PALO VERDE NUCLEAR GENERATING STATION
REMOTE SHUTDOWN PANEL
HUMAN FACTORS STUDY

EXECUTIVE SUMMARY REPORT

PREPARED BY
ARIZONA PUBLIC SERVICE COMPANY

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ACKNOWLEDGEMENTS

The following individuals are acknowledged for their participation in the Remote Shutdown Panel (RSP) Human Factors Study:

Arizona Public Service Company

- Plant Operators
- E. Sterling - I&C Supervisor
- J. Rowland - I&C Senior Engineer
- R. Bernier - Operations Supervisor
- J. Malik - Day Shift Supervisor
- M. Sulouff - Hot Functional Startup Test Engineer
- S. Le Clair - Shift Technical Advisor
- G. Sanchez - I&C Engineer

Bechtel Power Corporation

- K. Soteropoulos - Controls Supervisor
- J. Hunt - Controls Engineer
- System Designers

Combustion Engineering, Inc.

- R. Pierce - Principal Nuclear Engineer

1. Objectives

1.1 The objective of this study was to perform a human factors review of the Palo Verde Nuclear Generating Station (PVNGS) Remote Shutdown Panel (RSP) to identify, prioritize, and correct discrepancies using the knowledge gained from the Detailed Control Room Design Review (DCRDR) performed for the PVNGS Control Room.

1.2 Program Description

The review program established for the DCRDR was applied to the Remote Shutdown Panel Human Factors Study as indicated in Figure 1-1.

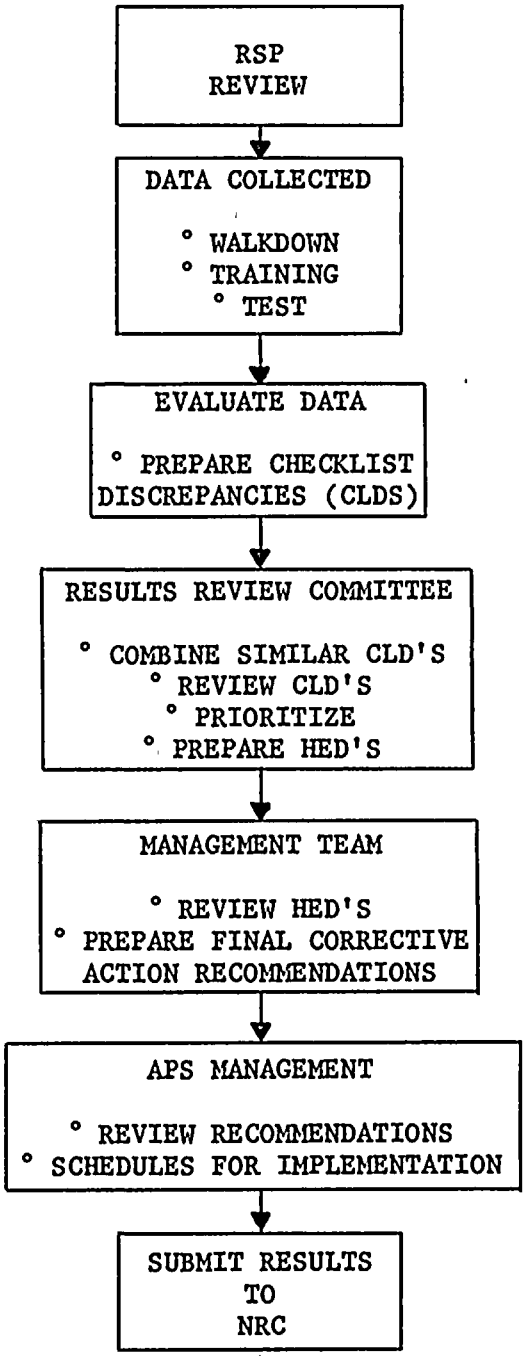

Figure 1-1. RSP REVIEW PROGRAM PLAN

2. Methodology

2.1 General

The APS' human factors review of the RSP consisted of:

- Walkdown of the Remote Shutdown Panel procedure which is an abnormal operating procedure.
- Discussion of problems raised during operator Remote Shutdown Panel Hot Functional Test training.
- Witnessing the operability of the Unit 1 Remote Shutdown Panel during the Hot Functional Startup Test held July 1983.

2.2 Data Collection

Data collection for the Remote Shutdown Panel Human Factors Study was performed by the Remote Shutdown Panel Review Team which consisted of individuals from the following APS organizations:

° Shift Technical Adviser	PVNGS Independent Safety Engineers Group (ISEG)
° Startup Engineer	PVNGS Hot Functional Test (HFT) Group
° Instrument & Controls (I&C) (I&C) Engineers	APS Nuclear Engineering Department

Data collection was performed during the following tasks by members of the Remote Shutdown Panel Review Team.

- Walkdown of the Remote Shutdown Procedure: During this task the Remote Shutdown Panel Review Team members performed a walkdown of the appropriate procedure used to achieve cold shutdown of the reactor.
- Attendance of the plant operators' Remote Shutdown Panel of Functional Test training sessions: During this task the Remote Shutdown Panel Review Team members obtained from the plant operators' comments and concerns which related to the operation of the Remote Shutdown Panel.
- Witnessing the demonstration of the Remote Shutdown Panel during the Remote Shutdown Panel Hot Functional Test: During this task members of the Remote Shutdown Panel Review Team obtained comments from the Remote Shutdown Panel Hot Functional Test participants and made note of all potential problems associated with the actual maintenance of the plant in hot standby and successful cooldown of the plant through Remote Shutdown Panel operation.

2.3 Data Evaluation

The data collected by the Remote Shutdown Panel Review Team was evaluated using the knowledge and experience gained from the Detailed Control Room Design Review performed for the PVNGS Control Room. Observations identified were documented and processed through the Results Review Committee and the Management Team using the forms and procedures established during the Detailed Control Room Design Review (DCRDR). The human engineering discrepancy categorization criteria used in the DCRDR to categorize the observations was used (Table 2-1) during the Remote Shutdown Panel Human Factors Review.

Table 2-1

Human Engineering Disrepancy Categorization Criteria

Category	Description
A	Safety
B	Reliability (90% Availability Criterion)
C	Reliability - Enhancement
D	Minor

Category D discrepancies were not considered as human engineering discrepancies and will be reviewed as plant betterment items.

3. Results

3.1 The review of the Remote Shutdown Panel identified 22 observations which were categorized as shown on Table 3-1.

3.2 Human Engineering Discrepancy categories A, B, and C in Table 3-1 were classified as HED's, which total 20. The remaining 2 were assigned Category D which were non-HED's.

Details for these discrepancies and their evaluation are contained in the Technical Report for the PVNGS Remote Shutdown Panel Human Factors Study.

Table 3-1

Summary of Human Engineering Discrepancies

	No. of HED's	Category
	12	A
	3	B
	5	C
NOTE:	2	Category D (non-HED's)

4. Conclusion

4.1 HED Corrective Actions and Implementation Schedules

Corrective actions for all HED have been identified and their implementation schedules are indicated on Appendix A.

APPENDIX A

REMOTE SHUTDOWN PANEL

HUMAN ENGINEERING DISCREPANCY

AND

IMPLEMENTATION SCHEDULES

NOTE:

The HED category is designated by an A, B, or C following the HED number.

Implementation: Prior to exceeding 5% power

HED 151A: Remote Shutdown (RS) area is too small. Inadequate workspace for staff interface and lack of storage.

APS Corrective Action

APS will remove the doors off equipment cabinets ZJB/D-E01, ZJA/C-E01, ZJB-E02 and ZJN-E01. (151)

APS will provide an appropriate surface suitable for writing in equipment area. (151)

HED 152A: Instruments nameplates lack proper color coding and consistent nomenclature with the Control Room.

APS Corrective Action

APS will provide instrument nameplates on the equipment panels that match the Main Control Boards (MCB) instrument nameplates for color and nomenclature. (152)

HED 154A: Indication for reset not sufficient for operator recognition (i.e., Steam Generator Pressure or Low Pressurizer Reset). No pretrip alarm exists in the RSP, as in the control room to warn operator if pretrip light fails.

APS Corrective Action

APS will provide an audible alarm to be annunciated during Steam Generator (S/G) Pressure Low Reset and Pressurizer Low Pressure Reset for visual indications. (154)

HED 158A: Indicators and controls are located too high on the RSP.

APS Corrective Action

Further review of the Remote Shutdown Panel top row of indicators (total 10) has shown that these indicators are not located too high on the panel as previously described. This was concurred by the staff during their October 10 and 11, 1984 CRDR audit. APS will provide zone markings to identify operating ranges and limits for these meters.

Implementation: Prior to exceeding 5% power (continued)

HED 161A: Insufficient communication equipment at the RSP area.

APS Corrective Action

APS will provide additional communications equipment in equipment area. Communications equipment will consist of (1) two radios/consoles, (2) one five-line telephone, and (3) one sound powered telephone jack. (161)

HED 163A: Function on indicating lights not provided.

APS Corrective Action

APS will engrave the lenses on the indicating lights with required functions. (163)

HED 164A: RSP area lacks emergency lighting on panel face.

HED 159B: RSP lighting is inadequate and insufficient. RSP Room for Panel ZJB/D-E01 lacks lighting (temporary lighting existing).

APS Corrective Action

APS will modify the essential lighting wiring, to connect the "A" room's lighting to the "A" Train essential power supply and the other room to the "B" Train essential power supply. (164)

APS will add permanent lighting by equipment panel ZJB/D-E01 and ZJB-E02. (164)

HED 165A: The Auto-Man switch for the Atmospheric Dump Valve (ADV's) controllers are mislabeled.

APS Corrective Action

APS is changing the labeling on the Atmospheric Dump Valves (ADVs) controller switches on equipment panel ZJA/C-E01 and ZJB/D-E01 from "Auto-Man to CR-Local".

HED 166A: Control room (CR) losing control of ADV due to existing switch inadvertently being switched.

APS Corrective Action

APS will add annunication in the Main Control Room to indicate when the Atmospheric Dump Valve controllers are in the manual/local control mode on equipment panels ZJB/D-E01 and ZJA/C-E01. (166)

Implementation: Prior to exceeding 5% power (continued)

HED 169A: RSP lacks ability for proper controlling of the Shutdown Cooling (SDC) loop warmup valves (SI-HV-690, 691). SDC loop warmup exceeded the specified limits of 17°F/minutes during HFT.

APS Corrective Action

APS will change procedure 41A0-1ZZ27 in order to prevent exceeding the maximum shutdown cooling warmup rate. (169)

HED 157A: RSP Room for panel ZJA/C-E01 does not have a fire detector.

APS Corrective Action

APS will add fire detection to RSP Room for panel ZJA/C-E01.

HED 153A: RSP controls lack functional grouping.

APS Corrective Action

APS will review instrumentation and controls on the RSP panels and provide functional grouping of instrumentation and controls by use of mimics or demarcation. (153)(160)

Implementation: Plant Betterment

HED 155C: RSP lacks method of monitoring different plant parameter alarms.

Recommended Corrective Action:

Provide Emergency Response Facilities Data Acquisition Display System (ERFDADS) terminal or review to determine necessary plant parameter alarms and provide annunciator.

Disposition:

Plant parameters which might be desirable in the Remote Shutdown Panel will be evaluated as a plant betterment item.

HED 162C: RSP Room A/C lacks sufficient ventilation.

Recommended Corrective Action:

Add ventilation to RSP Room for Panel ZJA/C-E01.

Disposition:

Currently the RSP is cooled by essential HVAC in the Engineered Safety Feature (ESF) switchgear rooms which are adjacent to the RSP. In addition, the RSP is not a control room which will be manned by operators on a continuous basis. Therefore, the addition of ventilation will be evaluated as a plant betterment item.

HED 167C: RSP Room concrete floor is hard and uncomfortable.

Recommended Corrective Action: Add floor mats.

Disposition:

The Remote Shutdown Panel is not a control room which will be manned by the operators on a continuous basis. Therefore, the addition of floor mats will be evaluated by APS as a plant betterment item.

HED 171C: No indication of spray pond flow discharge is readily accessible except in the control room. Existing FT's are in a concrete covered pit by spray ponds.

Recommended Corrective Action:

Add local Spray Pond Panel flow discharge indication/or review possibilty of using pump amperes and pressure at local Spray Pond Panel.

Implementation: Plant Betterment (continued)

Disposition:

Currently the existing FT's located by the spray pond provide proper flow indication to the operator. In addition the Remote Shutdown Panel was not designed as a control room and is considered to perform its designed functions of achieving Hot Shutdown Standby and Cold Shutdown through the use of suitable procedures. Therefore, the necessity of adding spray pond flow discharge to the spray pond local panel needs to be evaluated as a plant betterment item.

The following corrective action for the following HED's have been deleted/delayed for reasons stated.

HED 150B: RSP area too small. (The existing door is too narrow. Poor layout for staff interface.)

Recommended Corrective Action:

Modify fire wall by mechanization of door/review criteria to widen door.

Disposition

The expansion and modification of the RSP area, specifically the modification of the door between the RSP Room to double doors or a sliding door was thought necessary during the Hot Functional Test since it was not possible to supervise Trains A and B panels due to the door which has been placed between the panels.

It needs to be indicated that supervision of both Train A and B is not necessary to achieve safe shutdown condition of the Remote Shutdown Panel therefore modification of the door is not required for the operators to achieve a safe shutdown condition.

HED 156B: RSP lacks indicator test lamp capability.

Recommended Corrective Action:

Investigate various alternatives or handle in the same method as the Control Room (Administratively); or investigate use of lamp test socket.

Disposition:

This HED also exists in the Main Control Room. The Main Control Room issue remains unresolved between APS and NRC.

The RSP HED will be addressed in the same manner as the control room, once resolution has been reached between APS and NRC. (Note: The NRC has deferred resolution of this item as part of closing the DCRDR)

HED 160C: Two disconnect switches on panel ZJB/D-E01 are not located with other disconnect switches on panel ZJB-E02.

Recommended Corrective Action:

Provide demarcation or relocate the two disconnect switches to panel ZJB-E02.

Disposition:

The applicability of demarcation of these two switches will be evaluated during the Remote Shutdown Panel control functional grouping. Currently the procedure for shutdown outside the control room describes the location of these switches, therefore relocation of switches will not be performed.

Attachment 2

Control Room

Environmental Survey