Wayne H. Jens
Vice President
Nuclear Operations

Detroit Edison

2000 Second Avenue
Detroit, Michigan 48226
(313) 586-4150

April 18, 1984
EF2 - 67,808

Director of Nuclear Reactor Regulation
Attention: Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Youngblood:

Reference: (1) Fermi-2
NRC Docket No. 50-341

(2) Letter, D. Eisenhut to all Licensees and Applicants for Operating Licenses, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability (Generic Letter 82-33)", dated December 17, 1982

(3) Letter, H. Tauber to B. J. Youngblood, "Response to Supplement 1 of NUREG-0737", dated April 15, 1983

Subject: Safety Parameter Display System (SPDS) Safety Analysis

This letter transmits the SPDS safety analysis for Fermi-2. This analysis provides the documentation required in Section 4.2.a of Reference (2) and is submitted for NRC review in accordance with the schedule provided on Page 7 of Reference (3).

If you have any questions regarding the enclosed safety analysis, please contact Mr. O. Keener Earle, (313) 586-4211.

Sincerely,

Wayne H Jens.

cc: Mr. P. M. Byron
Mr. M. D. Lynch

A005
1/1

Enclosure
EF2-67808

SPDS Safety Analysis (Parameter Selection)
NUREG-0737, Supplement 1

One of the many modifications recommended as an aftermath of Three Mile Island (TMI-2) was the addition of a Safety Parameter Display System (SPDS) in the control room. Industry and NRC reports generally describe the SPDS as a concise display of important plant parameters to aid operating personnel in the assessment of abnormal conditions. Recent NRC guidance on SPDS is contained in Supplement 1 to NUREG-0737 and is interpreted as being the prevailing guidance if inconsistencies exist with other documents.

Supplement 1 to NUREG-0737 provides guidance on emergency response capabilities with Section 4 specifically addressing SPDS. Section 4.2.a requests licensees submit a written safety analysis describing the basis on which the selected parameters are deemed sufficient to assess the safety status of each of the identified functions. The purpose of the following analysis is to satisfy this NRC requirement.

REFERENCES

1. NUREG-0737, "Clarification of TMI Action Plan Requirements."

2. NUREG-0696, "Functional Criteria for Emergency Response Facilities"

3. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability"

4. Letter from H. Tauber (Detroit Edison) to B. Youngblood (NRC), "Response to Supplement 1 to NUREG-0737", dated April 15, 1983

5. NUREG-0835 (Draft), "Human Factors Review Guidelines for Safety Parameter Display Systems, Draft.

6. Letter from T. Dente (BWR Owners' Group) to D. Eisenhut (NRC), "NEDO-24934, Emergency Procedure Guidelines, BWR 1/6, Revision 2", dated June 1, 1982

7. Letter from D. Eisenhut (NRC) to T. Dente (BWR Owners' Group), "Safety Evaluation Report on Emergency Procedure Guidelines, Revision 2, NEDO-24934, June 1982", dated February 4, 1983

8. NUREG-0798, Supplement 1, "Safety Evaluation Report for Fermi-2", Docket 50-341

9. ALO-1003, "BWR Graphic Display System Dynamic Screening Program", printed February 1982

10. ALO-1019, "Simulator Evaluation of Boiling Water Reactor Owners' Group (BWROG) Graphic Display System (GDS)", printed May 1983

11. NSAC-21, "Fundamental Safety Parameter Set for Boiling Water Reactors", December 1980

SPDS PURPOSE

The purpose of the SPDS is to be an operator aid. The SPDS provides a concise display of critical plant variables to control room personnel to aid them in rapidly and reliably determining the safety status of the plant. The SPDS has the capability to provide: associated parameters on a single display; variable versus variable plots for emergency operating procedure limit curves; provide trending; and provide other features that complement the existing control room information available to the operator. However, the SPDS provides information only and it is intended that the operator confirm readings with existing control room instrumentation.

CRITICAL SAFETY FUNCTIONS/PARAMETER SELECTION

The SPDS monitors plant parameters or derived variables representative of the safety status of the plant. The parameters for the SPDS were selected based on industry guidance which identified critical safety functions and parameters which should be monitored, and a multi-discipline Fermi-2 group review of SPDS displays.

The Fermi 2 SPDS is based on the Graphic Display System (GDS) developed by the BWR Owner's Group Control Room Improvement Committee. The GDS display format contains critical safety functions for reactivity, core cooling, reactor coolant system integrity, containment system integrity and radioactive effluent to the environment. These safety functions parallel industry guidance such as NUREG-0696, NSAC-21 and Supplement 1 to NUREG-0737 which states:

"4.2.f. The minimum information to be provided shall be sufficient to provide information to plant operations about:

(i) Reactivity control
(ii) Reactor core cooling and heat removal from primary system.
(iii) Reactor coolant system integrity
(iv) Radioactivity control
(v) Containment conditions

The specific parameters to be displayed shall be determined by the licensee."

The primary variables which address industry guidance are identified below.

a. Reactivity. The primary variables used to monitor reactivity are provided by existing neutron monitoring instrumentation. APRMs provide data on reactor power and SRMs monitor subcriticality.

b. Core cooling. The primary variable used to monitor core cooling is reactor water level as provided by existing level instrumentation. Table 1 identifies the various level instruments used to monitor vessel level. Another SPDS parameter which may be used to complement the water level information for assessment of core cooling is RPV pressure data.

c. Reactor coolant system integrity. This parameter is assessed by monitoring reactor pressure, drywell pressure, drywell floor drain sump level, and RPV isolation. In addition, radiation monitors identified in Table 1, and used to support other SPDS displays, may be used to determine the integrity of the reactor coolant system.

d. Containment integrity. This parameter is assessed by measuring drywell and torus pressure, containment isolation status, combustible gas level, suppression pool temperature, torus level and drywell temperature.

e. Radioactivity effluent to environment. This parameter is assessed by monitoring the radioactivity at planned plant release points. Table 1 identifies radiation monitors which relate information on radiation levels within the plant structures (e.g., containment, reactor building).

Table 1 provides a list of parameters associated with the Fermi 2 SPDS. Emergency Procedure Guidelines (EPGs) have been developed by the BWR Owner's Group and have been submitted to and reviewed by the NRC (References 6 and 7). The EPGs are symptom based and are provided to improve the operators ability to mitigate the consequences of a broad range of initiating events and subsequent multiple operator errors. The Fermi 2 Emergency Operating Procedures (EOPs) were based on the EPGs and have been deemed adequate by the NRC (Item I.C.8 of Reference 8). The EOPs identify entry conditions and contain parameter versus parameter limit curves. The SPDS includes the EOP limit curves and parameter information which is supportive of determining entry conditions.

The SPDS displays are comprised of an overview display, critical safety function displays (generally a bar and/or trend) and

the EOP limit curves. The proposed SPDS displays were reviewed by a multi-discipline group composed of persons knowledgeable in the areas of system design, human factors, instrumentation and operations. Typical display formats for an EOP limit curve and bar chart are being incorporated into the Fermi 2 FSAR (Item H.III.A.1.2, Upgrade Emergency Support Facilities).

DESIGN ANALYSIS

The graphics provided to the operator by the SPDS are one of the man-machine interfaces to a computer based data acquisition, processing and display system. The system acquires both digital and analog inputs from field sensors and computer data links with monitoring and control systems throughout the plant. System design features for reliability, signal isolation, seismic requirements, signal validation and human factors have been incorporated, as discussed below, to ensure the goal of SPDS in assisting the operator.

The SPDS function is intended to be highly reliable. A dual computer system has been designed with automatic throwover for various conditions. Uninterruptible power has been provided to components essential to the operation of the computer system. The computer room air conditioning system has been redesigned to enhance the reliability of the computer system. Spare parts inventories have been provided and plant personnel have been trained to maintain the hardware and software of the system.

Existing signal loops of monitoring and control systems were tapped to provide inputs for the SPDS. The isolation requirement for analog safety-related circuits was provided by using a qualified modulator isolator for each circuit and a demodulator card in the data acquisition system. Dry contact inputs were provided for digital inputs. Additionally, computer links have been provided to other plant data systems. Engineering has been completed in accordance with applicable design criteria to ensure that the SPDS cannot adversely affect safety-related systems.

The requirements for the SPDS do not include seismic qualification. However, the structural integrity and mountings for the cabinets in the relay and computer rooms and the display generators/terminals in the control room operator console have been evaluated to ensure they do not adversely affect safety-related components in a sesmic event.

Signals for the SPDS are processed and validated to prevent misleading the operator. Redundant input signals are used for selected parameters and comparison limits are performed for validation. Additional information processing is performed for analog, digital and derived parameters and include the following:

- Sensor range limit checks
- Conversion to engineering units
- Validation routine processing
- On-line diagnostics for transmission
- Time tagging of data

Factory performance tests were conducted to validate the SPDS. These tests were completed at the vendor's facilities before shipment to the Fermi 2 site. The site acceptance testing includes repetition of many of these factory performance tests and validation of the SPDS system from field sensors to display.

The SPDS design incorporates human factors engineering guidance. The operator's interface with the displays and keyboard have been designed to provide easily accessed and readily understood displays. The BWR Owner's Group Control Room Improvements Committee developed the initial Graphic Display System (GDS) in a program which had extensive human factors evaluation. The program included development and dynamic screening of the GDS and later a simulator evaluation of the displays by operators. The dynamic screening and simulator evaluation are discussed in references 9 and 10, respectively. The Fermi 2 SPDS includes many features of the GDS, and has incorporated most of the recommendations from the findings of the simulator evaluation. Some of the human factors criteria which were considered in the SPDS design were:

- Use of color, shape, size and location of coding
- Single stroke key access of displays
- Grouping by function
- Protection/Authorization of changes
- Labeling, scaling and readability
- User review of displays
- Scan rate of inputs
- Response time to requests
- Development of a User's manual
- Minimization of reflection and glare
- Selection of font
- Data presentation formats
- Screen layout

SUMMARY

The Fermi 2 SPDS has been designed with a cognizance of industry and NRC guidance and represents a substantial good faith effort to meet the criteria of Supplement 1 to NUREG-0737. SPDS design requirements with regard to parameter selection, isolation, signal validation and human factors engineering have been analyzed. The critical safety function

based, and EOP-related, selected parameters are sufficient to assess the safety status of the indentified functions for a wide range of events, which include symptoms of severe accidents. The installation of SPDS does not represent an unreviewed safety question or a change to the draft Fermi 2 Technical Specifications.

Enclosure
EF2-67.808

TABLE 1
Parameters Associated With SPDS Displays

- Reactor Water Level
  - Wide Range Div I
  - Wide Range Div II
  - Narrow Range Div I
  - Narrow Range Div II
  - Fuel Zone Range Div I
  - Fuel Zone Range Div II
  - Shutdown Range
- Reactor Pressure
  - Wide Range Div I
  - Wide Range Div II
  - Dome Pressure Wide Range
  - Dome Pressure Narrow Range
- Neutron Monitoring

APRM A	SRM A
APRM B	SRM B
APRM C	SRM C
APRM D	SRM D
APRM E	
APRM F	

- Main Steam Line Radiation
- Containment High Range Rad Mon Div I
- Containment High Range Rad Mon Div II
- Drywell Pressure
  - Wide Range Div I
  - Wide Range Div II
  - Narrow Range Div I
  - Narrow Range Div II
- Primary Containment 02 Level Div I
- Primary Containment 02 Level Div II
- Torus Water Level Wide Range
- Suppression Pool Temperature
- Drywell Temperature
- Fuel Pool Div I Rad Mon A
- Fuel Pool Div I Rad Mon C
- SJAE Radiation Mon A
- SJAE Radiation Mon B
- Drywell Floor Drain Sump Level
- Main Steam Line Isolation Valve Status
- Safety Relief Valve Status
- SGTS Exhaust Fan Div I Status
- SGTS Exhaust Fan Div II Status
- Turbine Bldg Exhaust Fan Status
- Radwaste Bldg Exhaust Fan Status
- Reactor Bldg Exhaust Fan Status
- Gaseous Effluent Radiation Monitors
  - SGTS Div I Exhaust
  - SGTS Div II Exhaust
  - Reactor Bldg Exhaust
  - Radwaste Bldg Exhaust
  - Turbine Bldg Exhaust