August 3, 1984

Docket No. 50-298

Mr. J. M. Pilant, Technical
Staff Manager
Nuclear Power Group
Nebraska Public Power District
Post Office Box 499
Columbus, Nebraska 68601

Dear Mr. Pilant:

SUBJECT: SAFETY PARAMETER DISPLAY SYSTEM (SPDS) -
PREIMPLEMENTATION AUDIT

Re: Cooper Nuclear Station (CNS)

We have completed the first stage of the preimplementation review of the proposed Cooper SPDS and our preliminary conclusions are provided in the enclosure. Our preliminary conclusions are based on a review of your submittal dated March 1, 1984 and the information provided at the preimplementation audit conducted at the Nebraska Public Power District (NPPD) Headquarters on June 12 and 13, 1984.

Based on our review, we have determined the NPPD program provides a firm basis for developing an acceptable SPDS. As noted in the enclosure, certain concerns must be resolved before a final determination can be made on the overall acceptability of the SPDS relative to the guidelines of NUREG-0737, Supplement 1. The additional information required to resolve these concerns and to complete the NRC review was discussed with your staff at the meetings on June 12 and 13, 1984 and is summarized in the enclosure. In our view, if adequate information is provided, the second phase of our review need not include a visit to the Cooper site but will be strictly a "desk-top" audit.

We request that you provide a schedule for submittal of the additional SPDS information within 60 days after receipt of this letter.

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB clearance is not required under P.L. 96-511.

Sincerely,

Original signed by VLRooney for/

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

DISTRIBUTION
Docket File
NRC PDR
Local PDR
ORB#2 Reading
DEisenhut
OELD
SNorris
ESylvester
GLapinsky
ELJordan
JNGrace
ACRS (10)
Gray File

DL:ORB#2	DL:ORB#2	DHFS:HFEB	DL:ORB#2
SNorris:ajs	ESylvester	GLapinsky	DVassallo
08/1/84	08/1/84	08/2/84	08/3/84

Mr. J. M. Pilant
Nebraska Public Power District
Cooper Nuclear Station

cc:

Mr. G. D. Watson, General Counsel
Nebraska Public Power District
Post Office Box 499
Columbus, Nebraska 68601

Mr. Arthur C. Gehr, Attorney
Snell & Wilmer
3100 Valley Center
Phoenix, Arizona 85073

Cooper Nuclear Station
ATTN: Mr. Paul Thomason, Division
Manager of Nuclear Operations
Post Office Box 98
Brownville, Nebraska 68321

Director
Nebraska Dept. of Environmental Control
Post Office Box 94877
State House Station
Lincoln, Nebraska 68509

Mr. William Siebert, Commissioner
Nemaha County Board of Commissioners
Nemaha County Courthouse
Auburn, Nebraska 68305

Mr. Dennis DuBois
U. S. Nuclear Regulatory Commission
Resident Inspector
Post Office Box 218
Brownville, Nebraska 68321

U. S. Environmental Protection
Agency
Region VII Office
Regional Radiation Representative
324 East 11th Street
Kansas City, Missouri 64106

John T. Collins
Regional Administrator
Region IV Office
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

H. Ellis Simmons, Director
Division of Radiological Health
Department of Health
301 Centennial Mall, South
Post Office Box 95007
Lincoln, Nebraska 68509

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

SPDS PREIMPLEMENTATION AUDIT RESULTS

INTRODUCTION

All holders of operating licenses issued by the Nuclear Regulatory Commission (licensees) and applicants for an operating license (OL) must provide a Safety Parameter Display System (SPDS) in the control room of their plant. The Commission approved requirements for the SPDS are defined in Supplement 1 to NUREG-0737.

The purpose of the SPDS is to provide a concise display of critical plant variables to control room operators to aid them in rapidly and reliably determining the safety status of the plant. NUREG-0737, Supplement 1, requires licensees and applicants to prepare a written safety analysis describing the basis on which the selected parameters are sufficient to assess the safety status of each identified function for a wide range of events, which include symptoms of severe accidents. Licensees and applicants shall also prepare an implementation plan for the SPDS which contains schedules for design, development, installation, and full operation of the SPDS as well as a design verification and validation plan. The safety analysis and the implementation plan are to be submitted to the NRC for staff review. The results from the staff's review are to be published in a Safety Evaluation Report (SER).

The Nebraska Public Power District (NPPD) requested that the NRC conduct a pre-implementation review of their SPDS design. The results of the staff's design verification audit of the Cooper Station SPDS design are presented below.

SUMMARY

The audit was conducted by the staff during June 12-13, 1984, at the NPPD Headquarters located in Columbus, Nebraska. The audit was held in response

to NPPD's request for a SPDS Pre-Implementation Review, and it was based on the licensee's submittals as presented in Reference 1. Based on the licensee's submittals and the information presented during the audit, the staff concludes that a firm basis has been established for completing the design. If appropriate functional testing is done this program should result in a display system which meets the requirements for an SPDS as stated in NUREG-0737, Supplement 1. The staff has identified additional information that is needed in order to complete the pre-implementation review. Those information needs are summarized at the end of each section.

DISCUSSION

The audit results which follow are organized by general subject area. The branch(es) with primary review responsibility for each subject are are identified parenthetically.

Parameter Selection (Procedures and System Review Branch)

The Safety Parameter Display System (SPDS) uses plant variables available on the Cooper Nuclear Station Plant Management Information System (PMIS). The licensee has identified those parameters to be monitored by the Cooper SPDS in the Safety Analysis submitted on March 1, 1984 (Ref. 1). The safety analysis addresses only the SPDS portion of the PMIS. The bases for the parameters are the safety function requirements stated in NUREG-0737, Supplement 1 and the Emergency Operating Procedure (EOP) information needs as derived from Revision 3G of the BWR Owners Group Emergency Procedure Guidelines. The stated purpose of the Cooper SPDS is to satisfy NRC requirements and support the integration of the SPDS and the EOPs. The staff's preliminary conclusion was that the five Critical Safety Functions in NUREG-0737, Supplement 1 were adequately addressed and that the proposed list of parameters was tentatively acceptable for the stated purpose. It was noted that the proposed list of plant variables (Table 7-1 of the SPDS Safety Analysis) has not been finalized and that the list contained variables

identified as possible future additions to the SPDS. The staff commented that the final list should also reflect anticipated Revisions to the BWR EPGs, to the extent that the information is available, and that staff review would be based on the finalized list of parameters to be available on the Cooper SPDS.

Information Needs:
In order to complete its review of the analytical basis for parameter selection, the staff requests that the licensee submit a finalized list of parameters as well as a discussion of the rationale for any deletions and/or additions to the currently proposed parameter set (Table 7-1 of the Safety Analysis).

Reliability (Instrumentation and Control Systems Branch)

In its presentation the licensee stated that the SPDS is a subsystem of the Plant Management Information System (PMIS) and, as such, shares many characteristics with the PMIS including reliability. It was further stated that the current estimate of availability for the PMIS is 99.85%. This estimate was calculated on available data for hardware components, using the methodology of MIL Standard 217D. The availability of 99.85% did not take into consideration the redundant power supplies, or the final configuration of the uninterruptable power supplies. At the time of the audit, the issue of power to the SPDS was undecided. The staff requested that the final power supply configuration and its impact on the results of the reliability analysis be submitted to NRC for confirmatory review. The licensee stated that after implementation an empirical test of reliability, "the 1,000 hour test," would be performed which would implicitly test the hardware, software, and power supply.

Information Needs:
In order to complete its review of system reliability, the staff requests that the licensee submit: 1) a commitment to provide a highly reliable power

supply system for the SPDS, and a discussion of the power supply system in terms of its impact of total SPDS system reliability (flow charts or diagrams may be helpful); 2) a summary of the reliability report being prepared by Science Applications, Inc. -- this summary should describe both methodology and results; 3) (for confirmatory review, after implementation) the results of the "1,000 hour test."

Electrical and Electronic Isolation (Instrumentation and Control Systems Branch)

NUREG-0737 Supplement 1 requires the SPDS to be suitably isolated from electrical or electronic interference with equipment and sensors that are in use for safety systems. At the time of the audit, the acceptance criteria, test procedures, and test results for the isolation devices were incomplete. However, Nebraska Public Power District (NPPD) is in the process of specifying and procuring the isolation devices to satisfy this requirement. Prior to procurement, Burns & Roe, Inc., will conduct an analysis to determine the maximum credible fault (voltage and current) that the isolator will be exposed to during normal operation. The staff advised NPPD that the credible fault must be applied to the output of the device in the transverse mode (between signal and return) and other faults should be considered (i.e., open and short circuits).

Information Needed:

In order to complete its review of electrical and electronic isolation of the SPDS from safety systems, the staff requests that the licensee submit the certification report being prepared by Computer Products Incorporated (CPI) that discusses the acceptance criteria, testing procedures used to certify proper isolation and the results of that testing.

Display Data Validation (Human Factors Engineering Branch)

The method proposed for display data validation is limit checking, supplemented by redundant sensor checking if more than one sensor is

available. The limit check routine defines data as "good" if the sensor value falls within the engineering range of the variable. Data is defined as "suspect: if it falls beyond the engineering range but within sensor range. "Bad" data is that which falls beyond sensor range (high or low). Analytical redundancy, that is, comparison of a data point with a calculated expected value, is not proposed as a method of data validation. The staff commented that the method of data validation used at Cooper Station is comparable to methods being used by other utilities. However, the staff recommends that NPPD consider the use of analytical redundancy for important parameters that have only one sensor input.

The staff stated that a significant consideration regarding data validation is the method of display of data quality information. The licensee stated that color coding and textual information will be used to identify the quality of the displayed data. Currently, the system will provide nineteen (19) data quality descriptors. The staff commented that all information displayed, including quality codes, should fulfill an operator need. The staff further suggested that there may be a level of detail beyond which information becomes data and the designer must carefully choose whether it is necessary for the operator to have such detailed data or whether detailed data should be summarized at a higher level. The proposed set of 19 data quality descriptors may be just such an example. The staff recommends that the human factors review include consideration of the effectiveness of the proposed display techniques for data quality codes.

Information Needed:

None.

Human Factors (Human Factors Engineering Branch)

The licensee has developed a program to integrate human factors considerations into the SPDS design process. According to the information presented at the audit, the human factors plan consists of the following key

elements: 1) definition of user population, 2) integration of SPDS and procedures, 3) SPDS/control room interface requirements, 4) SPDS user/interface requirements, 5) training considerations, and 6) functional validation.

The human factors consultant, Science Applications, Incorporated (SAI) has provided NPPD with a compendium of human factors guidelines (based primarily on NUREG-0700) to be used "... before, during, and after the design is completed." The design guidelines include guidance on the following topics:

1) generating displays on a cathode ray tube (CRT),

2) CRT-associated equipment,

3) labels, and

4) controls.

When the staff asked about the level of human factors of involvement thusfar, the licensee stated that SAI provided human factors specifications for hardware currently on order or procured. In addition to providing guidelines for use during the design process, SAI will also provide a methodology for reviewing the final SPDS design. This review phase will include the use of a checklist of the design guidelines as well as a questionnaire to define operators' subjective impressions. When questioned about the integration of information from the detailed control room design review (DCRDR) with the SPDS, SAI responded that control room conventions developed during the DCRDR will be used as part of the "compliance checklist" in the final review. In general, the human factors plan seems adequate. The only exception is the apparent lack of emphasis on the sixth "key element" of the program, "functional validation." The staff displayed concern that the program did not provide for full system validation, that is, testing of all elements of the system (hardware, software, training, procedures/manuals, and operators).

The "functional validation" did not seem well-planned at the time of the audit. The staff strongly recommended that some measure of system effectiveness such as man-in-the-loop testing be done to assure that the SPDS provides appropriate information in a readily perceived form and is not misleading to operators. The staff concludes that if the "functional validation" is expanded to include some basis for assuring operator comprehension and ease of use, the proposed human factors program would be acceptable.

Information Needed:

In order to complete its review of the human factors program, the staff requests that the licensee provide documentation providing evidence that the information displayed on the Cooper Station SPDS is readily perceived and does not mislead the operator(s), e.g., results of man-in-the-loop testing, data from BWROG prototype experiments, operational experience with similar systems such as the SAI design at Fermi, etc. In addition, the licensee should provide large format color photographs or reproductions of: 1) all PMIS display pages that are defined as SPDS displays, and 2) all unique display/control hardware interfaces. To the extent displays are not self-evident, a written description should also be provided.

Verification and Validation Program (HFEB, ICSB, PSRB)

The proposed program of independent technical review and evaluation is based on NSAC-39, "Verification and Validation for Safety Parameter Display Systems." The independent review group consists of personnel from SAI-Lynchburg. The staff expressed concern that two areas were not adequately covered in the verification and validation plan or elsewhere. These were 1) validation of parameter selection and 2) validation of system effectiveness. Although the staff admitted that these two areas are generally not explicitly included in a software verification and validation program, they are an implicit part of system validation. According to NSAC-39 (Ref. 2), "Validation is the test and evaluation of the integrated

hardware and software system to determine compliance with the functional, performance, and interface requirements" (emphasis added). The staff had assumed that these areas would be tested by means of man-in-the-loop testing with dynamic, multi-variable inputs simulating transient and accident sequences. The licensee stated that it did not intend to use a full simulator for running transient and accident sequence test cases but rather to conduct individual component performance instrument tests. It was understood that these instrument tests would utilize time dependent algorithms to partially synthesize transient dynamics. The staff expressed a concern with this approach and stated that the portion of its review connected with parameter selection will consist of verifying that all the variables identified in the safety analysis report have been tested with full simulated input unless otherwise justified.

The staff concerns about the need for man-in-the-loop testing are discussed above in the section titled, "Human Factors."

Information Needed:

In order to complete its review of the Cooper Station Verification and Validation Program, the staff requests that the licensee provide: 1) validation test plans and results, and 2) a summary of verification and validation discrepancies and resolutions.

CONCLUSION

Based on the licensee's submittals and on information presented at the time of the audit, the staff concludes that the NPPD program provides a firm basis for developing an acceptable SPDS. If appropriate functional testing is incorporated, the program should result in the implementation of a display system that meets the requirements for an SPDS as stated in NUREG-0737, Supplement 1. Further information is necessary for the staff to complete its review. When that information becomes available, the staff will continue its pre-implementation review of the Cooper Station SPDS.

References

1) Ltr from J. M.Pilant, Nebraska Public Power District, to D. G. Eisenhut, NRC, forwarding three reports re Safety Parameter Display System, March 1, 1984.

2) NSAC-39, "Verification and Validation for Safety Parameter Display Systems, December, 1981, E. A. Straker.