Attachment to JPN-84-79

NEW YORK POWER AUTHORITY

James A. FitzPatrick Nuclear Power Plant

Safety Parameter Display System

Parameter Safety Analysis

Docket No. 50-333

November 30, 1984

1.0. INTRODUCTION

As a result of the Three Mile Island (TMI) nuclear power plant accident on March 28, 1979, and the subsequent studies of needed improvements to nuclear power plant safety, the Nuclear Regulatory Commission (NRC) and the nuclear industry identified the need for a Safety Parameter Display System (SPDS). The SPDS will provide a concise display of critical plant variables to the control room operators to aid them in rapidly and reliably determining the safety status of the plant. The SPDS is in addition to the control room instrumentation required by General Design Criteria 13 and 19 of Appendix A to 10 CFR 50, which provides the operators with the information necessary for safe reactor operation under normal, transient, and accident conditions. The SPDS, therefore, provides an improvement to the control room as it enhances the operator's ability to access plant conditions and interact in situations that require human intervention.

Supplement No. 1 to NUREG-0737, "Requirements for Emergency Response Capability," transmitted in NRC Generic Letter No. 82-33 (Reference 1), provides the NRC requirements for an SPDS. These requirements are a distillation of the basic requirements from previously issued NRC guidance documents (e.g. Reference 2,3, and 4). To meet the NRC requirements for an SPDS at the James A. FitzPatrick Nuclear Power Plant (JAFNPP), the Authority has developed a totally integrated system concept that combines the SPDS and plant process computer functions (including NSSS and BOP), and also provides supplementary operator aid functions in a single system known collectively as the Emergency and Plant Information Computer (EPIC) system. Reference 5 provides information on the JAFNPP SPDS/EPIC system and how it is being implemented by the Authority.

The purpose of this SPDS Parameter Safety Analysis is to document the basis on which the selected SPDS parameters are both necessary and sufficient to assess the safety status of each of the critical safety functions (i.e., reactivity, core cooling, heat removal, reactor coolant system integrity, primary containment, secondary containment, and radioactivity control) for a wide range of events, including those which are symptomatic of severe accidents. Section 2.0 of this safety analysis provides the basis used to select the JAFNPP SPDS parameters. Section 3.0 describes the critical safety functions and the JAFNPP SPDS parameters selected.

This SPDS Parameter Safety Analysis addresses the technical basis of the SPDS parameters as required by Reference 1. The human factor aspects of the SPDS display design will be separately documented and provided following completion of the on-going JAFNPP SPDS display development.

2.0 BASIS OF THE SPDS PARAMETER SELECTION

The JAFNPP Safety Parameter Display System (SPDS) will consist of a single, top-level, concise display of critical plant variables required to verify the safety status of the plant. Some of the variables will be summarized to facilitate a concise display.

In addition to the top-level display, other mid and lower level displays will be available to support corrective actions by control room personnel during abnormal and emergency conditions. Also, the JAFNPP EPIC system is replacing the existing plant process computer and will perform supplementary operator aid functions (e.g., alarm logs, various operator message logs, two-parameter plots, plant mimic/process-flow graphics). All together the EPIC system will receive approximately 2200 inputs from plant sensors. Only a small subset of these comprise the necessary and sufficient set of parameters required for the SPDS function.

The FitzPatrick SPDS Parameters are those plant parameters associated with each FitzPatrick Emergency Operating Procedure (EOP) entry condition. (These entry conditions are clearly identified at the beginning of each EOP.) These parameters are the same concise, critical plant variables required by the control room operators to determine the safety status of the plant.

The basis for this position are Supplement No. 1 to NUREG-0737 (Reference 1) concerning SPDS and Emergency Operating Procedures, NUREG-0899 (Reference 6) concerning symptom-oriented EOPs, JAFNPP Emergency Operating Procedures, and the NRC Safety Evaluations of the "Emergency Procedure Guidlines", Revisions 2 and 3 (Reference 7 and 8).

a. Supplement No. 1 to NUREG-0737 (Reference 1)

Reference 1 states that the SPDS should provide a concise display of critical plant variables to the control room operators to aid them in rapidly and reliably determining the safety status of the plant. The SPDS is intended to supplement and be in addition to, not instead of, the control room instrumentation required by General Design Criteria 13 and 19 of Appendix A to 10 CFR 50 that provides all the information necessary for safe reactor operation under normal, transient, and accident conditions. Thus, the SPDS provides an improvement to the control room by concentrating and displaying the necessary and sufficient critical plant data so that the operator can quickly assess and evaluate the plant safety status and detect abnormal operating conditions.

While supplement No. 1 to NUREG-0737 and its predecessor documents provide general guidelines for SPDS parameters, determining the specific SPDS parameters has been left up to the individual utilities for their specific plants. The only specific basis provided by the NRC is that the SPDS parameters shall be sufficient to provide information to plant operators concerning:

- Reactivity Control
- Reactor Core Cooling and Heat Removal from the Primary System
- Reactor Coolant System Integrity
- Radioactivity Control
- Containment Conditions

Supplement No. 1 also specified that Emergency Operating Procedures be symptom-oriented and will improve the ability to mitigate the consequences of a broad range of initiating events and multiple failures. In addition, technical guidelines are to be prepared after re-analyzing transients and accidents. These analyses will identify operator tasks and information and control needs and will serve as the basis for integrating upgraded emergency operating procedures and SPDS design.

b. NUREG-0899 (Reference 6)

NUREG-0899 defines a safety function as a function specifically required to keep the plant in a safe condition so that public health and safety will not be endangered. Additionally, NUREG-0899 explains that symptom - oriented EOPs provide the operator guidance on how to verify the adequacy of critical safety functions and how to restore and maintain these functions when they are degraded.

c. NRC Safety Evaluation of Boiling Water Reactor Emergency Procedure Guidelines Revisions 2 and 3, (References 7 & 8)

References 7 and 8 found the Emergency Procedure Guidelines (EPGs) acceptable for implementation, although some minor issues remain unresolved. References 7 and 8 agree that the entry conditions for the EPGs are symptomatic of both emergencies, and events which may degrade into emergencies and that the EPGs are designed to cover all emergency situations including Anticipated Transients Without Scram (ATWS). Therefore, small-break LOCA, large-break LOCA, transients with no or multiple failures, and inadequate core cooling are all addressed by the EPGs.

d. JAFNPP Emergency Operating Procedures (EOPs)

The JAFNPP EOPs are based on Revision 3B of the generic BWR EPGs. The entry conditions for both revision 3 and revision 3B are the same, and provide the critical variables which are monitored for determining the safety status of the plant. At present, the JAFNPP EOP entry conditions are also the same, but may change slightly as a result of the final issuance of the generic EPGs and any future work. Table 2.1 provides a list of these entry conditions which are by definition the SPDS parameters.

Table 2.1

SPDS Parameters (and Emergency Operating Procedure Entry Variables)

SPDS Parameter	EOP & EPG Variable
1) RPV Water Level	RPV Low Level
2) RPV Pressure	RPV High Pressure
3) (Note 1)	MSIV Isolation required
4) Reactor Power (APRM) and RPS Channel Activation	Reactor scram required and either power above APRM downscale trip or power undetermined.
5) Drywell Pressure	Drywell Pressure High.
6) Drywell Temperature	Drywell Temperature High.
7) Suppression Pool Water Level	Suppression Pool Water Level High/Low.
8) Suppression Pool Water Temperature	Suppression Pool Water Temperature High
9) Secondary Containment Differential Pressure	Secondary Containment Differential Pressure High.
10) Secondary Containment Area Temperatures	Secondary Containment Area Temperature High.
11) Secondary Containment Unit Cooler Temperatures	Secondary Containment Unit Cooler Temps. High (Note 2).
12) Secondary Containment Area Radiation Levels	Secondary Containment Area Radiation Levels High.
13) Secondary Containment Area Water Levels	Secondary Containment Area Water Levels High.
14) Secondary Containment Floor Sump Levels	Secondary Containment Floor Sump Levels High.
15) Secondary Containment Exhaust Ventilation Radiation	Secondary Containment Vent. Radiation Levels High (Note 2).
16) Air Ejector Off Gas Radiation	Air Ejector Off Gas Radiation High (Note 3).
17) Turbine Building Exhaust Ventilation Radiation	Turbine Building Vent Radiation High (Note 3).

3.0 SPDS PARAMETERS

This section provides additional justification for the JAFNPP SPDS parameters that have been selected to meet the NRC requirements and support the JAFNPP Emergency Operating Procedures.

The SPDS parameters have been organized to verify the status of those critical safety functions identified by the Emergency Procedure Guidelines (EPGs) and addressed in the JAFNPP Emergency Operating Procedures (EOPs). These guidelines which were approved by the NRC in References 7 and 8 are as follows:

a) Reactor Pressure Vessel Control
b) Primary Containment Control
c) Secondary Containment Control
d) Radioactivity Release Control

These guidelines also encompass all those safety functions identified in Section 4.1.f of Supplement No. 1 to NUREG-0737; i.e.:

a) Reactivity Control
b) Reactor Core Cooling and Heat Removal from the Primary System
c) Reactor Coolant System Integrity
d) Radioactivity Control
e) Containment Conditions

Table 3.1 classifies each FitzPatrick SPDS parameter into one of the above categories.

The Reactor Pressure Vessel Control Guideline provides the operator with sufficient direction to maintain adequate core cooling, shut down the reactor and cool down the RPV to cold shutdown conditions. The guideline requires the monitoring of the following parameters to determine the safety status of the plant and the need for operator actions: RPV water level, RPV pressure, primary containment pressure, average power range monitor level if scram required and MSIV isolation, (which has been deleted in a subsequent revision to the EPGs and will not be a SPDS parameter). Collectively, these parameters monitor the functions of core cooling, reactivity control, heat removal, and reactor coolant system integrity.

The Primary Containment Control Guideline provides the operator with sufficient direction to maintain primary containment integrity, protect equipment in the primary containment, and maintain the capability for heat removal. The guideline requires the monitoring of the following parameters to determine the safety status of the plant and the need for operator actions; suppression pool level, suppression pool temperature, drywell pressure and drywell temperature. Collectively, these parameters monitor the functions of reactor coolant system integrity, primary containment conditions, heat removal, and core cooling capability.

The Secondary Containment Control Guideline protects equipment in the secondary containment, limits radioactivity release to the secondary containment and either maintains secondary containment integrity or limits radioactivity release from the secondary containment. The guideline requires the monitoring of the following parameters to determine the safety status of the plant and the need for operator action; secondary containment temperatures (area, and unit cooler inlet), secondary containment radiation levels (area, and ventilation exhaust), secondary containment water levels (floor drain sumps and area levels), and secondary containment differential pressure. Collectively, these parameters monitor the functions of reactor coolant system integrity, radioactivity control and secondary containment conditions.

The Radioactivity Release Control Guideline provides the operator with sufficient direction to limit radioactivity release into areas outside the primary and secondary containments. This guidelines requires the monitoring of the following parameters to determine the safety status of the plant and the need for operator actions; Turbine Building, Secondary Containment and Radwaste Building ventilation exhaust radiation levels; and, the air ejector off gas radiation levels. Collectively, these parameters monitor the function of radioactivity control.

TABLE 3.1

FitzPatrick SPDS Parameters

Classified by Supplement No. 1 to NUREG-0737 Minimum Information

(i) Reactivity Control

- Reactor Power (APRM) & RPS Channel Activation
- RPV Pressure
- RPV Water Level

(ii) Reactor Core Cooling and Heat Removal from the Primary System

- RPV Water Level
- RPV Pressure
- Suppression Pool Water Level
- Suppression Pool Water Temperature
- Drywell Temperature
- Drywell Pressure

(iii) Reactor Coolant System Integrity

- Drywell Pressure
- Drywell Temperature
- Suppression Pool Water Temperature
- Secondary Containment Differential Pressure
- Secondary Containment Area Temperatures
- Secondary Containment Unit Cooler Temperature
- Secondary Containment Area Radiation Levels
- Secondary Containment Area Water Levels
- Secondary Containment Floor Sump Levels
- RPV Water Level
- RPV Pressure

(iv) Radioactivity Control

- Radwaste Building Exhaust Ventilation Radiation
- Turbine Building Exhaust Ventilation Radiation
- Secondary Containment Exhaust Ventilation Radiation
- Air Ejector Off Gas Radiation

(v) Containment Conditions

- Drywell Pressure
- Drywell Temperature
- Secondary Containment Differential Pressure
- Secondary Containment Area Temperatures
- Secondary Containment Unit Cooler Temperatures
- Secondary Containment Area Radiation Levels
- Suppression Pool Water Level
- Suppression Pool Water Temperature
- Secondary Containment Area Water Level
- Secondary Containment Floor Sump Level

4.0 REFERENCES

1. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability "(Generic Letter No. 82-83, dated December 17, 1982).

2. NUREG-0696, "Functional Criteria for Emergency Response Facilities," February, 1981.

3. NUREG-0814, "Methodology for Evaluation of Emergency Response Facilities," August, 1981.

4. NUREG-0835, "Human Factors Acceptance Criteria for SPDS," October, 1981

5. NYPA SPDS/EPIC Implementation Plan dated November 30, 1984.

6. NUREG-0899 "Guidelines For The Preparation of Emergency Operating Procedures," August, 1982.

7. NRC Safety Evaluation of "Emergency Procedure Guidelines, Revision 2," NEDO-24934, June, 1982; dated February 4, 1983.

8. NRC Safety Evaluation of "Emergency Procedure Guidelines, Revision 3" dated November 23, 1983.