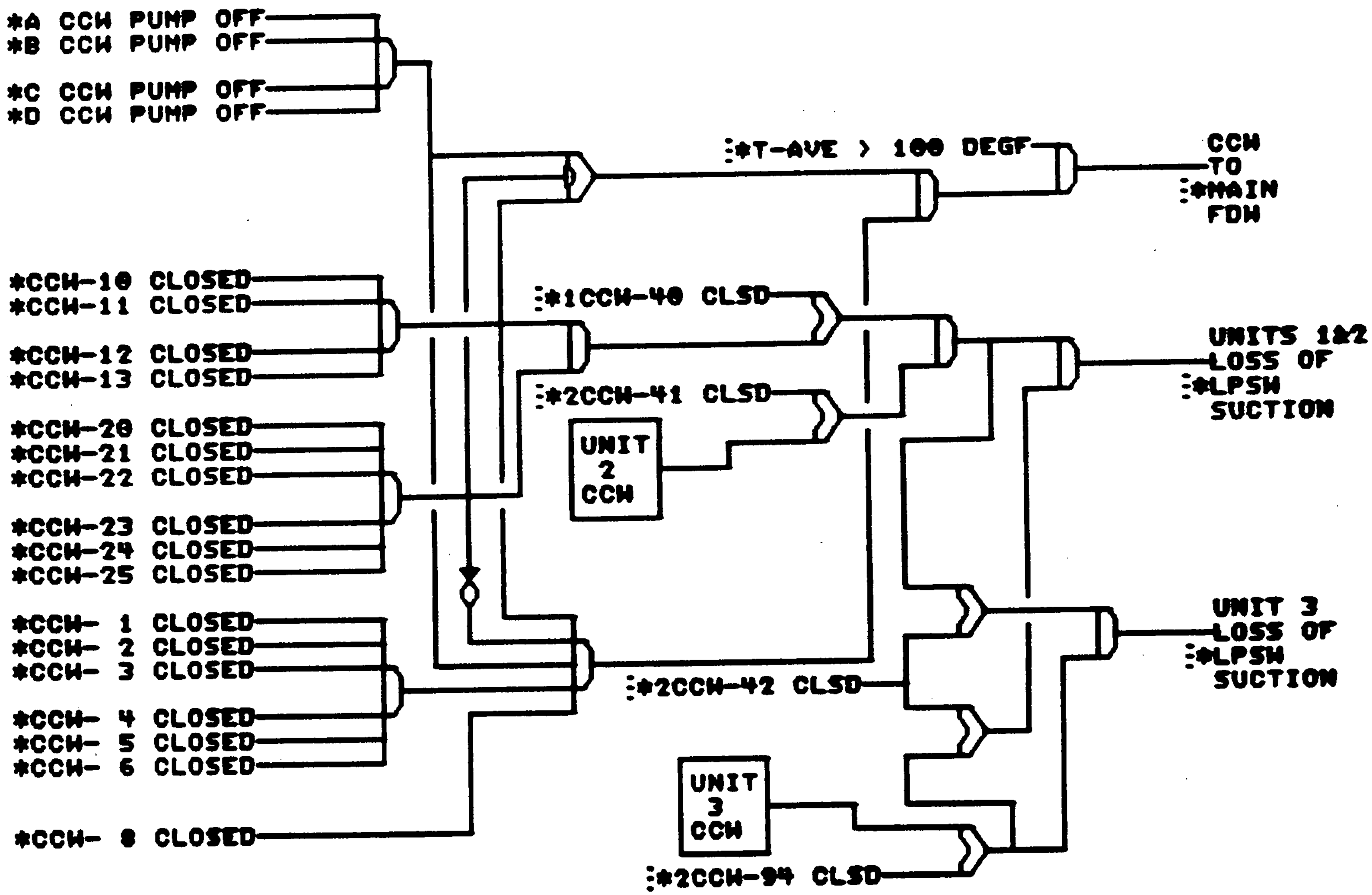


*HEAT SINK CENTRAL

SUBCRIT | ICC | RCS INTEG | CONTAIN | RCS INVEN

HEAT SINK CCW

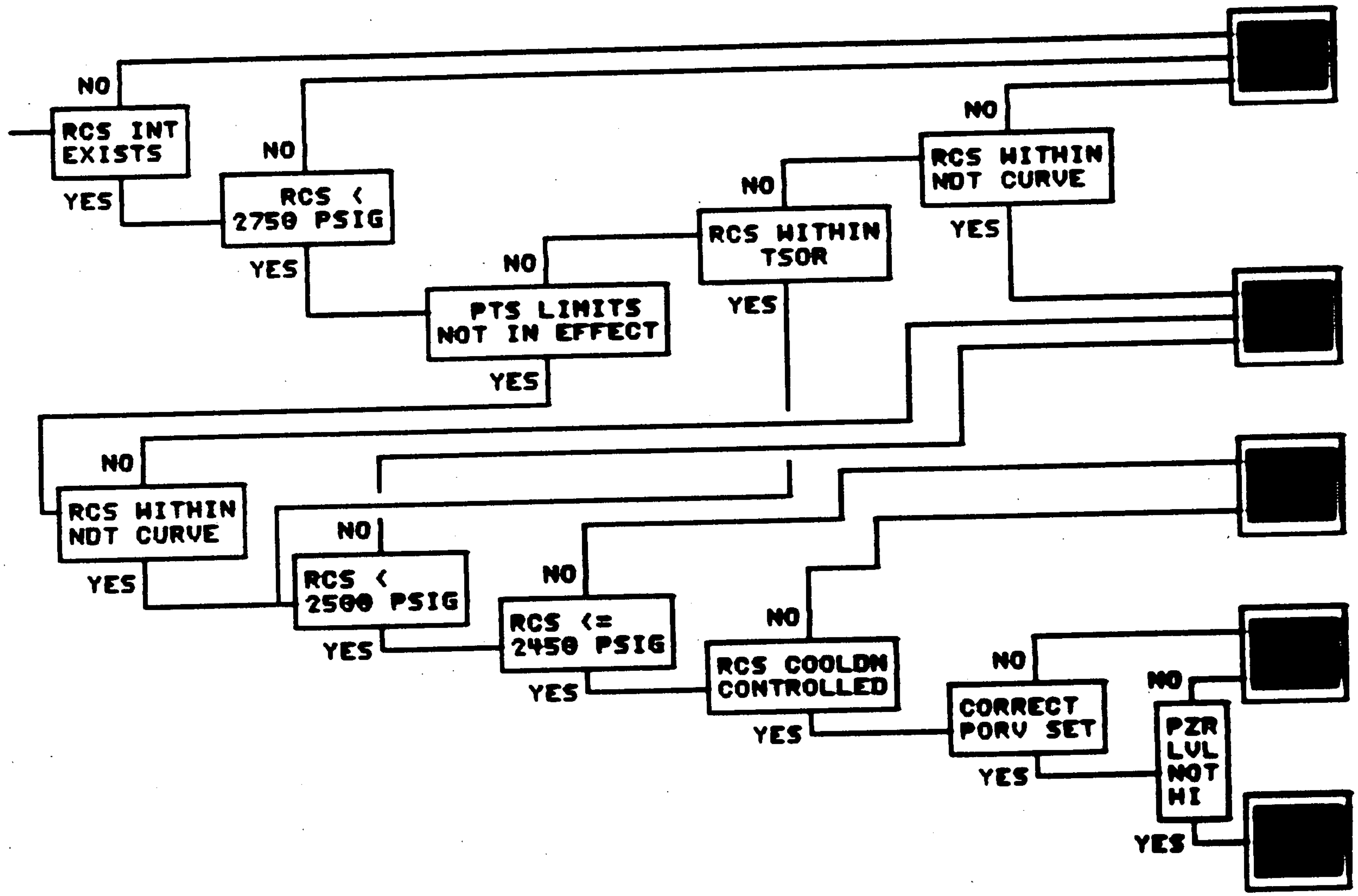
A221



*HEAT SINK CENTRAL

SUBCRIT | ICC | RCS INTEG | CONTAIN | RCS INVEN

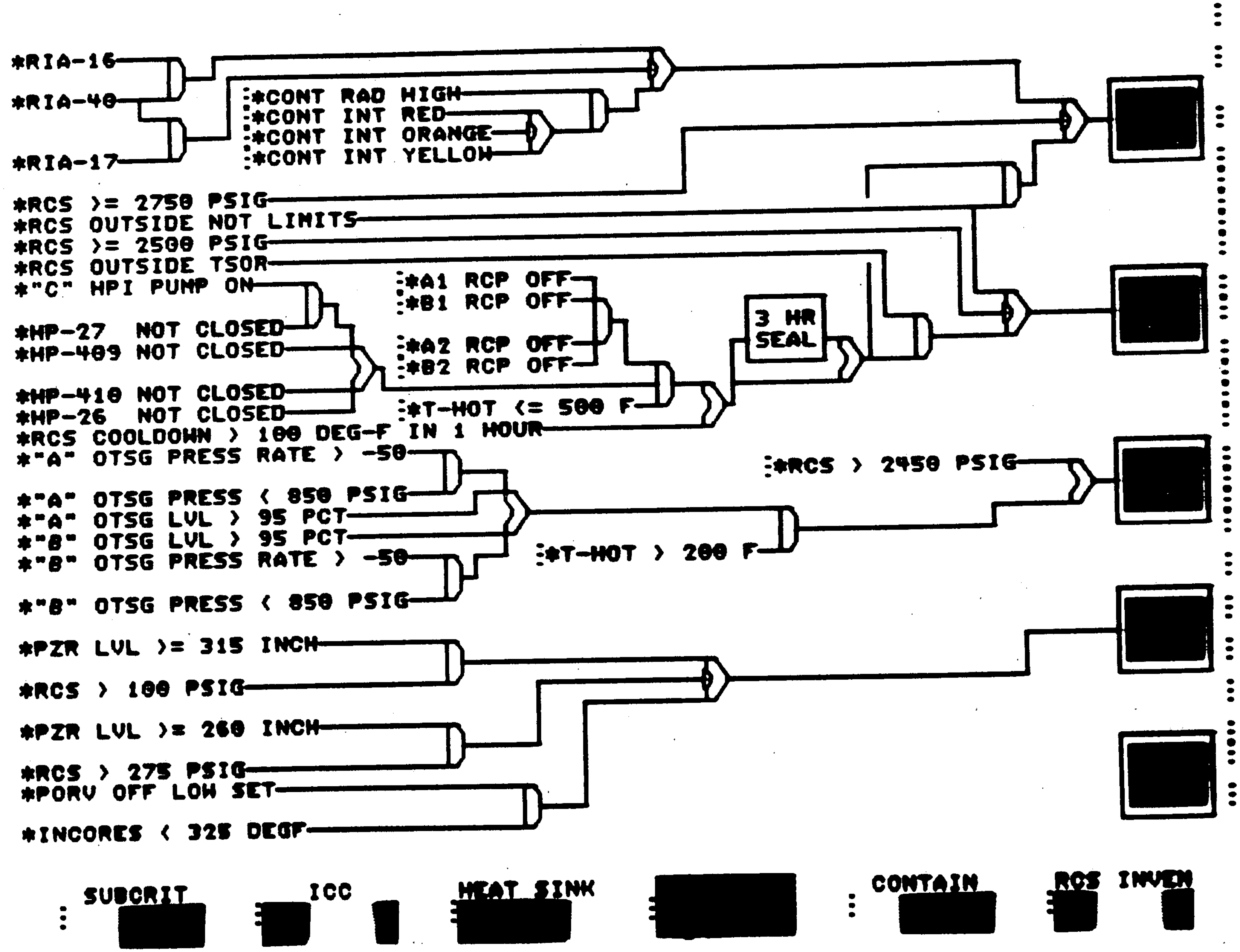
RCS INTEGRITY



SUBCRIT | ICC | HEAT SINK | CONTAIN | RCS INVEN

A227

RCS INTEGRITY



D

RCS OUTSIDE TSOR

CPS005 & CPS006

A1887	RC AVG TEMP	DEGF	INVD
A1416	RC LOOP A WR PRESS 1	PSIG	INVD

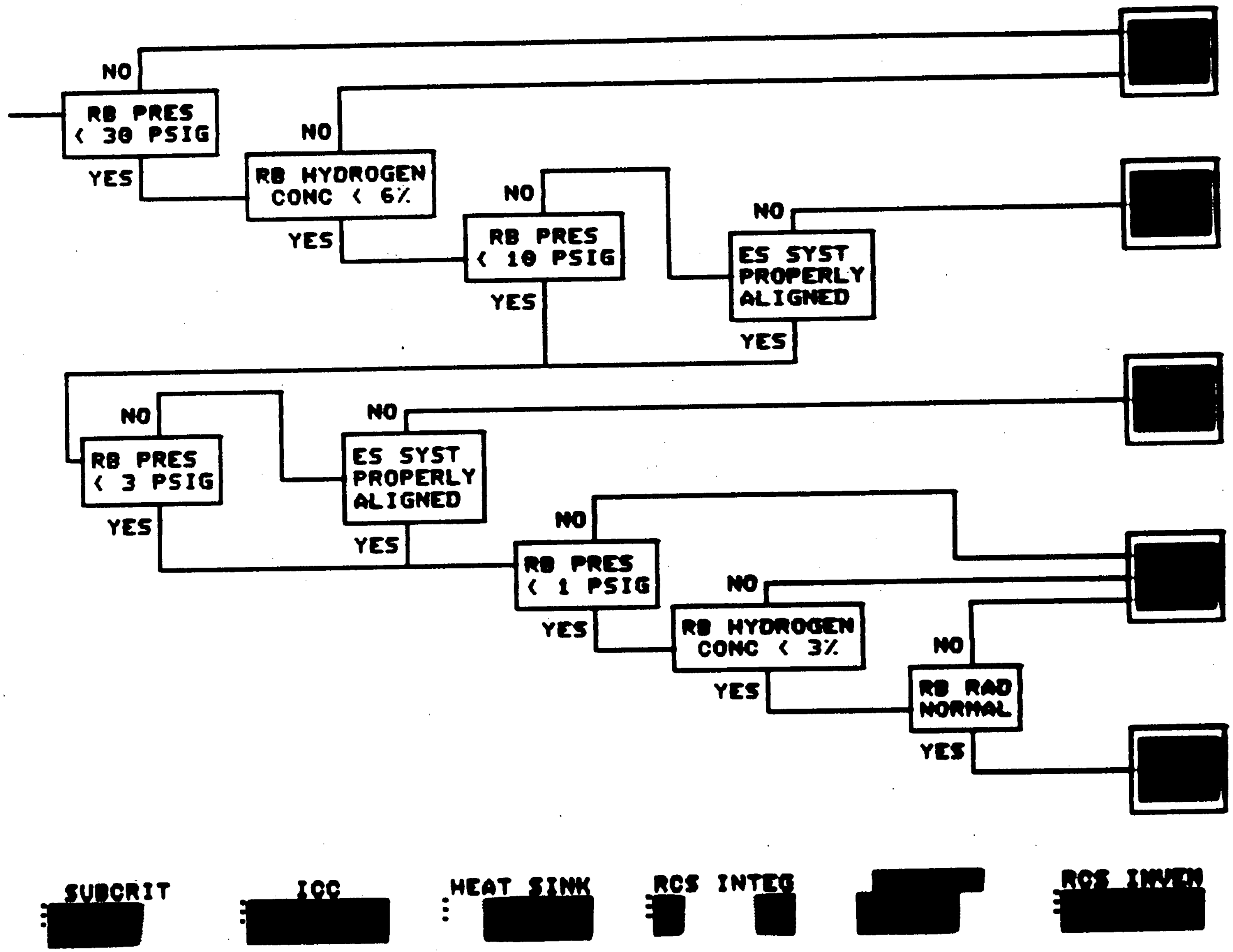
RCS OUTSIDE NDT LIMITS

CPS008 & CPS009

A1417	RC LOOP B WR PRESS	PSIG	INVD
A1887	RC AVG TEMP	DEGF	INVD

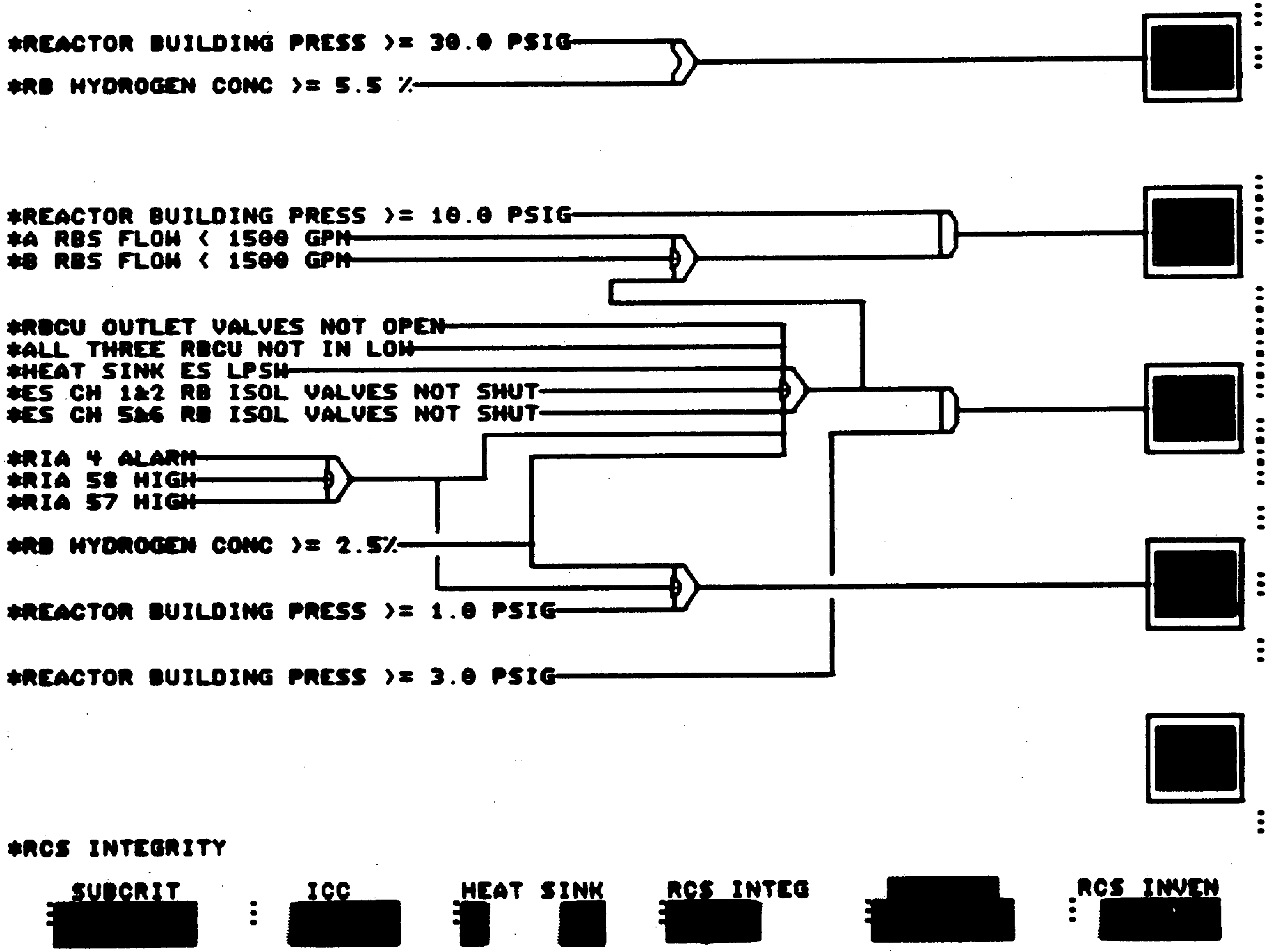
CONTAINMENT INTEGRITY

A231



CONTAINMENT INTEGRITY

A232



D

ES CHANNEL 1 & 2 RB ISOL VALVES NOT OPEN

CH. 1	D0581	HP 3 LETDN CLR A OUT	INVD
	D0583	HP 4 LETDN CLR B OUT	INVD
	D0661	HP 20 SEAL RET IS RB	INVD
	D0433	GWD 12 QNCH TK VENT	INVD
	D0847	LWD 1 RB NOR SUMP PENT	INVD
	D0251	CS 5 COMP DRN HDR IS	INVD
	D1015	PR 1 RB PURGE OUT	INVD
	D1013	PR 6 RB PURGE INL	INVD
	D1021	PR 7 RB RAD MON INL	INVD
	D1025	PR 9 RB RAD MON OUT	INVD
	D1051	RC 5 PRZR STM SAMPLE	INVD
	D1057	RC 6 PRZR WTR SAMPLE	INVD
	D0405	FDW 105 SG A SMPL PENT	INVD
	D1139	FDW 107 SG B SMPL PENT	INVD
CH. 2	D0571	HP 5 LETDN LINE ISOL	INVD
	D0663	HP 21 SEAL CLR OS RB	INVD
	D0435	GWD 13 QNCH TK VENT	INVD
	D0849	LWD 2 RB NOR SUMP PENT	INVD
	D0253	CS 6 COMP DRN HDR 3S	INVD
	D1017	PR 2 RB PURGE OUT	INVD
	D1019	PR 3 RB PURGE CONTRL	INVD
	D1009	PR 3 RB PURGE INL	INVD
	D1011	PR 5 RB PURGE INL	INVD
	D1023	PR 8 RB RAD MON INL	INVD
	D1027	PR 10 RB RAD MON OUT	INVD
	D1053	RC 7 PRZR SAMPLE OS	INVD
	D1133	FDW 106 SG A SMPL PENT	INVD
	D0409	FDW 108 SG B SMPL PENT	INVD
	D0397	FDW 103 SG A DRN	INVD
	D0399	FDW 104 SG B DRN	INVD

ES CHANNEL 5 & 6 RB ISOL VALVES NOT OPEN

D

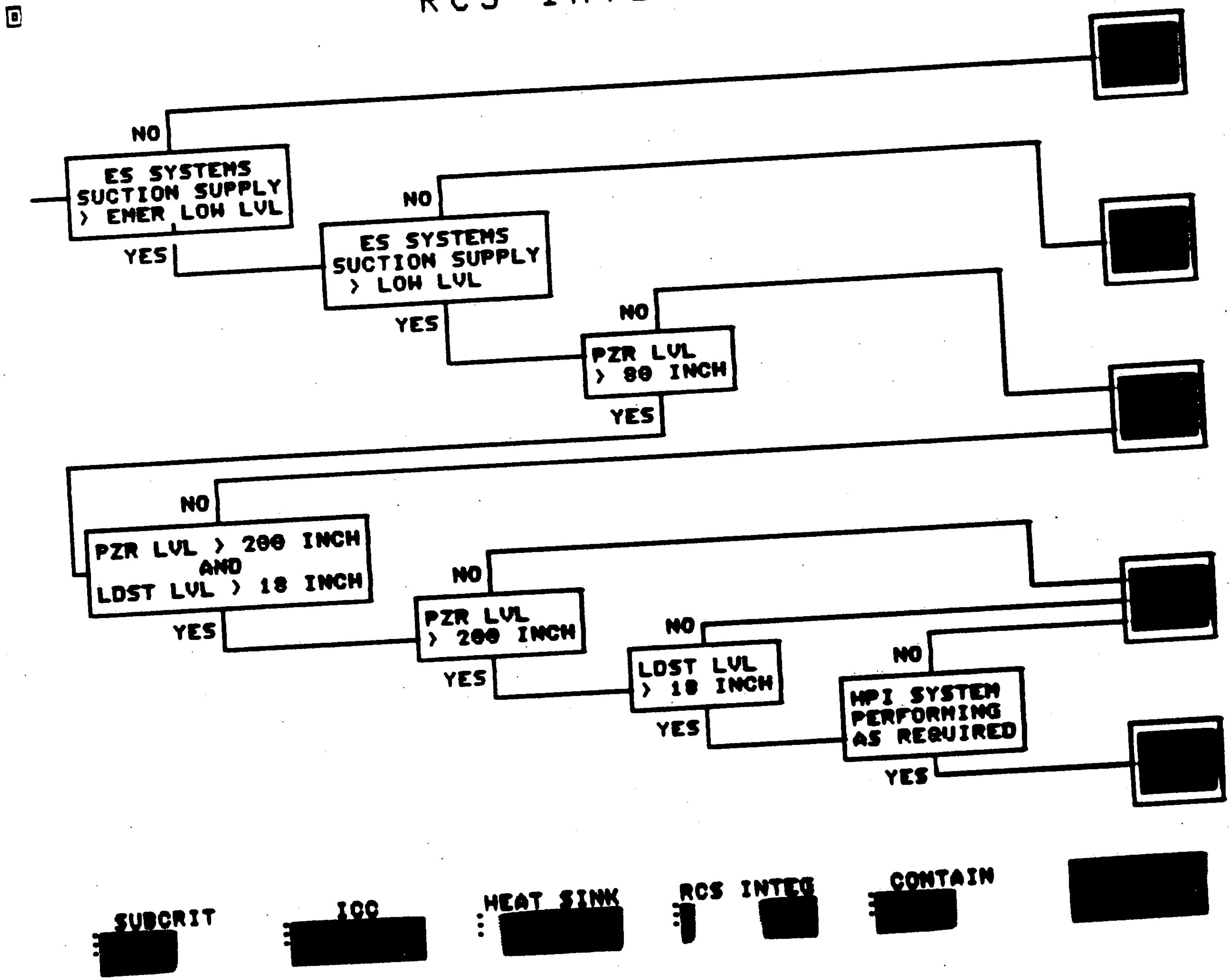
CH. 5	D0125	CC 7 PENT IS	INVD
	D0797	LPSW 15 RCP CLR OUT	INVD
	D0795	LPSW 6 RCP CLR SUP	INVD
	D1187	LPSW 565 AUX VENT ISOL	INVD
CH. 6	D0127	CC 8 PENT OS	INVD
	D0797	LPSW 15 RCP CLR OUT	INVD
	D0795	LPSW 6 RCP CLR SUP	INVD

RBCU'S IN LOW AND LPSW VALVES NOT OPEN

D1152	RBV RBCU A FAN	INVD
D1154	RBV RBCU B FAN	INVD
D1156	RBV RBCU C FAN	INVD
D0824	LPSW 16 RBCU A INL	INVD
D0826	LPSW 18 RBCU A OUT	INVD
D0830	LPSW 19 RBCU B INL	INVD
D0832	LPSW 21 RBCU B OUT	INVD
D0836	LPSW 22 RBCU C INL	INVD
D0840	LPSW 24 RBCU C OUT	INVD

A236

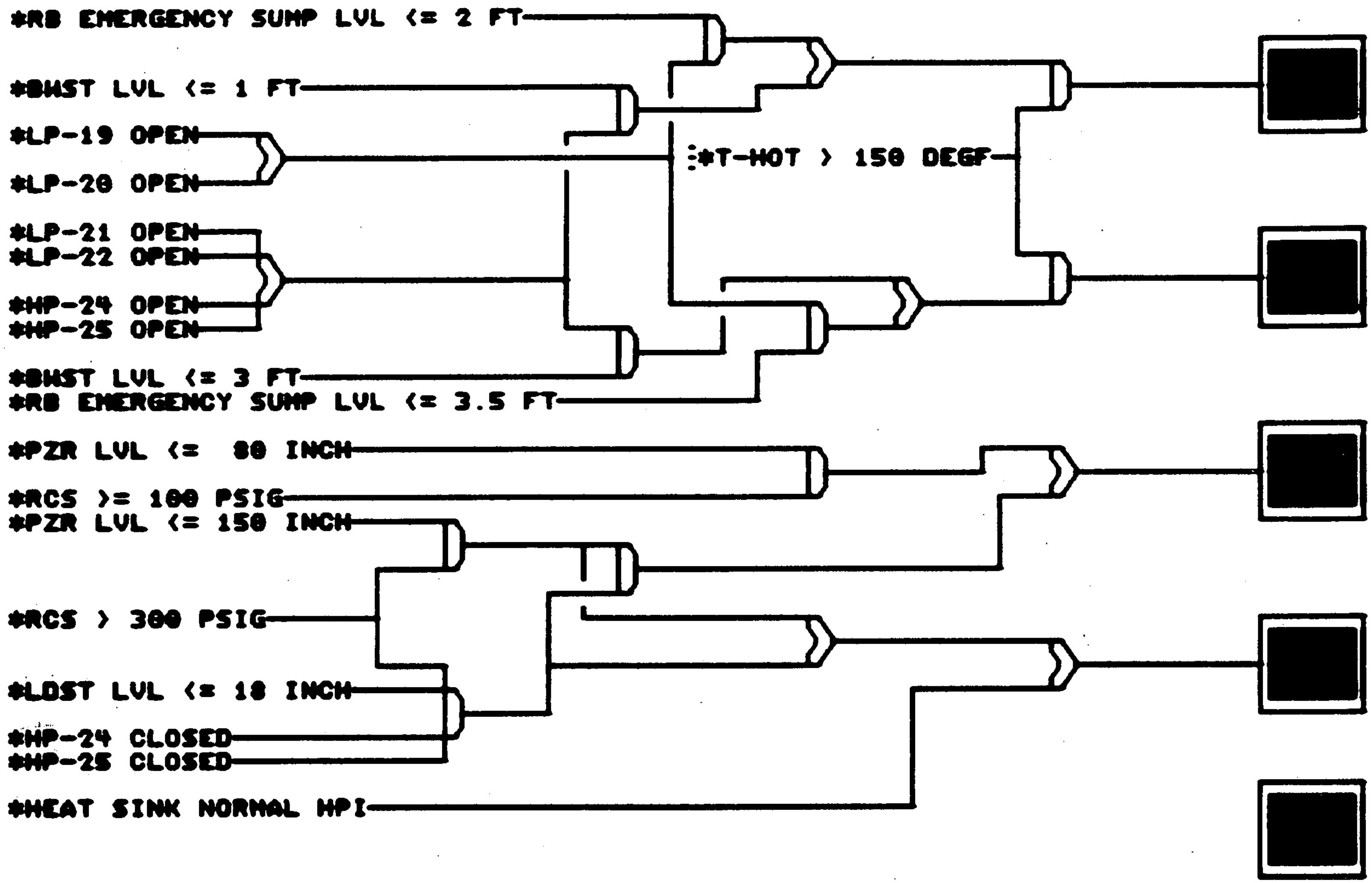
RCS INVENTORY



D

RCS INVENTORY

A237



SUBCRIT ICC HEAT SINK RCS INTEG CONTAIN

Attachment 3

Duke Power Company

OCONEE NUCLEAR STATION

Response to Generic Letter 89-06

Evaluation of Acceptability of
Parameters Chosen for Oconee SPDS

I. Introduction

An evaluation was performed to determine if the parameters selected for the Oconee Safety Parameter Display System (SPDS) meet the requirements of NUREG-0737, Supplement 1, Section 4.1.f, taking into account the information provided in NUREG-1342 (Reference 1). The information presented in this reference provides examples of monitored SPDS parameters which are acceptable to the NRC staff.

II. Reactivity Control

Reference 1 suggests that the source range, intermediate range, and power range monitors are the preferred means by which the rate of change in neutron flux is monitored in the SPDS for detection of abnormal reactivity conditions. It also suggests that other parameters, such as rod position and reactor trip indications, may also be used but are less direct indicators of the overall status of reactivity control.

The Subcriticality critical safety function (CSF) logic monitors reactivity control. This CSF utilizes all of the suggested neutron flux indications as well as rod position and Reactor Protection System (RPS) trip status to monitor reactivity control. All parameters monitored in the Subcriticality CSF are therefore consistent with the acceptable parameters listed in Reference 1.

III. Core Cooling and Heat Removal

Core cooling and heat removal are monitored separately with the Inadequate Core Cooling CSF logic and Heat Sink CSF logic, respectively. As Reference 1 advises, a multitude of parameters have been selected and combined with the appropriate logic, to signify anomalies in either separate but related safety function. Table 1 provides a list of the parameters and their intended diagnostic function(s) which are specifically identified in Reference 1.

The parameters and logic chosen for the Inadequate Core Cooling and Heat Sink CSFs include, as a subset, all of the parameters and intended functions listed in Table 1 with three exceptions. Hot and cold leg temperatures are not used in the SPDS to monitor the establishment of natural circulation flow. This has already been noted in

Reference 2 where additional information was requested to justify the omission. In response to this request, Duke provided a response (Reference 3) which indicated that "... a RCS P/T color graphic display has been included as part of the Opertor Aid Computer (OAC) upgrade to assist the operator in identifying transient as well as typical plant response. Included in the P/T displays are hot leg, cold leg, and core exit temperatures as well as steam generator level and pressure. From this display, the operator can readily monitor natural circulation..."

Monitoring the development and adequacy of natural circulation flow under all conditions with boolean logic is not appropriate because too many factors influence flow (e.g. decay heat power level, SG level, SG pressure, etc.). The P/T display provides a superior means for monitoring natural circulation heat transfer since key temperatures are monitored. The conditions necessary for establishing natural circulation, however, are monitored by the SPDS (i.e., SG level, subcooled margin). Therefore the intent of verifying natural circulation flow is satisfied.

The omission of RCS level in the SPDS was also noted in Reference 2. Although the RCS level measuring instrumentation was not installed at the time of the SER, Duke stated in Reference 3 that "At the time of implementation, this instrumentation will be included in the SPDS to enhance the Inadequate Core Cooling and RCS Inventory CSFs."

Guidance for use of the Reactor Vessel Level Instrumentation (RVLIS) was included in the Emergency Operating Procedure (EOP) once the instrumentation was installed and operational on each unit (January 1988). Changes which will incorporate RCS level measurements into the SPDS have been proposed. A SPDS program change which is intended to incorporate the proposed changes is currently ongoing to include RCS level measurements to identify the approach to inadequate core cooling conditions, loss of heat sink, and/or loss of inventory. When these changes are complete, all parameters monitored in the Inadequate Core Cooling and Heat Sink CSFs and the P/T display will be consistent with the acceptable parameters listed in Reference 1.

IV. RCS Integrity

The parameters suggested in Reference 1 to use when monitoring RCS integrity are listed in Table 2 along with their intended diagnostic function(s). These parameters are intended to alarm a breach of RCS integrity or conditions which may threaten RCS integrity.

RCS integrity is monitored by the RCS Integrity CSF, and to a lesser extent, the RCS Inventory CSF. The parameters and logic which compose these CSFs satisfy all diagnostic functions listed in Table 2 although Reactor Building radiation, instead of containment sump level, is

currently used to diagnose a LOCA. This approach is considered superior to monitoring emergency sump level alone for the following reasons.

Whenever the RCS boundary is breached by a pipe break, high energy primary coolant is released into the Reactor Building. The continuous energy release from the break will cause the building pressure to increase. In addition, radioactivity levels will increase above background due to the release of activation products and radioactive gasses dissolved in the coolant. These parameters are combined in the SPDS to unambiguously alarm a LOCA. Although Reactor Building sump level will provide a rapid indication that a release of fluid into containment has occurred, it cannot distinguish the source. For example, if a main feedwater, main steam line, or component cooling water system ruptured, a LOCA would be indicated even though there is no breach of RCS integrity.

During the review of parameter selections and logic of the RCS Integrity CSF, it was noted that two of the three radiation monitors are used to identify a LOCA alarm at very high radiation levels. Following a small break LOCA, radiation levels may not be sufficient to cause these monitors to alarm. As a result, the RCS Integrity CSF may not appropriately alarm a small break LOCA. For this reason, the SPDS will be modified to ensure detection of a small break LOCA by monitoring the containment emergency sump level and validating the integrity alarm with Reactor Building pressure. Once this modification is complete, all parameters monitored by the RCS Integrity and RCS Inventory CSFs will be consistent with acceptable parameters listed in Reference 1.

V. Radioactivity Control

Reference 1 generally considers three variables acceptable for monitoring radioactivity control: stack monitors, steam line monitors, and containment radiation monitors. Because these indications alone are fairly limited in scope, the SPDS does not include a CSF which specifically monitors radioactivity control. Instead, radioactivity is monitored in the CSFs which alarm the mechanisms by which radioactivity may be released to the environment. Radiation releases resulting from a steam generator tube rupture (SGTR) or a LOCA are alarmed in the RCS Integrity CSF (steam line and condenser off-gas monitors) while high radiation levels inside containment will alarm the Containment CSF (containment monitors). The steam line radiation detectors are located downstream of the safety relief valves. However, Reg. Guide 1.97 modifications in progress will add radiation monitors upstream of the safety relief valves. As an enhancement, the SPDS will be upgraded to include these monitors.

The stack radiation monitor is not currently included in the SPDS as suggested in Reference 1. The release of fuel gap activity will be alarmed by the SPDS before the radiation reaches the stack which meets the overall intent of the radioactivity control safety function. However, the SPDS will be modified to include the stack radiation monitor to bring the Oconee Nuclear Station into compliance with the requirements.

VI. Containment Conditions

The Containment Integrity CSF is used to monitor containment conditions. This CSF incorporates the three key parameters discussed in Reference 1 to monitor containment conditions: containment pressure, isolation, and hydrogen concentration.

Containment isolation is monitored by verifying that the appropriate isolation valves close when required by an Engineered Safeguards (ES) signal. This logic ensures that when demanded, the appropriate process pathways penetrating containment have been secured.

VII. Conclusion

It is apparent the SPDS will not fully meet the requirements of NUREG-0737, Supplement 1, Section 4.1.f, and recommendations of Reference 1, until the following modifications have been completed:

1) Complete the implementation of RCS level measurement into the SPDS.
2) Complete revisions to the RCS Integrity CSF to ensure that a small break LOCA will produce a red alarm.
3) Include the stack radiation monitor into the SPDS.

References:

1) "A Status Report Regarding Industry Implementation of Safety Parameter Display Systems", NUREG-1342, U.S. Nuclear Regulatory Commission, April, 1989, Section III.F.

2) Letter, J. F. Stolz (NRC) to H. B. Tucker (Duke) dated June 4, 1985 (SPDS SER).

3) Letter, H. B. Tucker (Duke) to J. F. Stolz (NRC) dated July 19, 1985 (response to SER question).

Table 1

Core Cooling and Heat Removal Parameters

Parameter	Diagnostic Function
Subcooling	* Ensure RCS pressure and temperature are being controlled
RCS Level	* Ensure sufficient RCS inventory to maintain SG heat transfer * Monitor the approach to ICC conditions
Core exit temp	* Determine viability of natural circulation * Combined with RCS pressure to calculate subcooling * Monitor the onset of ICC conditions
Hot leg and cold leg temperature	* Determine viability of natural circulation * Ensure adequate natural circulation
SG level	* Determine availability and proper control of the secondary heat sink
SG pressure	* Determine viability and integrity of the secondary system * Determine the viability of natural circulation flow
DHR flow	* Determine viability of heat removal when the secondary system is not used

Table 2

RCS Integrity Parameters

Parameter	Diagnostic Function
RCS pressure	* Principal indicator of RCS integrity * Key parameter in brittle fracture consideration
Cold leg temp	* Key parameter in brittle fracture considerations
Containment sump level	* Identify breach of RCS integrity due to LOCA * Indicates viability of ECCS recirculation mode
SG pressure, level, radiation	* Identify breach of RCS integrity due to SGTR

Attachment 4

Duke Power Company

Oconee Nuclear Station

Response to Generic Letter 89-06

Safety Parameter Display System

Summary of Action Items

Summary of Action Items

1. The color behavior of the Logic Diagram Displays is to be changed such that the lines and logic elements between the input statements and the CSF Status Blocks will change color depending upon the status of the input statements and if the logic elements are satisfied. If there is no alarm, the true input statements, satisfied logic elements, and connecting lines will output in yellow. If there is an alarm, true input statements, satisfied logic elements, and connecting lines which input the alarm will be output to the screen in red. All true input statements, satisfied logic elements, and lines which do not input the alarm will be yellow. All false input statements, unsatisfied logic elements and lines will be green.

2. The OAC has available, in many cases, multiple inputs for the same parameter being used by the SPDS logic. Through the usage of OR GATE logic, one or more inputs from the same measured parameter will be made available to the SPDS. The OAC or SPDS will not automatically block a signal determined to be "bad" or invalid since notification of input failure is an important part of the SPDS function. Rather, the ability to "de-select" SPDS input points should be available manually as described below. When using the peek-point feature of the SPDS Logic Diagram Displays, the first point listed as entering the OR GATE should be the one displayed unless it has been locked out as described below or placed in scan lockout or contains an inserted value, in which case the second point providing input to the OR GATE will be displayed.

3. The Reactor Vessel Head Level and Reactor Coolant System Hot Leg Level indications input to the OAC from the Westinghouse RVLIS or ICCM Systems are to be integrated into the SPDS alarm logic for the following Critical Safety Functions:

   RCS INVENTORY
   INADEQUATE CORE COOLING
   HEAT SINK

4. Implement modification to include the Stack radiation monitor in the SPDS.

5. Complete revisions to the RCS Integrity CSF to ensure that a small LOCA will produce a red alarm by monitoring the containment emergency sump level and validating the integrity alarm with Reactor Building pressure.

6. Modifications described in items 1 through 5 will be implemented by July 9, 1990.

7. The current steam line radiation monitors are located downstream of the Safety Relief Valves. Modifications committed under our response to Reg. Guide 1.97 to add radiation monitors upstream of the Safety Relief Valves are in progress. The parameter from these monitors will be included in the SPDS as an enhancement of the present SPDS. Implementation schedule for Reg. Guide 1.97 modifications was provided to the NRC in a letter dated April 20, 1988.

8. Preliminary indications from our review of the SPDS are that all computer input points for the SPDS may not now be covered by the surveillance activities. The ongoing review will be completed by October 16, 1989. At that time we will notify the NRC of the results of our findings and schedules for implementation or corrective actions to assure that all SPDS computer points are included in surveillance activities.