PSNH PUBLIC SERVICE
Company of New Hampshire

SEABROOK STATION
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May 4, 1982

SBN-268
T.F. B7.1.2

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Frank J. Miraglia, Chief
Licensing Branch #3
Division of Licensing

References: (a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444

Subject: Submittal of Followup Documentation; Instrumentation and Control Systems Branch Review

Dear Sir:

We have enclosed the following documentation which was requested by ICSB during the March 23-25, 1982 review meetings:

- Main Plant Computer System Overview
- Video Alarm System Functional Description

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

Allen S. Legendre Jr.

for: J. DeVincentis
Project Manager

Enclosure

cc: Mr. Robert Stevens
Instrumentation and Control Systems Branch

B001
S1/1

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

SEABROOK STATION

MAIN PLANT COMPUTER SYSTEM OVERVIEW

APRIL 5, 1982

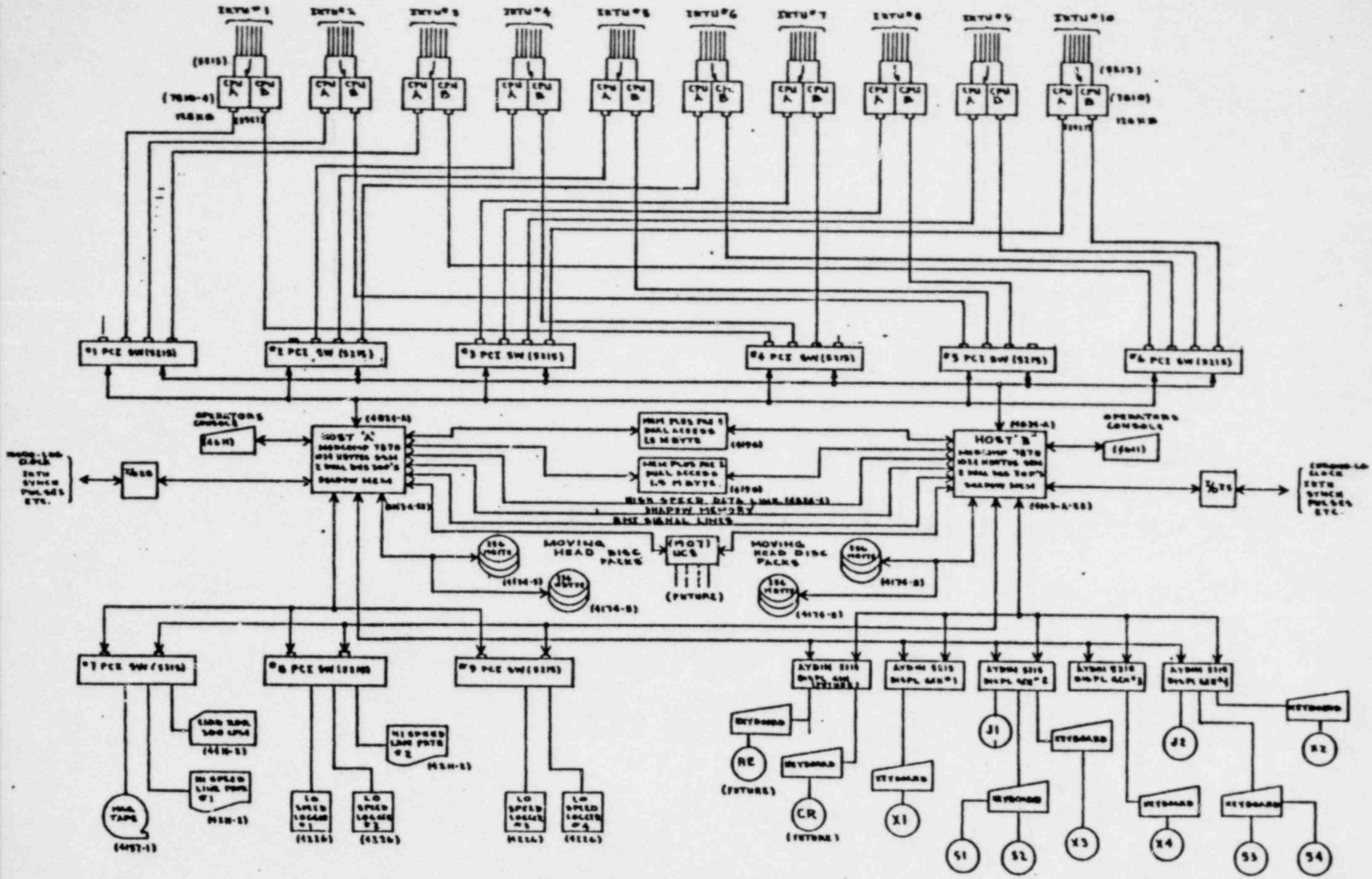
The Main Plant Computer System is an integrated network of twenty-two computers. Two large host computers, located in the plant computer room, are connected via data links to ten remote computer systems. Each remote system, or IRTU, consists of two small computers and a compliment of process I/O gear used to monitor the plant's instrumentation. The IRTUs have been situated in areas of the plant where instrumentation is concentrated so as to minimize the wiring of field sensors to the computer system. This network has the capacity to monitor more than 6000 plant parameters.

The function of the IRTUs is to continuously check the status of the plant, and to report this status back to the host computers. The host computers' function is to process the information and present it to the operators and engineering personnel in usable form. There are many peripheral devices connected to the hosts for display, retrival, and storage of information. For instance, ten color CRT terminals and four printers, located in the control room, provide the operators with alarm messages, logs, trends, and calculations. Card readers, line printers, and terminals are provided in the computer room to support engineering applications, program maintenance, and future software development.

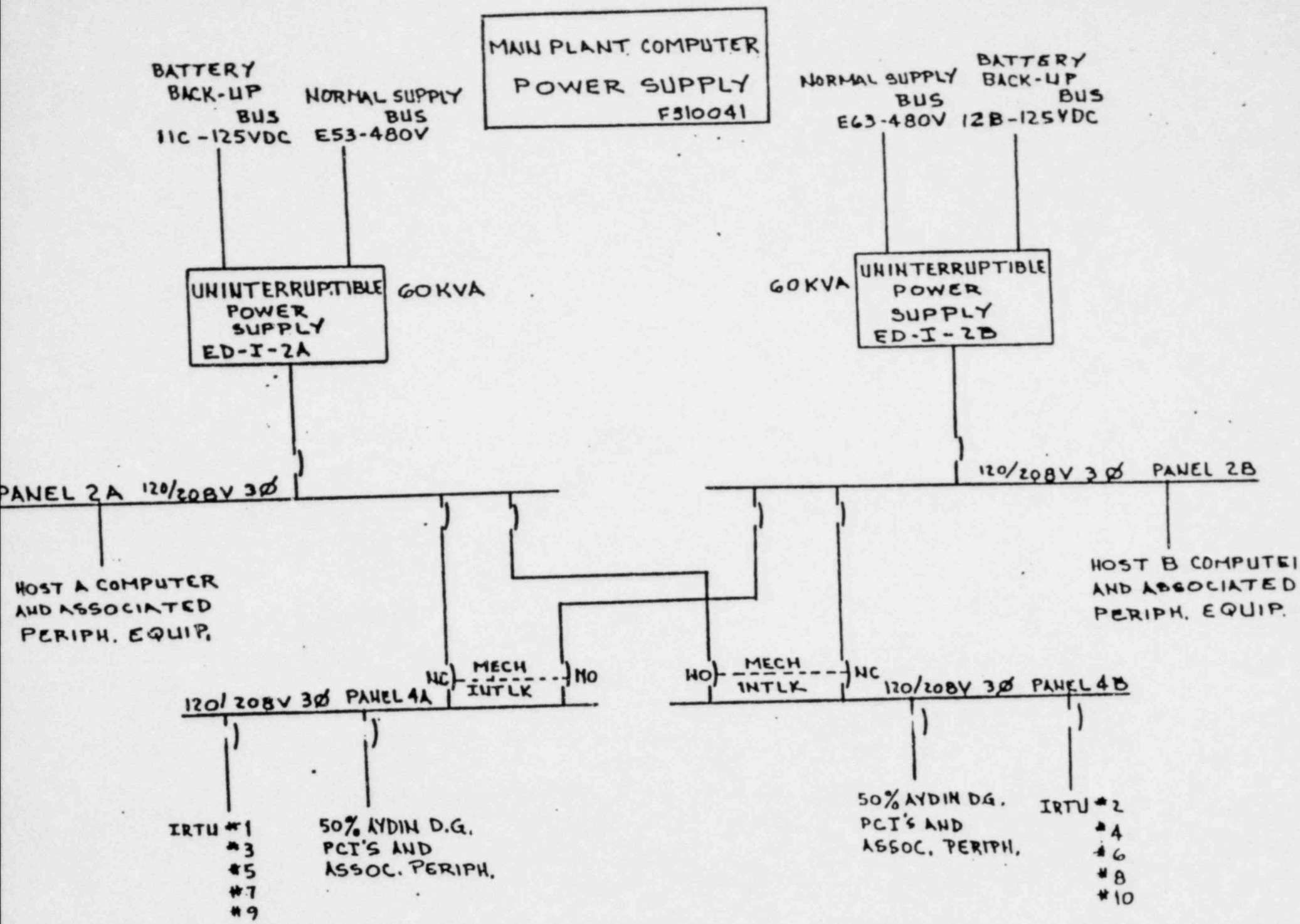
In configuring the system, reliability was the primary design goal. This is achieved through the use of redundancy. Each computer and peripheral device has a backup capable of assuming all real time processing functions. In addition, any failed component, with the exception of the process I/O gear, can be isolated, repaired, and returned to service without degrading system operation. Another factor contributing to the system's reliability is the use of proven hardware and software. By the time it is installed, each piece of equipment will have been in the field a minimum of two years, and the executive programs were introduced more than four years ago.

A further design criteria in configuring the system was its future expansion capability. Without disturbing the existing system, it will be possible to connect new field sensors, to add peripheral devices, and to expand computer memory. In addition, it should be possible to handle major expansions by linking new computers to the existing system.

The attached diagrams depict the system hardware configuration and its electrical distribution system.



MPCS HARDWARE CONFIGURATION



ELECTRICAL DISTRIBUTION SYSTEM

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

SEABROOK STATION

VIDEO ALARM SYSTEM FUNCTIONAL DESCRIPTION

March 30, 1982

Abstract

The video alarm system as herein described is intended to be an alternate method of presenting field contact changes indicating plant alarm conditions to the conventional light box technique. A simple, direct and efficient method of information transfer to the plant operator concerning alarm status was the major design criteria. Supplemental information about any alarm point is retrievable via computer data storage and is a beneficial byproduct of this method. The video alarm system will be implemented on the Main Plant Computer System.

CRT Hardware Arrangement

There will be four 25" eight color CRT's located (one each) in the four functional areas of the main control board. Refer to attachments 1 and 2 for the general layout of the board. The four functional areas are defined as follows:

a. Engineered Safeguards
b. Primary and Reactor Systems
c. Turbine and Generator Systems
d. Electrical Systems

Below each of these CRT's will be a 45 function pushbutton console (see attachment #3) including a cursor control mechanism from which various programs may be activated in the computer. These four CRT's will be used exclusively for alarm presentation and are called alarm review CRT's. They are identified as VA1, VA2, VA3, and VA4.

At the center section of the board (see attachment #4) will be four 19" color monitors with two full display editor keyboards including the 45 function buttons (see attachment #5). In addition, at each of the corners of the control board, and overhead will be two 25" color CRT's which will not be directly connected to any keyboards. These last six CRT monitors will be used for management functions and procedure displays.

Miscellaneous Hardware Arrangement

The four major areas of the control board previously defined will be broken down into two groups called the primary and secondary sides. There will be an alarm horn for each side with different irritating tones to announce new alarms. Additionally there will be two non-irritating, self-terminating horns (one each

for the primary and secondary side) to announce reset conditions. Three heavy duty buttons for horn silence, alarm acknowledge, and reset acknowledge will be positioned near each of the four alarm review CRT's. Note too, that buttons on one side of the board have no effect on horn silence, acknowledge, or reset functions concerning alarms occurring on the other side of the board.

Four medium speed data loggers will be located in the control room. One will record all alarm point status changes; the other three will be for status summaries and other hardcopy requirements.

Alarms

All alarm points will be classified in one of three alarm priorities. They are:

a. Class I - Priority alarms
b. Class II - System alarms
c. Class III - Housekeeping alarms

The respective colors indicating alarm severity (chosen for visibility reasons) are yellow, light blue and orange.

In addition, alarms will be grouped into the four broad plant systems that correspond to the four areas of the main control board. Thus, each of the CRT display positions in the control board will contain only alarms relevant to the specific area of the board.

Alarm Review Page Format

Alarm displays will be formated similarly to the enclosed sketch (see attachment #6). The top of the page will contain the time, alarm group title (a function of CRT control board position), and page number, all in "large" or double size white characters. After skipping a double line, previously acknowledged alarms are listed, again in "large" characters. There is space for up to 17 alarm messages. If there are more alarms for this section of the control board, they will be displayed on additional pages. Pages 1, 2 and 3 are retrievable via dedicated function pushbuttons. If still more pages exist, they may be displayed via the PAGE FORWARD and PAGE BACKWARD function buttons.

All existing acknowledged alarms will be grouped and presented by priority. Class I alarms will be shown first, followed by Class II and Class III using as many pages as is necessary to present them all. There is a limit of 30 alarm review pages that may exist at each alarm review position. However, it is expected that there should be no more than one or two pages per CRT control board position under normal plant operating conditions. The priority of any displayed alarm is indicated by its color. Within any priority group alarms are time-oriented with the newest alarm placed at the head of the list.

Individual alarms are displayed according to the following format. The entire message will be in double-sized or "large" characters and will start with a four digit alarm point identification number (point ID). After a space comes a 28-character alarm description, another space, and finally a 6-character status word, again all in double-sized characters.

At the bottom of the display, separated by a solid reduced-intensity red bar, is located an "unacknowledged alarms area". This area may contain up to four new unacknowledged alarms. The 6-character status word will be flashing to help attract the operators attention. This area will be organized by priority and time, similarly to the acknowledge alarms area described above, for multiple simultaneous alarm conditions. If there are more than four unacknowledged alarms in existence, only the four alarms that come in first will be displayed. Alarms occurring later will be held in the queue and will be displayed after the first four have been acknowledged and entered in the proper CRT positions' acknowledged alarms area. Blinking downward-pointing arrows within the red bar indicate the existence of unseen unacknowledged alarms in this queue. Consequently, the plant operator will have to push the acknowledged button several times during a flurry of alarm activity.

Alarm Annunciation Sequence

The following illustrates the typical sequence of events for up to four simultaneous alarms.

1. A field contact changes state and is sensed by the computer.

2. A continuous horn, indicating primary or secondary side or both, is sounded.

3. A colored alarm message with a flashing status word is added to the unacknowledged alarms area below the red bar. This occurs on either the two alarm CRT's on the primary side of the control board or the two CRT's on the secondary side.

4. A similar message, including time of occurrence, is printed on the alarm logger in the control room.

5. The operator may then push the alarm horn silence button on the appropriate side of the control board. When the separate acknowledge button is pushed, the following results:

6. All displayed alarms in the unacknowledged alarms area are removed and added to the appropriate alarm review page on the proper CRT. This will depend on the control board section to which the alarm belongs. If more than four alarms had occurred, then the additional unacknowledged alarms, waiting in the que, will now be shown in the unacknowledged alarms area.

7. Alarms added to the acknowledged alarms area above the red bar retain their color indicating alarm class, are grouped by priority, and are listed in order of occurrence, newest being at the top. No part of the acknowledged alarm message will be flashing.

Alarm Reset Sequence

1. A field contact changes state and is sensed by the computer.

2. An audible tone indicating the appropriate side of the control board and different from the alarm annunciation tone will be initiated. It will be non-irritating and will self terminate after about one second.

3. The entire alarm message will change to white if it is presently shown on a CRT. The reset status word will be flashing. In addition, the word RESET will appear in white, flashing, double-sized characters just below the CRT page number in the upper right corner. This will direct the operator to the proper CRT if the alarm message is not presently being shown. The operator must go to the page the alarm is on before it can be acknowledged as reset.

4. A similar message is printed on the alarm logger.

5. When the operator pushes the reset button and the alarm is being shown on the CRT, the alarm is removed from its assigned alarm review page. Remaining alarms are then re-packed.

Procedures Display

For each and every VAS alarm message, there will be a brief recommended procedure to guide the plant operator in taking any necessary restorative action. These procedures may be shown on the corner overhead 25" CRT's and/or the 19" CRT's located in the center section of the control board (refer to attachment #2). Each procedure may contain up to 2 pages of information. This will allow approximately 2000 words of text (see attachment #7 for format).

There will be two methods that the plant operators may use in obtaining this display, depending upon at which keyboard the request is given. At any of the four VAS alarm review CRT positions, the operator moves his cursor down to the alarm message for which he desired the procedure. He then pushes the VAS PROCEDURE function pushbutton. The appropriate procedure is obtained from a disc file and is displayed on the corner overhead CRT. If the cursor is placed at the HOME, or any other invalid location, then the last previously called procedure will be displayed. This operation will in no way affect the response of the alarm CRT's during concurrent new alarm reporting.

To obtain a procedure display while at one of the two center full display editor keyboards, the operator simply pushes the VAS PROCEDURE function pushbuttons. The last peviously called procedure will be displayed in front of him on one of the 19" CRTs. To obtain a new procedure, the operator enters the new point ID number in the space provided on the display. He then pushes the VERIFY function pushbutton which will cause the point ID number to blink where it valid, else it will reset to dashes. If valid, the operator pushes ENTER and the new procedure will be displayed. At this point, the CORNER CRT function pushbutton may be used to place this display on the appropriate corner overhead CRT.

Management Functions

Management functions are a group of activities the operator may perform to individual alarms and groups of previously selected alarms. They will be initiated from a dedicated page that may be displayed on any of the four 19" CRT's in the center of the control board (see Attachment #10). The following functions may be performed from this display:

a. Delete a point from alarming
b. Restore a deleted point
c. Delete a group of points from alarming
d. Restore a deleted group of points
e. Print a summary of all deleted points
f. Print the status of each of the alarm groups
g. Print a summary of all alarmed points

In order to perform a management function, the operator first draws up the management function display via a dedicated function pushbutton. Beside each listed function are instructions on how to complete it. For example, to delete a point from alarming, the operator positions his cursor to the first underline character immediately to the left of the phrase "ENTER POINT ID". The operator then types in the ID number via the numeric keypad. The digits selected replace the four underline characters. For the third step the VERIFY function key is pushed interrupting the computer to read the entered number, check its validity, and if it's valid, make it blink. For an invalid number the digits are erased and a new entry is awaited.

Pushing the ENTER button consists of the last step. The function is performed, the operation recorded on the logger, the digits cleared from the CRT, and the cursor returned to HOME. Other functions are performed similarly. Page two has a listing of alarm point group descriptions.

Calculated Alarms

Alarms resulting from Computer Calculations and certain other analog input limit violations will be handled similar to field contact changes except that the computer will sense the out-of-limit condition and will generate the VAS input.

Logic by Computer

An additional function that will be incorporated in the video alarm system is known as "logic-by-computer". In order to increase a plant operator's awareness of the operating condition of a component or system, it is very useful to automatically analyze for him certain raw contact status information. Thus, the operator will then only be presented with information that distinctly increases his knowledge of the current operating state.

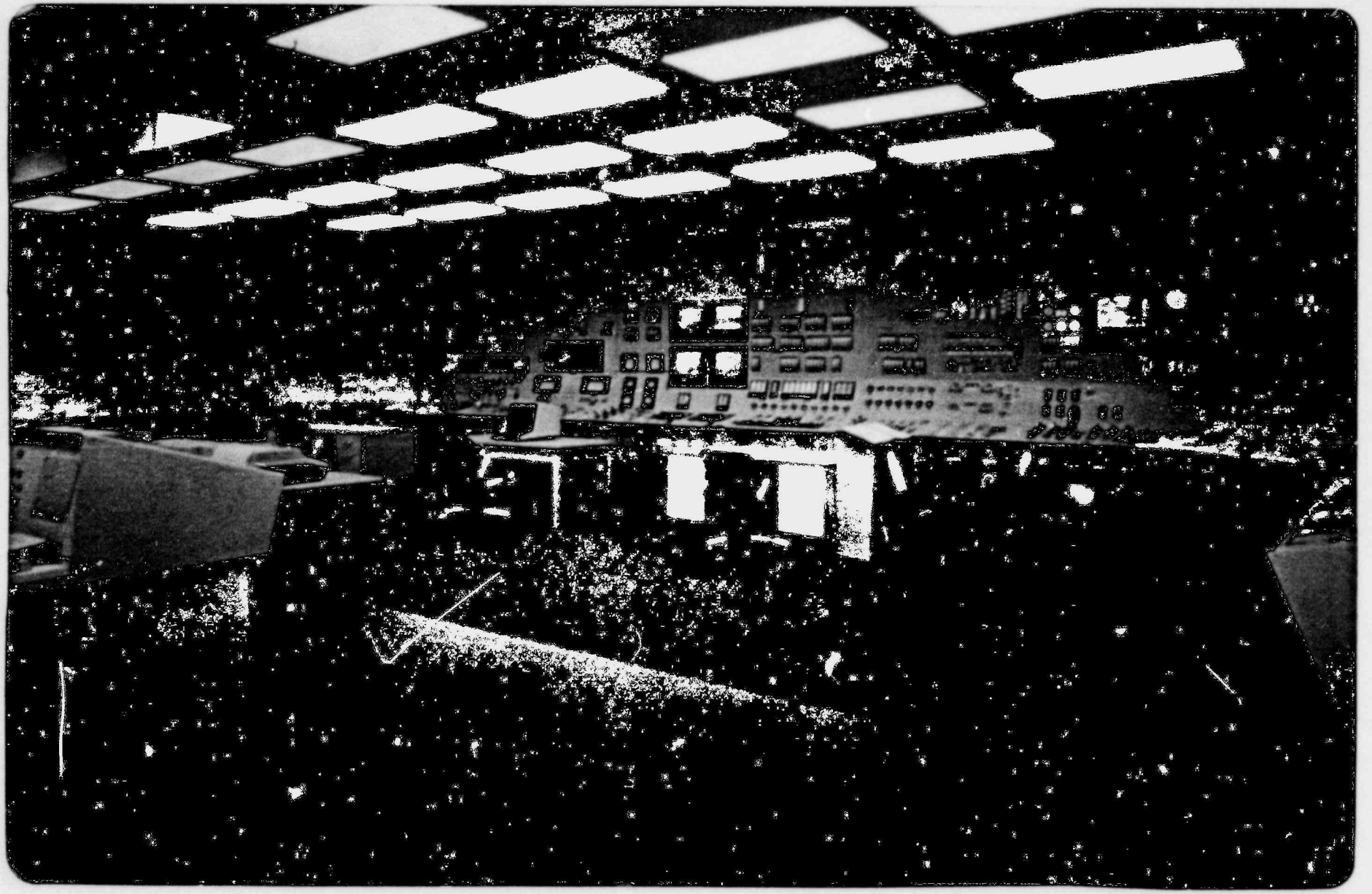
This analysis can be performed via logic gates and time delays. In the past, these gates were incorporated by wiring in hardware components. It has been determined that implementing this function through computer software is a desirable alternative.

Currently, the following five types of gate functions will be programmed for use - AND, OR, NOT, DELAY, and M-out-of-N. The gates may be linked via software programming in any series or paralleled combination to either field contacts or to each other. This allows the plant designer considerable flexibility in having the computer perform alarm analysis thereby reducing significantly screen clutter of redundant or meaningless information.

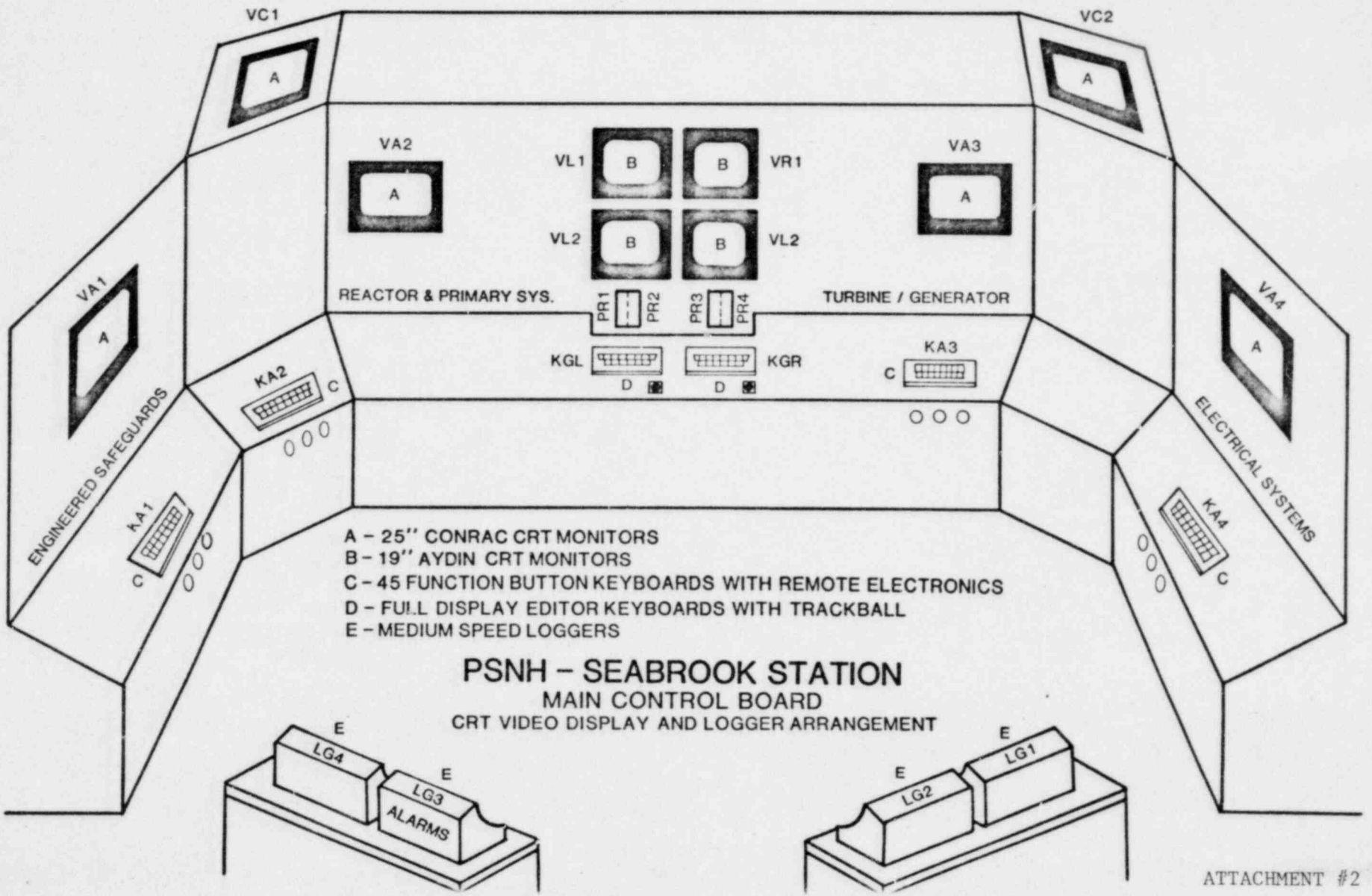
Summary

The basic concepts of a video alarm system have been presented. It is felt that the goal of straightforward and efficient alarm presentation to the operator has been reached and offers certain improvements over the conventional "light-box" approach.

LIST OF ATTACHMENTS



ATTACHMENT #1



ATTACHMENT #2

ALARM ACKNOW	RESET ACKNOW													
		VAS PRO-CEDURE												
PAGE BACKWD	PAGE 1	PAGE 2	PAGE 3	PAGE FORWRD		CORNER PAGE BACKWD	CORNER CRT	CORNER PAGE FORWRD						

AYDIN 45 FUNCTION BUTTON KEYBOARD

General Engraving Schedule for
Seabrook Main Plant Computer System

Keyboard Positions KA1, KA2, KA3, & KA4

ATTACHMENT #3

ATTACHMENT #4

ALARM ACKNOW	RESET ACKNOW 1/3	RESET ACKNOW 2/4												
	VAS MANAGE FUNCTN	VAS PRO-CEDURE	VAS DIGITAL STATUS			PCS RELATED SYSTEM	PCS BLOCK TREND	PCS POINT TREND	PCS LOGS	PCS DIAGRAM	PCS NUCLAR DISPLY	PCS ALERT REVIEW	PCS MANAGE FUNCTN	PCS MENU
PAGE BACKWD	PAGE 1	PAGE 2	PAGE 3	PAGE FORWRD		CORNER PAGE BACKWD	CORNER CRT	CORNER PAGE FORWRD				EXECUT	CANCEL	VERIFY

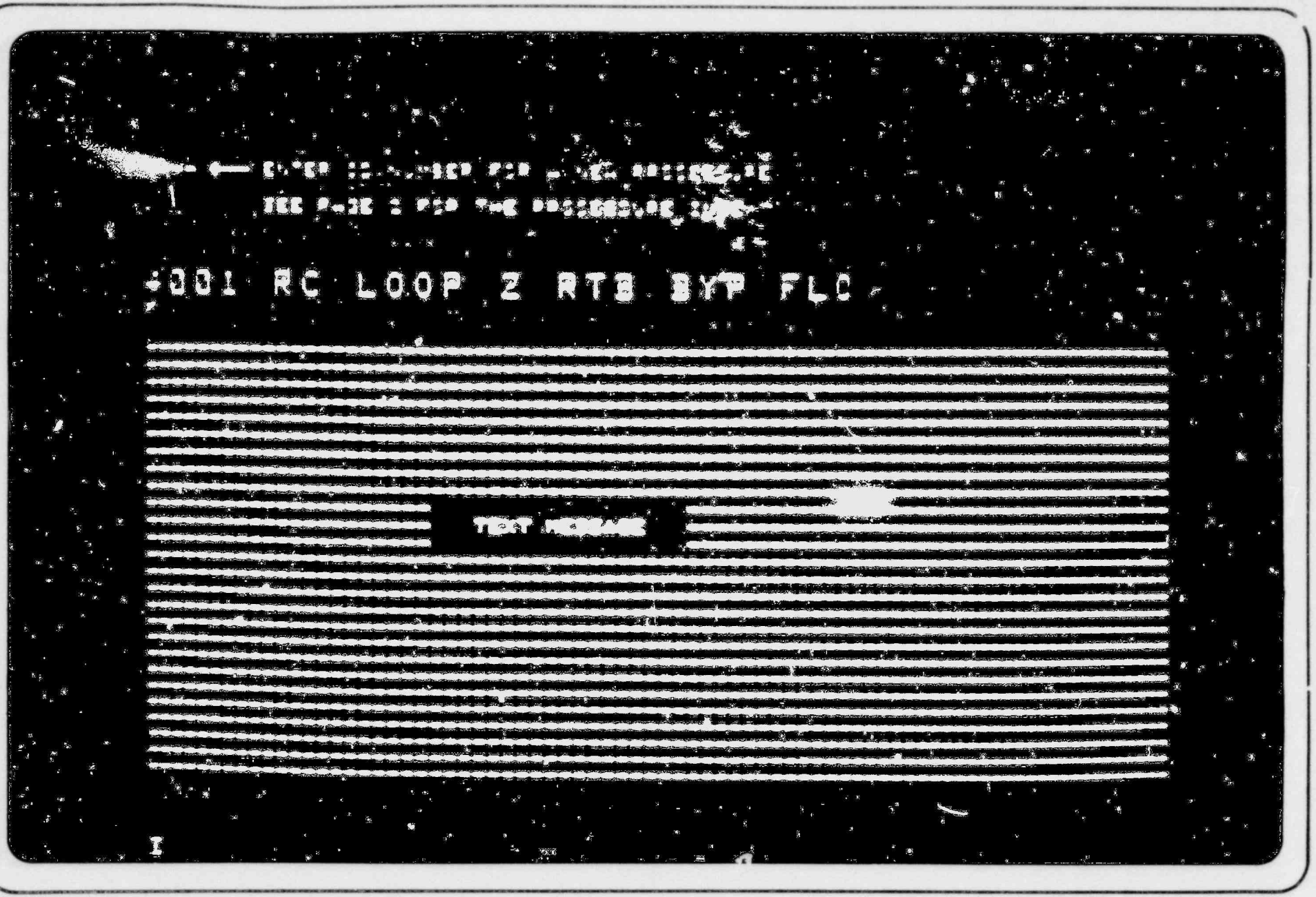
AYDIN 45 FUNCTION BUTTON KEYBOARD

General Engraving Schedule for
Seabrook Main Plant Computer System

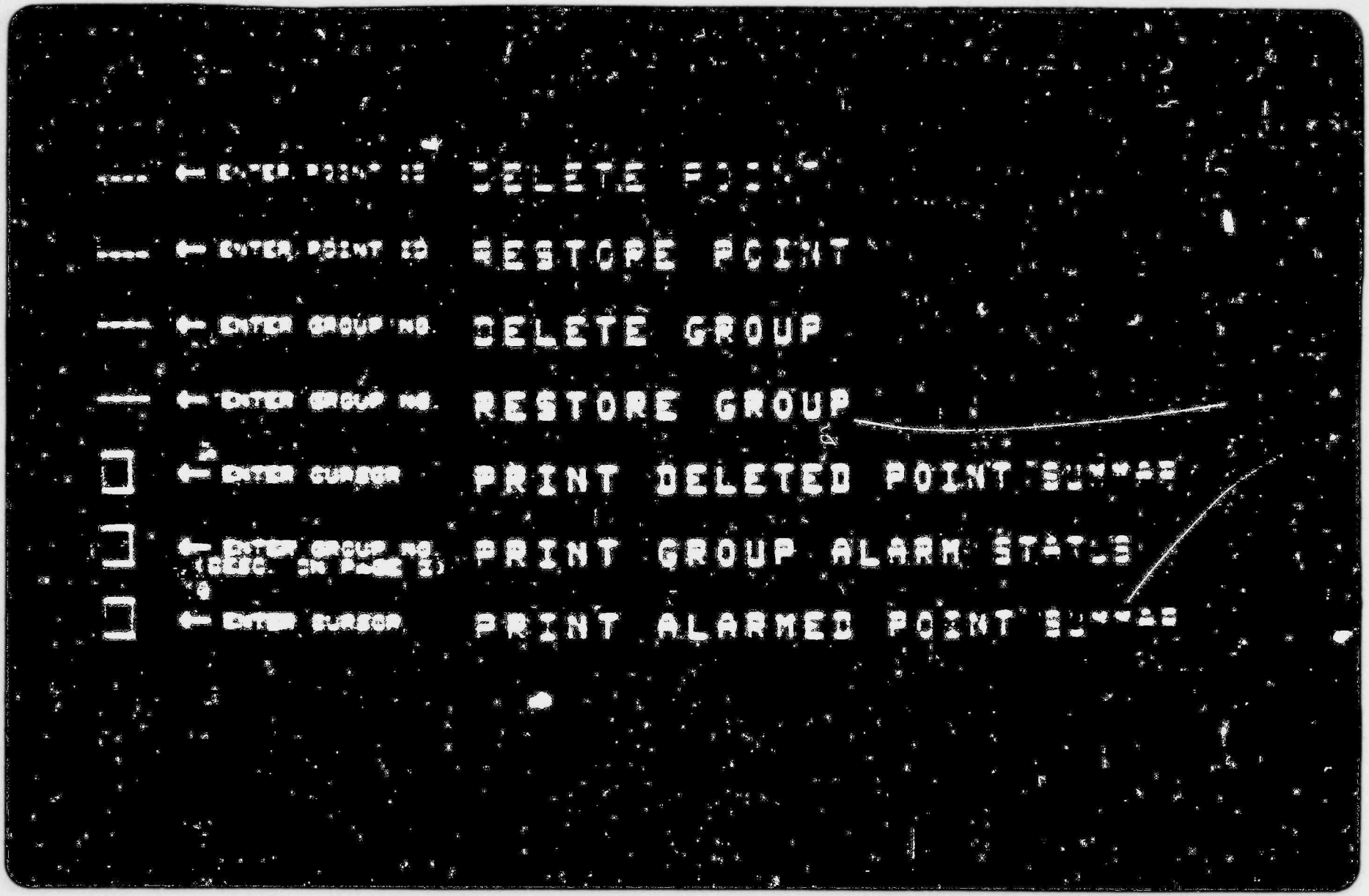
Keyboard Positions KGL, KGR

ATTACHMENT #5

ATTACHMENT #6



ATTACHMENT #7



ATTACHMENT #8