Department of Energy
Washington, D.C. 20545
Docket No. 50-537
HQ:S:82:114

OCT 2 1 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

CONTROL ROOM PHILOSOPHY EXCHANGE MEETING, OCTOBER 19, 1982

On October 19, 1982, the Clinch River Breeder Reactor Plant (CRBRP) project met with the Nuclear Regulatory Commission to describe the CRBRP control room design philosophy and approach. Enclosure 1 to this letter is a list of attendees, Enclosure 2 is a copy of all the handouts from the meeting, and Enclosure 3 is the action items resulting from the meeting. If there are any questions, please call A. Meller (FTS 626-6355) of the CRBRP Project Office.

Sincerely,

John R. Longenecker
Acting Director, Office of the
Clinch River Breeder Reactor
Plant Project
Office of Nuclear Energy

Enclosures

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ENCLOSURE 1

CRBR CONTROL ROOM WORKING MEETING OCTOBER 19,1982

LIST OF ATTENDEES

Richard Stark	NRR	CRBRPO
Robert J. Schemel	NRR	HFEB
S. H. Weiss	NRR	HFEB
Mark Greenberg	NRR	HFEB
Lisamarie Lazo	NRR	HFEB
Neil W. Brown	GE(WLLCO)	
Peter J. Gross	DOE	CRBRP-PO
Joel J. Kramer	NRR	DHFS
Dave Elias	CRBRP-PO	
C. H. Fox	CRBRPO	
George Clare	Westinghouse-Oak Ridge	
Bob Rosecky	CRBRP-PO	
Al Meller	CRBRP-PO	
Don Florek	CRBRP-PO	
John Longenecker	DOE	
Voss Moore	HFEB/Chief	

CRBRP CONTROL ROOM

BRIEFING FOR

NUCLEAR REGULATORY COMMISSION
CRBRP PROGRAM OFFICE

OCTOBER 19, 1982

10-82-3036-34

BRIEFING ON

CBRRP CONTROL ROOM DESIGN

FOR THE
NUCLEAR REGULATORY COMMISSION
CRBRP PROGRAM OFFICE

BETHESDA, MARYLAND

OCTOBER 19, 1982

AGENDA

• INTRODUCTION	C. FOX
• CONTROL ROOM DESIGN— AN OVERVIEW	P. PLANCHON
• CONTROL ROOM DESIGN	P. PLANCHON
– OPERATOR RESPONSE TIME	J. COX
– ALARM LOGIC	
– SYMPTOMATIC PROCEDURE	
– DARK PANELS	
– CONTROL ROOM ACCESS	
• DISCUSSIONS	P. PLANCHON
– NUREG 0718 ITEMS	
– FUTURE MEETINGS	

INTRODUCTION

OBJECTIVES

- PRESENT CRBRP CONTROL ROOM DESIGN BASIS AND PHILOSOPHY
- OBTAIN NRC ENDORSEMENT OF CRBRP APPROACH TOWARDS CONTROL ROOM DESIGN
- OBTAIN PROMPT IDENTIFICATION AND RESOLUTION OF ANY MAJOR ISSUES CONCERNING CONTROL ROOM DESIGN
  - IMPACT ON MAIN CONTROL ROOM PANEL PROCUREMENT
  - IMPACT ON SIMULATOR DESIGN AND PROCUREMENT
  - SIGNIFICANT CHANGES MAY PLACE THE DESIGN OF THE MAIN CONTROL PANEL ON THE CRITICAL PATH
- IDENTIFY ADDITIONAL MEETINGS WITH STAFF REGARDING CRBRP CONTROL ROOM
  - CONTROL ROOM MOCK-UP, OAK RIDGE

CRBRP CONTROL ROOM DESIGN—OVERVIEW

BRIEFING FOR

NUCLEAR REGULATORY COMMISSION
CRBRP PROGRAM OFFICE

PRESENTED BY

H. P. PLANCHON
MANAGER, PLANT SYSTEMS AND
SAFETY-RELATED DESIGNS
WESTINGHOUSE-OR
CRBRP PROJECT

J. J. COX
COGNIZANT ENGINEER
PLANT CONTROL SYSTEM
WESTINGHOUSE-OR
CRBRP PROJECT

10-82-3036-35

OVERVIEW

- DESIGN PHILOSOPHY
  - COMMAND AND CONTROL OF OPERATIONS
  - RELIABILITY
- PROGRESSIVE DESIGN PROCESS
- CONTROL ROOM REVIEW
- STATUS/SUMMARY/CONCLUSIONS

CRBRP CONTROL ROOM PHILOSOPHY

- COMMAND AND CONTROL OF OPERATIONS
  - COMMAND, SUPERVISOR
  - CONTROL, UNIT OPERATOR
- MAXIMUM RELIABILITY OF SAFETY CONTROLS AND INDICATIONS
- SAFETY FUNCTIONS - AUTOMATIC
- OPERATOR ACTIONS - MONITORS PERFORMANCE, CARRIES OUT CONTINGENCY ACTIONS

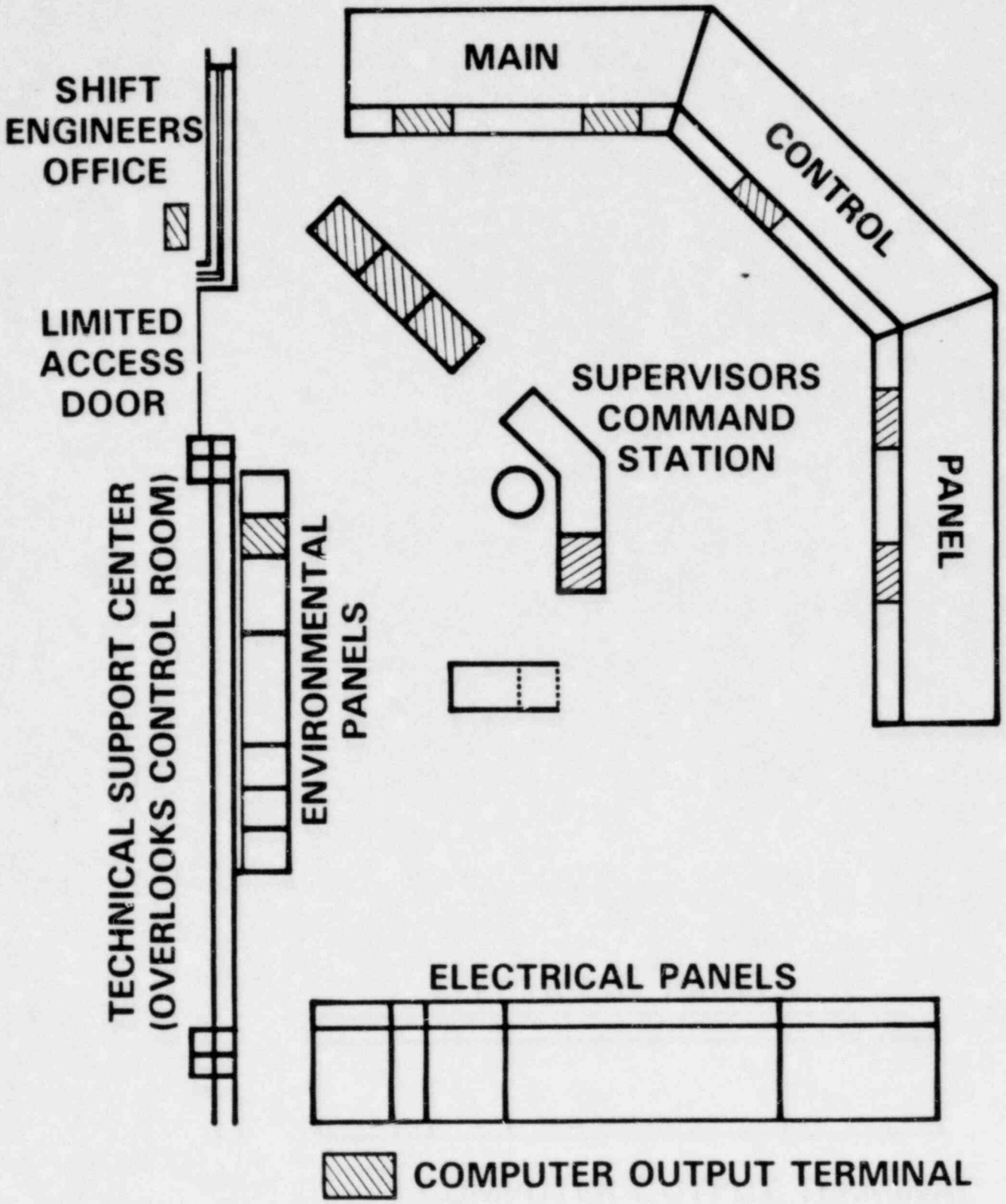
COMMAND AND CONTROL OF OPERATIONS

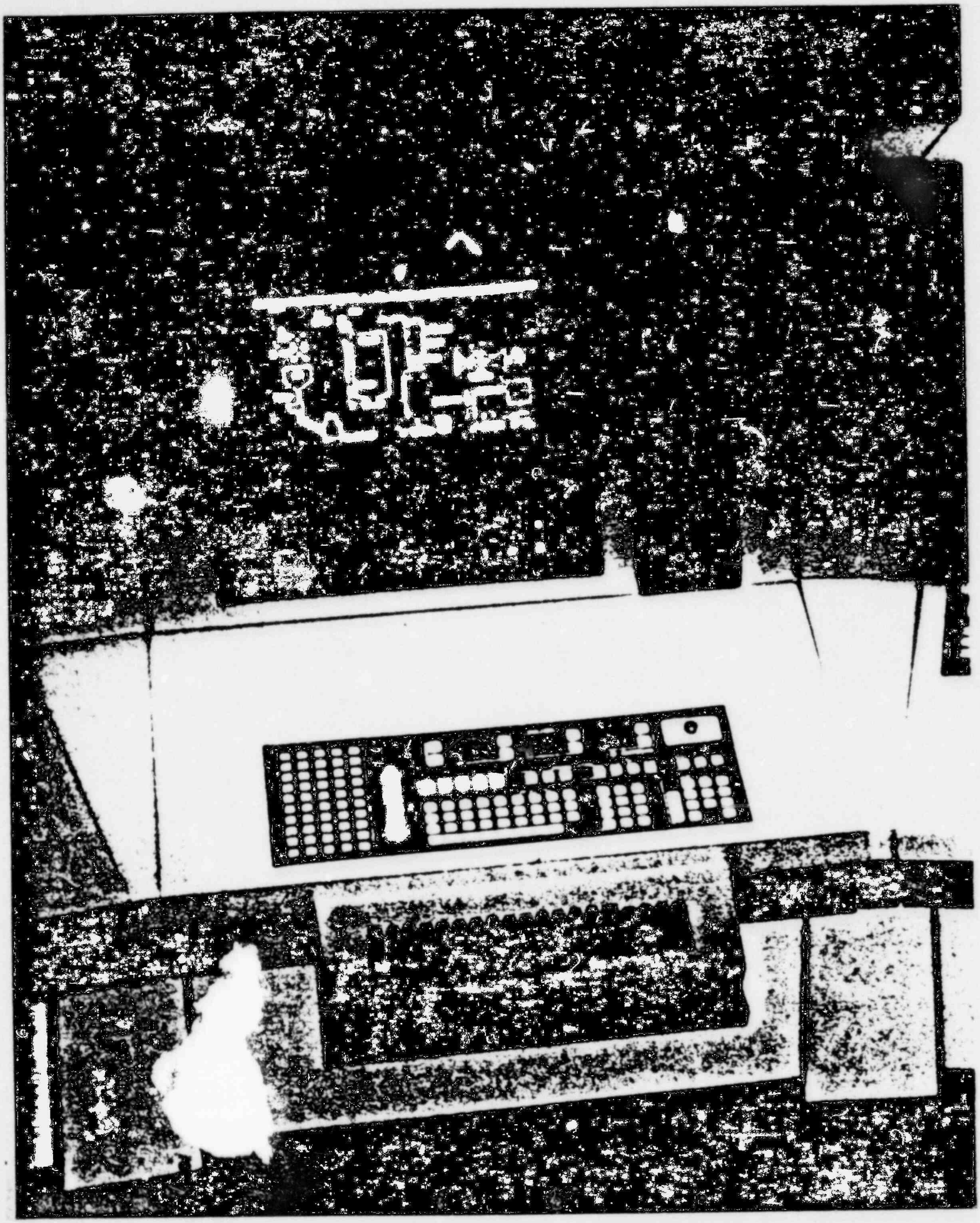
- PROVIDE THE CONTROL ROOM SUPERVISOR WITH INFORMATION THAT WILL SUPPORT COGNITIVE BEHAVIOR
- PROVIDE CONTROL ROOM OPERATORS WITH INFORMATION AND CONTROLS THAT WILL SUPPORT RULE AND SKILL BASED BEHAVIOR
- TO ACHIEVE THE ABOVE
  - PROVIDE A STATE-OF-THE-ART COMPUTER SYSTEM TO ENHANCE COGNITIVE FUNCTIONS OF THE SUPERVISOR
  - PROVIDE CONTROL ROOM AND CONTROL PANELS LAYOUT WHICH EMPHASIZES MAN-MACHINE INTERFACE CONSIDERATIONS

RELIABILITY

- PLANT PROTECTION SYSTEM
  - HIGHLY RELIABLE DESIGN
  - EXTENSIVE HARDWARE TEST PROGRAM
- ACCIDENT MONITORING INSTRUMENTATION
  - CATEGORY 1 INSTRUMENTS ARE REDUNDANT, CLASS 1E, SEISMIC, ENVIRONMENTALLY QUALIFIED, INTEGRATED INTO THE VIEWING AREA OF THE OPERATOR
- OTHER CONTROL SYSTEMS
  - UTILIZE MODERN EQUIPMENT PROVEN IN COMMERCIAL APPLICATION

CRBRP CONTROL ROOM LAYOUT





A DELIBERATE AND PROGRESSIVE DESIGN

BEFORE TMI

- WESTINGHOUSE R&D AND CORPORATE DESIGN HUMAN FACTOR FERSONNEL INVOLVED
- ORNL HUMAN FACTORS PERSONNEL INVOLVED
- INTERACTION WITH EPRI ON MAIN CONTROL PANEL DESIGN
- HALF SCALE MODEL BUILT
- FULL SCALE MODEL BUILT
- ITEMS OF SIGNIFICANCE
  - OVERVIEW SHAPE OF CONTROL ROOM SUPPORTS SUPERVISOR AND OPERATOR FUNCTIONS
  - VERTICAL "K-FRAME" PANELS
  - ENERGY FLOW LAYOUTS
  - MODERN HARDWARE UTILIZED
  - PROVIDE PLANT COMPUTER

AFTER TMI

- EXTENSIVE CONTROL ROOM REVIEW
- ENGINEERED CONTROL ROOM LAYOUT TO SUPPORT SUPERVISOR AND OPERATOR FUNCTIONS
- OPTIMIZED MAIN CONTROL PANEL ARRANGEMENT FROM A HUMAN FACTORS VIEWPOINT
- ENHANCED COMPUTER ABILITY TO ASSIST SUPERVISOR/OPERATOR
- UTILIZED LATEST NRC GUIDANCE (PRIOR TO NUREG 0700)

FUTURE PLANS

- MAINTAIN HUMAN FACTORS CONTROL OVER ALL CHANGES TO THE CONTROL ROOM
- USE CONTROL ROOOM MOCKUP AND WORKiNG MODEL OF COMPUTER FOR HUMAN FACTORS EVALUATIONS
- UTILIZE SIMULATOR AS IT PROGRESSES

A DELIBERATE AND PROGRESSIVE DESIGN

CONCLUSIONS

- CRBRP CONTROL ROOM PRIOR TO TMI INCORPORATED MANY HUMAN FACTORS CONSIDERATIONS
- FOLLOWING TMI EXTENSIVE DETAILED ANALYSIS ON THE CONTROL ROOM WAS PERFORMED RESULTING IN FURTHER ENHANCING OF THE MAN-MACHINE INTERFACE
- FUTURE DESIGN CHANGES IN THE CONTROL ROOM WILL BE REVIEWED WITH RESPECT TO HUMAN FACTORS CONSIDERATIONS

CONTROL ROOM DESIGN REVIEW

(STARTED OCTOBER 1979, ENDED JUNE, 1980)

- TOP PROJECT MANAGEMENT ESTABLISHED CHARTER
- REVIEW TEAM SELECTED FROM WIDE RANGE OF BACKGROUNDS (23 MEMBERS, 6-9 MONTHS)
  - COMMERCIALLY LICENSED OPERATORS OF LIGHT WATER PLANTS
  - OPERATORS WITH SODIUM PLANT EXPERIENCE
  - PERSONNEL EXPERIENCED IN NUCLEAR PLANT DESIGN/ANALYSIS, OPERATIONS, MAINTENANCE, TESTING, TRAINING
  - PERSONNEL WITH HUMAN FACTORS BACKGROUNDS

    INSIDE NUCLEAR INDUSTRY—DRS. LEW HANES, DAVE WOODS, WESTINGHOUSE
    DR. SHARON ECKERT, EPRI REPORT

    OUTSIDE NUCLEAR INDUSTRY—DRS. JOHN SNIDER, JOHN HUNGERFORD, UNIVERSITY OF TENNESSEE

CONTROL ROOM DESIGN REVIEW (CONT.)

- METHODOLOGY ESTABLISHED
  - TEAM MEMBERS RECEIVED SPECIAL HUMAN FACTORS TRAINING
  - UTILIZED TVA SIMULATORS
  - UP-FRONT ANALYSIS
  - OTHER KEY SYSTEM REVIEW RESULTS RELATED TO CONTROL ROOM DESIGN WERE REVIEWED
- CONDUCTED EVALUATIONS IN FULL SCALE MOCKUP
- RECOMMENDATIONS ASSESSED AND IMPLEMENTED
- DESIGN MODIFIED AS REQUIRED

STATUS/SUMMARY/CONCLUSIONS

STATUS OF CONTROL ROOM AND RELATED SYSTEMS

- SIMULATOR
- MAIN CONTROL PANEL
- COMPUTER

SUMMARY OF CONTROL ROOM

- DESIGNED TO COMMAND AND CONTROL OPERATIONS IN A RELIABLE WAY

CONCLUSION

- CONTROL ROOM DESIGN IS FELT TO BE APPROPRIATE FOR CRBRP

CRBRP CONTROL ROOM—DESIGN

BRIEFING FOR

NUCLEAR REGULATORY COMMISSION
CRBRP PROGRAM OFFICE

PRESENTED BY

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10-82-3036-38

CRBRP CONTROL ROOM

- CONTROL ROOM DESIGN MODERNIZATION/HUMAN FACTORS
- OPERATOR RESPONSE
- HALO
- SYMPTOM VERSUS EVENT LOGIC
- DARK PANELS
- CASHIER'S WINDOW

RECENT ENHANCEMENT OF CONTROL ROOM CAPABILITY (COMPUTER RELATED)

- ACCIDENT MONITORING INSTRUMENTS
  - FUNCTION BASED
  - RELIABILITY
  - COMPUTER FUNCTIONS
- SAFETY PARAMETER DISPLAY SYSTEM
  - WILL PROVIDE SAFETY STATUS OF PLANT
  - DETECT ABNORMAL CONDITIONS
  - PROVIDED BY PLANT COMPUTER SYSTEM
- INOPERABLE SYSTEMS MONITORING
  - INDICATION OF BYPASS OR INOPERABLE STATUS
  - AUTOMATIC
  - PROVIDED BY PLANT COMPUTER
- EMERGENCY REPONSE DATA SYSTEM
  - PROVIDED BY PLANT COMPUTER SYSTEM
  - CONSISTENT WITH ACCIDENT MONITORING DATA SET

PLANT COMPUTER CHARACTERISTICS

- FUNCTIONS
  - DATA RECORDING
    - TREND
    - HISTORICAL
  - ALARMING
    - OUT-OF-LIMIT
    - VALIDITY
    - INTER-CHANNEL COMPARISON
  - PERFORMANCE ANALYSIS
  - INFORMATION DISPLAY
    - CRT
    - TYPERS
    - LINE PRINTERS
    - PLOTTER
- SIGNIFICANT HARDWARE FEATURES
  - > 5K INPUTS
  - DISTRIBUTED PROCESSING
  - REDUNDANT HARDWARE FEATURES
  - EXPANDABILITY
  - FLEXIBILITY
- STATUS—ON ORDER, PARTS BEING DELIVERED

EMPHASIS ON MAN-MACHINE INTERFACE

CONTROL ROOM LAYOUT

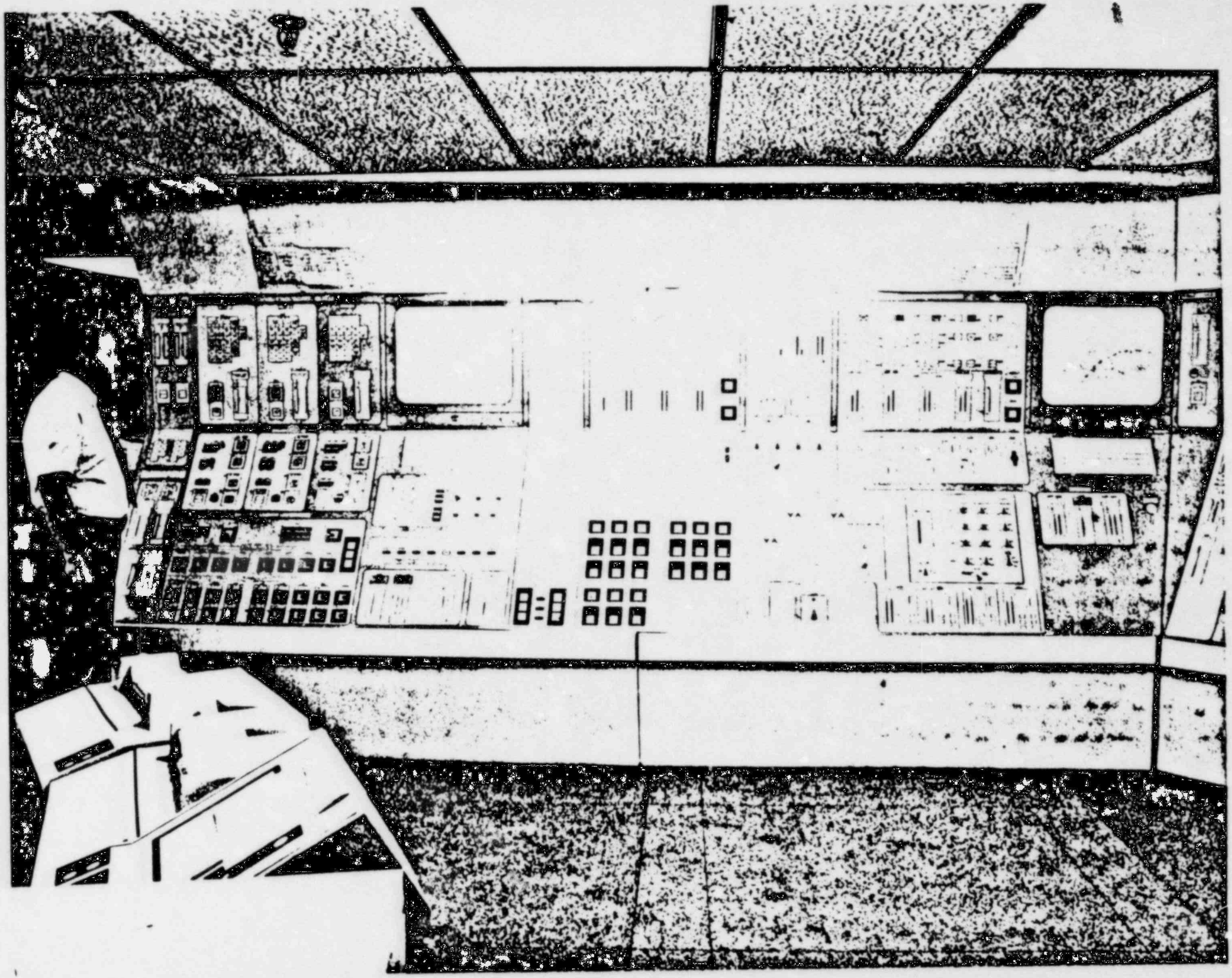
- SUPERVISOR HAS OVERVIEW OF OPERATING AREA
- LAYOUT IS IN ENERGY FLOW SEQUENCE
- SAFETY FUNCTIONS ARE CLUSTERED
- GROUPING OF ENVIRONMENTAL TYPE PANELS
- GROUPING OF ELECTRICAL PANELS
- LIMITED ACCESS

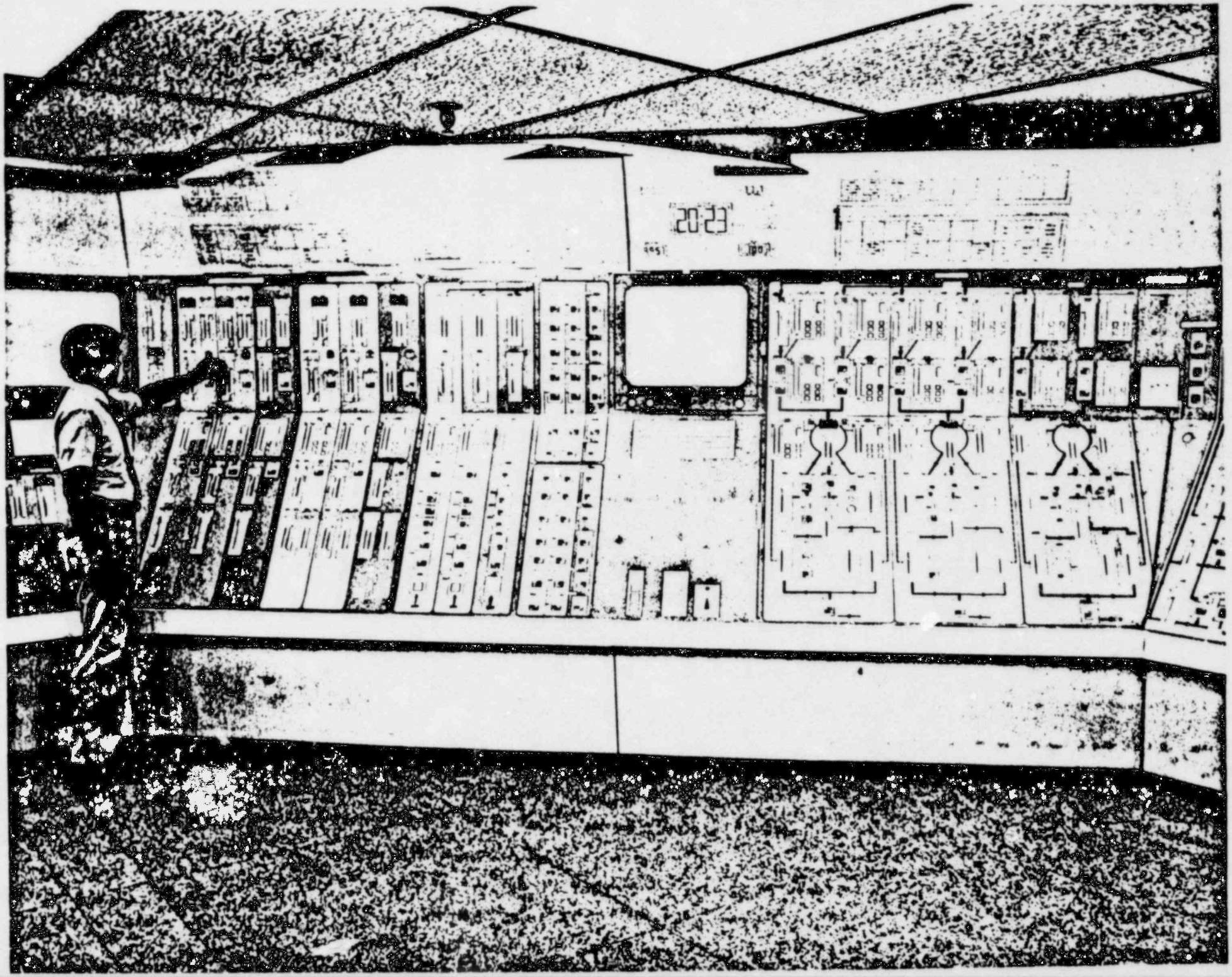
MAIN CONTROL PANEL ENERGY FLOW SEQUENCE

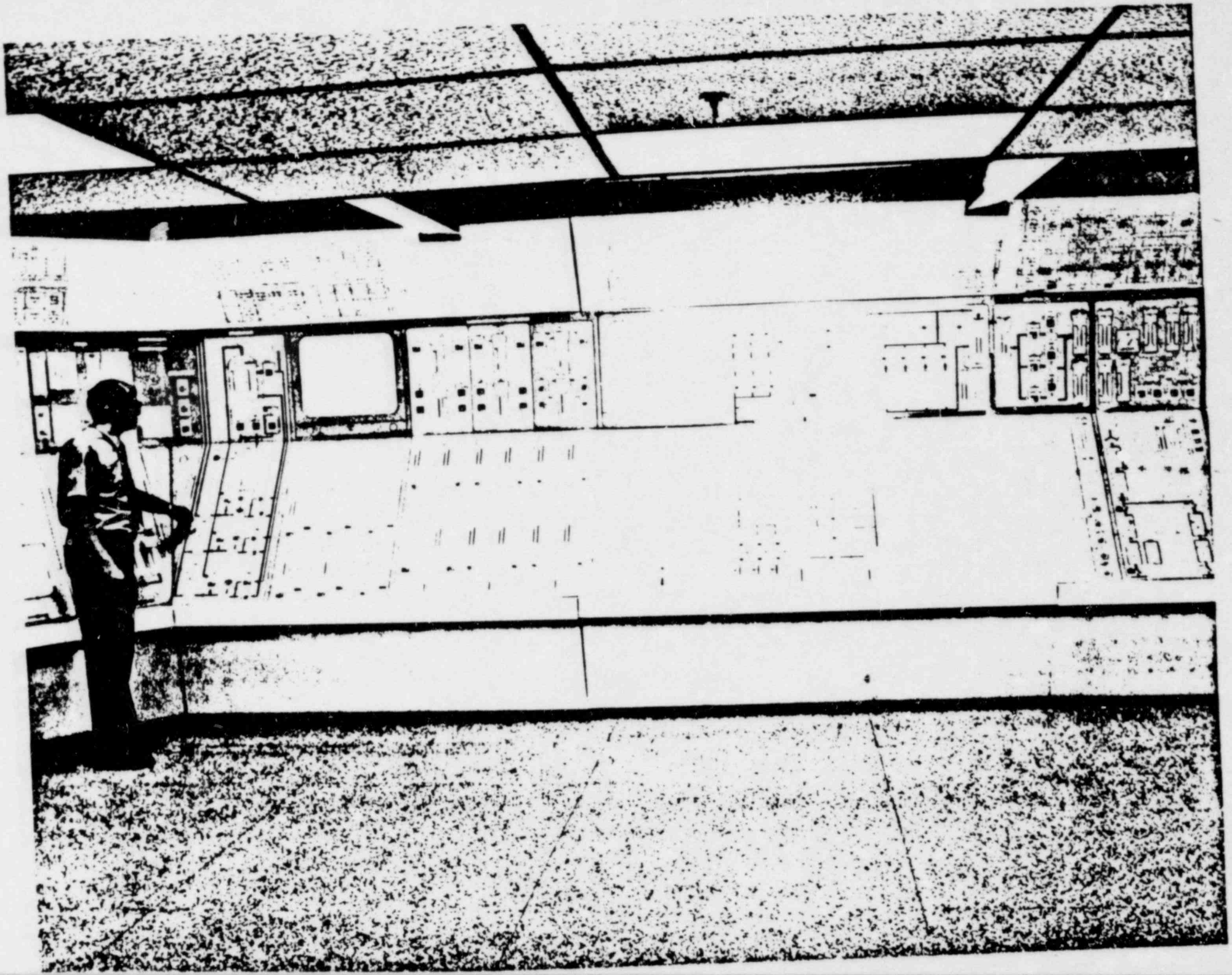
FUNCTION	HEAT GENERATION	HEAT REMOVAL		
INDICATION	REACTOR	PRIMARY LOOP	INTERMEDIATE LOOP	HEAT SINK
	FLUX	FLOW	FLOW	STEAM DRUM LEVEL
	ROD POSITION	TEMPERATURES	TEMPERATURES	PRESSURE
				AFW FLOW

CLUSTERING OF SAFETY FUNCTIONS

CONTAINMENT ISOLATION	REACTOR SHUTDOWN SYSTEM	PRIMARY AND INTERMEDIATE COOLING LOOPS	STEAM GENERATOR AUXILIARY HEAT REMOVAL





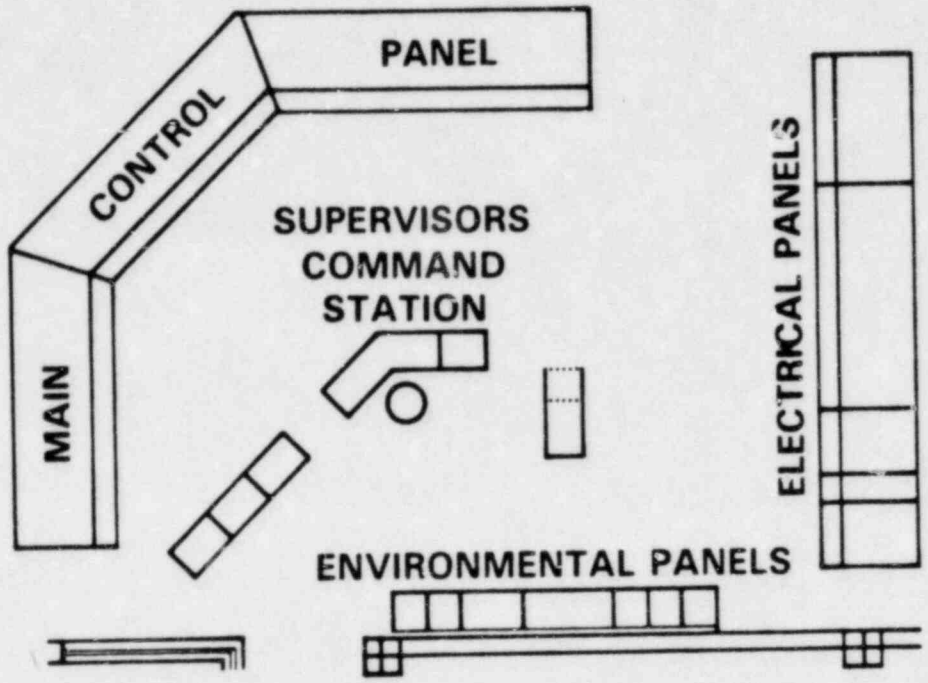


EMPHASIS ON MAN-MACHINE INTERFACE (CONT.)

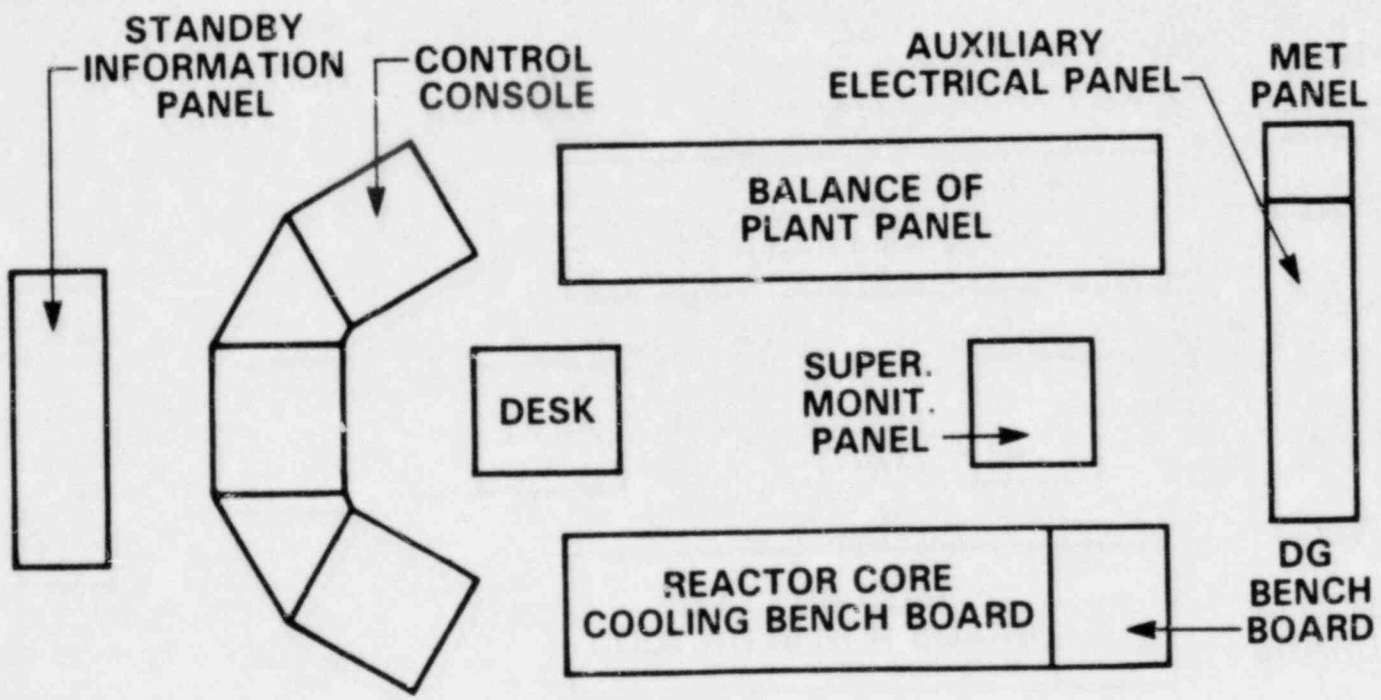
CONTROL PANELS

- NORMAL AND EMERGENCY OPERATIONS ARE PERFORMED FROM SAME LOCATION
- IMPORTANT PARAMETERS ARE LOCATED AT EYE LEVEL
- LAYOUT IS IN ENERGY FLOW SEQUENCE
- PROCESS CONTROLS ARE LOGICALLY CLUSTERED
- HUMAN FACTORS CONSIDERATIONS ARE INCORPORATED
  - AUDITORY
  - TACTILE
  - VISUAL
    - SHAPES
    - COLORS
    - MIMICS
  - CONSISTENT NOMENCLATURE

ADVANCED CONTROL ROOMS



OVERVIEW TYPE



COCKPIT TYPE

ASSESSMENT OF OVERVIEW TYPE CONTROL ROOM

- SUPPORT FOR SUPERVISOR IN COGNITIVE MODE
- SUPPORT FOR OPERATOR IN RULE AND SKILL BASED MODE
- OPERATION OF SAFETY SYSTEMS
- RELIABILITY
- DENSITY OF CONTROLS

- ENGINEERED IN
- ENGINEERED IN

  OPERATED IN SAME MANNER AS DURING NORMAL OPERATION
- ENGINEERED INTO NORMAL OPERATING PANELS AS PART OF DESIGN
- MODERN EQUIPMENT IS USED WHICH HAS LARGE OPERATIONS OR TEST HISTORY

  MEETS IEEE 384 BY INCORPORATING THE SEPARATION INTO NORMAL OPERATING PANELS

ASSESSMENT OF OVERVIEW TYPE CONTROL ROOM (CONT.)

• INTEGRATED SPDS AND ERF	TOTALLY INCORPORATED
• FLEXIBILITY (INCORPORATE NEW OPERATING SCHEMES)	
– INFORMATION	• COMPUTER SYSTEM HAS ADD ON CAPABILITY FOR HARDWARE, AND PROGRAM FLEXIBILITY FOR SOFTWARE
– CONTROLS	• PLACEMENT OF SAFETY CONTROLS ON PANEL COULD AFFECT DESIGN
• DIVERSITY IN TASKS	• REQUIRES PHYSICAL WHOLE BODY MOVEMENTS • VIEWING TARGETS ARE OF DIFFERENT MAGNITUDE, COLOR, SHAPE

SCHEDULE

- FINALIZE CONTROL PANEL SPECIFICATION 6 YRS BEFORE CRITICALITY
  - SUPPORTS TESTS AND OPERATIONS
  - SUPPORTS SIMULATOR DEVELOPMENT AND DESIGN
  - TVA IS IN PROCESS OF INITIATING SIMULATOR DEVELOPMENT
- COMPUTER SOFTWARE AND GRAPHICS MUST START 6 YRS. BEFORE CRITICALITY
  - SUPPORT TESTS AND OPERATIONS
  - SUPPORT SIMULATOR DEVELOPMENT
- SIMULATOR PROCURED 5 YRS BEFORE CRITICALITY
  - SUPPORT OPERATOR TRAINING

OPERATOR RESPONSE

SAFETY FUNCTION ARE AUTOMATIC

- NO OPERATOR ACTUATION OR CONTROL IS NECESSARY
- OPERATOR FUNCTION IS TO
  - VERIFY SAFETY FUNCTIONS ARE BEING PERFORMED
  - VERIFY PROPER OPERATIO OF SAFETY SYSTEM EQUIPMENT

SAFETY SYSTEMS DESIGNED TO PERFORM SAFETY FUNCTIONS IN THE EVENT OF EQUIPMENT FAILURE

- REDUNDANT REACTOR SHUTDOWN SYSTEM
- REDUNDANT DECAY HEAT REMOVAL SYSTEMS

MULTIPLE FAILURES—DESIGN SUPPORTS OPERATOR IN DEALING WITH BEYOND DESIGN BASE FAILURE

- FUNCTION BASED ACCIDENT MONITORING IS BEING ACCOMPLISHED
  - INDICATES THAT SAFETY FUNCTION IS BEING ACCOMPLISHED
  - INDICATES THAT SAFETY EQUIPMENT IS FUNCTIONAL

HALO

- HANDLING OF ALARMS USING LOGIC (HALO)
- SUPPRESS ALARMS NOT SIGNIFICANT FOR A SPECIFIC OPERATING CONDITION
- FRENCH HAVE SUPPRESSION USING A MANUAL MODE SELECTOR
- CONCEPT IS BEING CONSIDERED IN U.S.
- CRBRP CRTF ADDRESSED SUBJECT
  - SUPPRESSION NOT RECOMMENDED FOR ANNUNCIATOR
  - PLANT COMPUTER SUPPORT OF ALARMS RECOMMENDED

SYMPTOM VERSUS EVENT LOGIC

- PROCEDURES
  - SYMPTOM BASED – DEAL WITH LOSS OR THREAT TO SAFETY FUNCTION
  - EVENT BASED – DEAL WITH RESPONSE TO IDENTIFIED EVENT
  - CRBRP COMMITMENT IN PSAR APPENDIX H
    - CONSIDER INPO WORK RELATIVE TO DEVELOPMENT OF PLANT PROCEDURES
    - UTILIZE STATE-OF-THE-ART PROCEDURE FORMAT AT TIME OF CRBRP PROCEDURE WRITING
  - TVA WILL ULTIMATELY WRITE THE SYMPTOMATIC BASED PROCEDURES
- CRBRP INFORMATION SYSTEMS SUPPORT SYMPTOM BASED OPERATOR ACTION
  - ACCIDENT MONITORING INSTRUMENTS
  - SAFETY PARAMETER DISPLAY SYSTEM

DARK PANELS

- NO SAFETY PANEL LIGHTS ARE ILLUMINATED WHEN THE PLANT IS IN THE NORMAL CONDITION
- CRBRP CRTF ADDRESSED THIS SUBJECT
  - RESULTS
    - LIGHT MODULES WHICH REFLECT SAFETY FUNCTION STATUS REMAIN DARK UNTIL SAFETY FUNCTION IS INITIATED

CASHIER'S WINDOW

- PROVIDE A CASHIER'S WINDOW IN CONTROL ROOM TO FACILITATE HANDING SMALL ITEMS INTO CONTROL ROOM
- SHIFT ENGINEERS OFFICE IS ADJACENT TO CONTROL ROOM FOR MANAGEMENT OF ROUTINE ACTIVITIES
- POSITIVE METHODS OF CONTROLLING ACCESS ARE PROVIDED BY A CARD KEY AND CIPHER PAD SYSTEM
- PLANT SECURITY CONTROLS LEVELS OF PERSONNEL IN CONTROL ROOM

ENCLOSURE 3

CONTROL ROOM PHILOSOPHY EXCHANGE MEETING OCTOBER 19, 1982

ACTION ITEMS

1) NRC will review the Summary Report on the Conduct of the CRBRP Key Systems Reviews, submitted February 19, 1982, Longenecker to Check.

2) PO will review the FNP PSAR Amendment 28, July 15, 1981, pages C222 on and assess the need to revise the CRBRP PSAR accordingly.

3) A meeting will be scheduled in the next 2 - 3 weeks, hopefully at the CRBRP Control Room Mock-up in Oak Ridge, to discuss the results of the above and to permit NRC Staff to review the Control Room Mock-up.

ATTACHMENT