HOPE CREEK GENERATING STATION FUNCTION AND TASK ANALYSIS CONTROL ROOM DESIGN REVIEW

April 9, 1984

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INTRODUCTION

This document is PSE&G's response to NRC comments on the Hope Creek Generating Station (HCGS) Control Room Design Review (CRDR) Program Plan. The HCGS CRDR Program Plan was submitted to the NRC on October 14, 1983, and NRC comments were reviewed on February 2, 1984, at a status review meeting between PSE&G and NRC representatives.

Per NRC request, PSE&G has prepared this document to provide a more extensive explanation of the HCGS CRDR function and task analysis methodology.

BACKGROUND

PSE&G has designed the HCGS CRDR program to interface with related initiatives including upgraded emergency operating procedures, SPDS, training, etc. Furthermore, PSE&G acknowledges:

- NUREG-0737 Supplement 1 serves as a guidance document to define a baseline integration strategy which a utility can use to effectively integrate related initiatives to meet the intent of NRC guidance in NUREGs 0700, 0801, 0696, 0814, 0835, 0899, etc.
- The formal mechanism by which a utility commits to a strategy for meeting the intent of NUREG-0737 Supplement 1 is its April 15, 1983, submittal to the NRC in response to Generic Letter 82-33.
- NRC comments on the utility's April 15, 1983, response to Generic Letter 82-33, and NRC comments on utility submissions in accordance with the April 15, 1983, utility commitment, serve as a forum for resolution of potential licensing issues related to NUREG-0737 Supplement 1.

Since Hope Creek is an NTOL plant, PSE&G has developed a tailored strategy for function and task analysis for the HCGS CRDR. Although the HCGS CRDR summary report will be submitted prior to finalization of both the HCGS EOPs and the Safety Parameter Display System, this approach complies with the guidance in NUREG-0737 Supplement 1 and complies with licensing commitments in the April 15, 1983, submittal.

NUREG-0737 Supplement 1 integrates guidance from several NUREGs, but there is one primary interface which is crucial to successful integration of related efforts in support of the CRDR. The CRDR function and task analysis is to be the same function and task analysis that was used for development of the upgraded EOPs. To use any other

function and task analysis (e.g., independent of EOP development) would not follow NUREG-0737 Supplement 1 guidance regarding integration of upgraded EOP development with the CRDR. Although upgraded EOPs for HCGS will not be submitted to the NRC until after completion of the CRDR, the CRDR is being conducted as an integrated project with substantial input from HCGS operations and in close coordination with the HCGS EOP development project.

The HCGS EOPs are based on BWR Owner's Group (BWROG) generic emergency procedure guidelines (EPGs), which have been reviewed by the NRC and approved technically as an adequate mitigating strategy for responding to accidents. As a separate licensing submittal, PSE&G will submit a Procedures Generation Package, including a procedures verification and validation program plan. The NRC will have an opportunity to review the plant-specific technical guidelines to ensure technical accuracy. Execution of the EOP verification and validation program will ensure that the EOPs are usable and operable in the HCGS control room and will effectively mitigate the consequences of accidents. The HCGS EOP development process, together with appropriate NRC approvals, will therefore provide the NRC with an additional opportunity (beyond the CRDR function and task analysis) to confirm that the HCGS EOPs incorporate correct system functions and operator tasks.

HCGS CONTROL ROOM DESIGN PROCESS

The HCGS control room was designed by a process which included human factors considerations from the initial design through fabrication. The design process was started prior to the TMI-2 incident and subsequent NRC regulatory guidance. In 1977, an Operability Analysis was performed to determine the initial layout of the HCGS control panels. A full-scale mockup of the control panels was constructed with movable components magnetically attached to the panel surfaces.

PSE&G assembled a team of representatives from General Electric, Bechtel Power Corporation, and the Peach Bottom operations staff to assist in the Operability Analysis. For two weeks, the team walked through Peach Bottom procedures to improve the layout of the HCGS control panels to support effective operations. The layout resulting from this analysis incorporated functional grouping, demarcation, mimicking, and hierarchical labeling as primary considerations. A report was written documenting the methodology used, participants, and results of the Operability Analysis.

PSE&G has also incorporated "lessons learned" from their experience as architect-engineer and operator of Salem. For example, PSE&G has included a lamp test capability into the HCGS control room design. Since the vertical indicators in the HCGS control room do not fail downscale upon loss of power, PSE&G has incorporated, on each vertical indicator, an LED that is illuminated when the indicator has power.

DEVELOPMENT OF HCGS EOPs

PSE&G has been actively involved in the BWROG EPG development project and has provided a representative to the BWROG to assist in the EPG development. In addition, HCGS operations staff provided technical review of the EPGs as part of the industry review process.

The HCGS EOPs follow the BWROG EPGs very closely. The differences that do exist have a sound technical and operational basis, and will be assessed by the NRC as part of the EOP technical review process.

The HCGS EOPs were tested on the Susquehanna simulator as part of the EOP development process to demonstrate that the EOPs are effective and operationally correct. It should be noted that since the panel configuration of this simulator is quite different from the control panel of the HCGS, the simulator exercises were not constrained by the particular controls and displays of the actual Hope Creek control room.

Since the control room has not been available until recently, and the simulator is not yet available, the operations staff working on the EOPs and the CRDR task analysis team have little bias towards forcing the EOPs to match the specific panel layout.

HCGS CRDR SCHEDULE MILESTONES

PSE&G is conducting its CRDR at an earlier point in the plant construction schedule than most other NTOL plants. Table 1 presents relevant schedule milestones. The HCGS control panels were set in the control room in mid-1983, and the control room complex was turned over to PSE&G on December 15, 1983. Submission of the Procedures Generation Package and technical guidelines is scheduled for January 1985. Fuel load is scheduled twelve months later, in January 1986. The HCGS CRDR Summary Report is scheduled for submission to the NRC on August 15, 1984.

HCGS CRDR TASK ANALYSIS METHODOLOGY

The task analysis for the HCGS CRDR has been conducted to define the operator tasks, and operator control and information requirements. Attachment 1 to this document is a form used in the conduct of the HCGS task analysis. The left side of the form is primarily task descriptive, whereas the right side of the form supports verification. This format supports the methodology of collecting the two types of data at different times or different places. Attachment 2 demonstrates the use of the form.

Three documents served as information inputs to the task analysis. They were:

- o BWR Owner's Group EPGs.
- o HCGS EOPs, which track closely with the EPGs and provide plant specificity. HCGS EOPs are in flowchart form.
- o A draft document prepared by Operations Engineering, Inc., under contract to EPRI/DOE to define operator information needs for a BWR Graphics Display System (GDS). The draft BWR GDS document defines, at a generic level, information required to execute the BWR EPGs.

All three of these documents have the BWROG EPGs in common, and all three were used and compared in the HCGS CRDR task analysis. The task analysis process began with the development of data sheets designed to systematically record task-relevant information for the EOPs. The sentence structure format of the Task Data Form, including constrained language, explicitly defines displayed information requirements, and implicitly defines display type, required control capabilities, and controls characteristics.

The next step was for the Essex Corporation staff, who are PSE&G's human factors consultant for the HCGS CRDR, to develop a thorough familiarity with the HCGS emergency operating procedures through review and comparison of EPGs, EOPs, and the draft BWR GDS functional analysis document. This review was conducted with the concurrent input of PSE&G engineering and operations personnel, in addition to engineers from Bechtel Power Corporation. Based on this input, the Essex team, which included a senior reactor operator with previous experience in control room supervision and a human factors analyst experienced in nuclear and non-nuclear process control task analysis, developed an elaboration of the behavioral elements required for each task.

Major outputs of this process were the specific information needs and control needs, based on the plant system equipment (pumps, valves), followed by a description of operator activities required to effectively use that plant equipment. This description of operator needs and activities was based on the plant functions and plant equipment indicated by the EOPs, EPGs, and the GDS functional analysis.

Nowhere in the analysis up to this point has the human factors task analysis referred to the HCGS control panel configuration. The specific control panel configuration does become an important part of the CRDR later as part of the verification process. It is in this phase that the task analysis output is compared to the actual inventory of control panel components. This comparison determines whether the panel components required to control the plant equipment are available and suitable.

SUMMARY

In conducting the HCGS CRDR, PSE&G is continuing to include human factors and operations considerations as critical inputs to the design of the HCGS control panels. Function and task analysis is the key to making certain that procedures and control panel design mutually support each other to ensure safe and effective operations.

With respect to HCGS, not only has the function and task analysis been performed in accordance with approved human factors principles as part of the CRDR, it also has been performed throughout the control room design and EOP development processes.

TABLE 1

CHRONOLOGY OF EVENTS

September 1977	Operability Analysis conducted to develop HCGS control panel layout
May 1980	NUREG-0660 published (revised August 1980)
January 1981	First revision of Emergency Procedure Guidelines
May 1983	HCGS CRDR started
June 1983 - current	Development of plant-specific upgraded EOPs
December 1983	Control room turnover to PSE&G
August 15, 1984	CRDR Summary Report
January 1985	Submission of Procedure Generation Package to NRC
March 1985	Validate plant-specific SPDS
January 1986	Fuel Load

PSE&G — HOPE CREEK GENERATING STATION
TASK DATA FORM

PROCEDURE NAME _____ # _____ PAGE _____ OF _____

STEP # _____ STEP TITLE _____ STEP OBJECTIVE _____

INITIATING CUE _____

PERFORMANCE CRITERIA _____ REFERENCES _____

COMMENTS

STEP #	WHO TAKES ACTION	ACTION (VERB)	OBJECT OF ACTION					MEANS OF ACTION			COMMUNICATIONS (OTHER PARTY, CONTENT)	HED ID
			PLANT SYSTEM	PLANT COMPONENT	PLANT PARAMETER	STATE	OTHER	CONTROL ROOM COMPONENT TYPE	CONTROL ROOM COMPONENT ID	OTHER		

TASK

VERIFICATION

Attachment 1

PSE&G — HOPE CREEK GENERATING STATION
TASK DATA FORM

PROCEDURE NAME LEVEL/POWER CONTROL **#** _____ **PAGE** 4 **OF** 11

STEP # 2.0 CONT'D **STEP TITLE** TERMINATE ALL INJECTIONS INTO RPV EXCEPT BORON & CRD INSERTION **STEP OBJECTIVE** REDUCE POWER

INITIATING CUE POWER > 3% AFTER SCRAM AND RPV LEVEL ABOVE TAF AND EITHER SRV OPEN OR DRYWELL PRESS > 2 PSIG

PERFORMANCE CRITERIA MONITOR RPV WATER LEVEL: IF IT DROPS BELOW -129 INCHES AT ANY TIME DURING THIS STEP, INHIBIT ADS INITIATION **REFERENCES**

COMMENTS

STEP #	WHO TAKES ACTION	ACTION (VERB)	OBJECT OF ACTION					MEANS OF ACTION			COMMUNICATIONS (OTHER PARTY, CONTENT)	HED ID
			PLANT SYSTEM	PLANT COMPONENT	PLANT PARAMETER	STATE	OTHER	CONTROL ROOM COMPONENT TYPE	CONTROL ROOM COMPONENT ID	OTHER		
2.14	NCO2	POSITIONS	CORE SPRAY	PUMPS	PUMP MODE	OFF		CONTROL - LEGEND PUSHBUTTON	BV AP 206 (180) A CV BP 206 (028) B BV CP 206 (181) C CV DP 206 (029) D			
2.15	NCO2	OBSERVES	CORE SPRAY	PUMPS	PUMP MODE	OFF		DISPLAY - LEGEND IND LIGHT	SAME AS ABOVE			
2.16	NCO2	OBSERVES	CORE SPRAY	PUMPS	FLOW	DECREASE TO ZERO		DISPLAY - VERTICAL METER-INDICATOR	BV FI-E21(A601)A (163) A CV FI-E21(A601)C (011) B			

Attachment