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February 1, 1985

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Office of Nuclear Reactor Regulation
Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing

References:
(a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, FVY 83-30, dated April 19, 1983
(c) Letter, VYNPC to USNRC, FVY 83-85, dated August 4, 1983
(d) Letter, VYNPC to USNRC, FVY 83-90, dated August 12, 1983
(e) Letter, USNRC to VYNPC, NVY 84-128, dated June 12, 1984, "Issuance of Order Confirming Licensee Commitments on Emergency Response Capability"
(f) Letter, VYNPC to USNRC, FVY 84-127, dated October 30, 1984, "NUREG-0737, Supplement I - Regulatory Guide 1.97"
(g) EPRI Document NP-3701, dated September 1984 and entitled, "Computer Generated Display System Guidelines"

Dear Sir:

Subject: Safety Parameter Display System

In previous correspondence [References (b), (c), and (d)], Vermont Yankee provided an integrated plan and schedule for addressing the concerns detailed in NUREG-0737, Supplement I, "Requirements For Emergency Response Capability." This overall integrated approach resulted in mutually acceptable program plans for the Emergency Operating Procedures, the Detailed Control Room Design Review, the Regulatory Guide 1.97 Assessment, and a new Emergency Response Facility. Each of these integrated tasks has provided meaningful contributions to the finalization of the Safety Parameter Display System (SPDS) design, the major features of which are described in the enclosed report.

At the present time we have also completed an evaluation of the existing plant computer and its peripheral equipment for suitability to perform the SPDS task. Memory limitations, data trend, expansion, communication, Off-Line calculation, a lack of CRT Compatibility, and approaching computer obsolescense problems have been identified. It is our belief that SPDS and replacement of

our plant process computer are dependent tasks which will share common components and must proceed concurrently. The existing General Electric supplied Honeywell GEPAC-4020 must be maintained available to support the plant through the next two refueling outages, but will be phased out in a series of equipment upgrades. Our overall schedule is to complete Phase I during the Refueling Outage in 1987 and complete Phase II during the 1988 Refueling Outage. The SPDS installation would be completed concurrent with Phase II.

As committed to in References (c) and (f), the enclosed functional Safety Analysis Report (SAR) provides the Vermont Yankee SPDS design approach, major safety functions and parameters and SPDS implementation schedule. We have elected to follow a design and procurement process similar to that presented in Reference (g) and intend to integrate the SPDS with other related tasks, including NUREG-0737, Supplement I, the replacement of our plant process computer, and future scheduled plant outages. We believe we have established a schedule and program that is both reasonable and consistent with other utilities regarding SPDS and plant process computer replacement.

Should you have any questions on this matter we would be pleased to answer them.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Warren P. Murphy
Vice President and
Manager of Operations

WPM/ss

Enclosure

FUNCTIONAL

SAFETY PARAMETER DISPLAY SYSTEM

(SPDS)

SAFETY ANALYSIS REPORT

FOR

VERMONT YANKEE
NUCLEAR POWER CORPORATION

JANUARY 1985

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SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

The primary purpose of the Vermont Yankee Safety Parameter Display System (SPDS) will be to provide a concise display of Critical Safety Function parameters (CSF) to station operating personnel. The SPDS will graphically display plant variables and computer derived displays to operating personnel and aid them to reliably and rapidly determine the safety status of the plant. It will be operated during both normal and abnormal plant conditions. However, the principal purpose and function will be to aid personnel during abnormal and emergency conditions. Control room personnel may use the displays to determine the plant status and assess whether abnormal conditions warrant corrective action to avoid core degradation. The SPDS is expected to fulfill the information requirements for the Technical Support Center (TSC), and the Emergency Off-site Facility (EOF) under construction in Brattleboro. The TSC will share the full capabilities of the SPDS and have the ability to call-up the same process variable and display information as the control room. The EOF will be able to access derived data on high speed peripheral printers but may not have CRT graphic displays.

The SPDS design approach at Vermont Yankee will be to monitor CSF parameters derived from the BWR Owner's Group (BWROG) Emergency Procedure Guidelines (EPG's), the Vermont Yankee specific Emergency Operating Procedures (EOP's) and the integration of other concurrent NUREG 0737 mandated activities. Vermont Yankee has maintained a continuing dialogue with the USNRC on progress in the matters of EOP's, Regulatory Guide 1.97, EOF siting plans, the completed TSC, the Detailed Control Room Design Review (DCRDR), and the Procedures Generation Package (PGP). Integration of all of these activities will be factored into the SPDS specification activity.

The SPDS will be designed to interact with existing signals within the control room, gather data from diverse sources and present integrated cohesive video displays which will aid operating personnel to track process events. The SPDS will not be designed for any control function, but will be capable of monitoring plant analog and digital signals, calculated value and time-trend plot displays. The information displays will be capable of tracking reactivity control, reactor core cooling and heat removal, reactor coolant system integrity, radioactivity control and drywell and secondary containment conditions. The SPDS design, in concert with the EOP's, will provide operating personnel with valid process information so they can concentrate on the resolution of any unusual plant condition. The control room Class 1E electrical and electronic equipment remain as the key displays and will remain as the only control points available to the station operators. The SPDS will be available to the Shift Engineers (STA's) to monitor overall plant conditions and to track the plant response to the actions of station operators.

SPDS software and firmware available within the BWROG will be evaluated and utilized. The BWROG display concepts modified to meet plant specific needs will dictate the programming efforts. A determination of these needs is currently in progress.

The SPDS input sources will be predominantly Class 1E electrical safety circuits. The computer and most of its peripherals except the DAS signal input circuit isolation boards will be acquired from competent commercial sources of non-Class 1E non-seismic equipment. Class 1E signals to DAS equipment interfaces will be appropriately qualified. Manufacturers of the DAS I/O circuitry and cards will have to qualify their apparatus which interacts with plant Class 1E circuits to equipment qualification criteria imposed by Vermont Yankee.

A duplicate display of the Control Room SPDS will be located in the Technical Support Center (TSC). This will improve the operational aids available to the TSC staff and assist them in evaluating transient conditions and providing guidance and direction to the plant operating personnel. Also, the Emergency Off-Site Facility (EOF) under construction in Brattleboro will have access to the SPDS to meet information requirements via hard copy high speed peripheral printers.

The SPDS will be designed to be an aid to operating personnel. All of the parameters available for display on the SPDS are also located in the main control room. The existing control room instruments are the information sources the operator has been trained to use. They are currently being further verified by the EOP and DCRDR program plans. The SPDS displays and trending capabilities will assist the Shift Supervisor in evaluating the adequacies of his instructions to the operators.

The major features of the Vermont Yankee SPDS are described in more detail in the following sections.

SECTION 2.0

DISPLAYS

2.0 DISPLAYS

The Vermont Yankee SPDS will be equipped with two or more color graphic display monitors. One or two will be located in the Control Room (CR) and one in the Technical Support Center (TSC). Each monitor will have a keyboard which instructs the SPDS to produce the desired display on that monitor. The SPDS will also have connections which allow off-site access to SPDS information via hard copy high speed peripheral printers.

The Vermont Yankee SPDS will be specified with as many as thirty specific displays that are available at each of the color graphic monitors. Each one may be called up on any monitor. The SPDS displays will be designed to monitor CSF parameters derived from the BWROG Emergency Procedure Guidelines, the Vermont Yankee specific Emergency Operating Procedures, and the integration of other concurrent NUREG 0737 activities. A tentative listing of the displays is shown on Table 2.1. A similar listing of the process instrumentation signals, both Class 1E and non-1E sources is detailed in Table 2.2 and 2.3. These listings are subject to change as vendor selection and industry experience develop.

The SPDS displays may be either graphic in nature in the form of X-Y axis displays with a time-history plot of CSF multiple parameter overlays or a graphical presentation of a single point time trend history. The displays will alert the viewer that an alarm status change has occurred. Acknowledgement of the altered signal status will be required to ensure the man-machine interface is transacted whenever an alarm condition occurs. It will be the design intent to collect appropriate control room display data within the SPDS in a family of cohesive displays. The SPDS will be designed to be incapable of any process control tasks. Control tasks remain at their present panel board locations. Human factors engineering and task coordination will be prudently applied so coordinated SPDS information graphics and reports will enhance the operators tasks.

Vermont Yankee will acquire proven, user maintainable software program routines, so that future alteration is possible if it is required. The graphic displays may be direct or derived data displays which combine calculated input data sources into a special display. An example would be pressure-temperature reactor vessel conditions coupled with a steam table enthalpy calculated from a programmed algorithm. Rate of change alarms, preferred warm-up and cool-down metal temperature rates would be examples of calculation routines.

TABLE 2.1

TENTATIVE
LISTING OF SPDS GRAPHIC DISPLAYS

DISPLAY	TITLE	NOTE 1
1	RCS Summary	-
2	Pressure vs Temperature	-
3	Emergency Operating Procedures	-
4	Trend Plot	-
5	RCS Integrity	iii
6	Reactivity Neutron Flux	i
7	Residual Heat Removal	ii
8	High Pressure Coolant Injection	ii
9	Low Pressure Coolant Injection	ii
10	Core Spray	ii
11	Standby Liquid Control	i
12	Reactor Vessel Inventory	ii
13	Primary Containment Integrity	v
14	Secondary Containment Integrity	-
15	Electric Supply	ii
16	Isolation Valve Status	v
17	Traveling In-Core Probes, IRM, SRM, APRM	i
18	Rod Control & Position	i
19	Torus Conditions	ii
20	Radioactivity: Steam Tunnel, Standby Gas, Coolant High Range Drywell, etc.	- iv
21 - 30	Unassigned	

NOTE: CFS designator i, ii, iii, iv, and v refer to NUREG 0737, Supplement 1, paragraph 4.1f, Critical Safety Function Parameters. See Table 2.2 for inputs.

TABLE 2.2

SPDS INPUTS
REG. GUIDE 1.97: CATEGORY 1 AND 2
INSTRUMENTED PROCESS VARIABLES

(i) REACTIVITY CONTROL

Neutron Flux

(ii) REACTOR CORE COOLING & HEAT REMOVAL

RV Press
RV Lev
RV Ref Leg Temp
Torus Press
Torus Wat Temp
Torus Wat Lev
Torus Air Temp
PRI Relief ADS Pos
RCIC Flow
HPCI Flow
Core Spray Flow
LPCI Flow
SLC Press
SLC Lev
RHR Flow
RHR Ht.x Temp
Power Source(s)

(iii) REACTOR CCOLANT SYSTEM INTEGRITY

Drywell Press
Drywell Sump Lev
Torus Wat Lev
RCS Pressure

(iv) RADIOACTIVITY CONTROL

Drywell Rad
Standby Gas

(v) CONTAINMENT CONDITIONS

Drywell Press
Drywell Temp
PRI CTMT Isol Val Pos
RCS Press
PRI CTMT Press
CTMT/Drywell H_2 Conc
Supp Pool Lev
Supp Pool Temp
Drywell Environ Temp
Drywell Spray Flow
CTMT/Drywell O_2 Conc
Supp Spray Flow

TABLE 2.3

SPDS INPUTS

(Extracted from FVY 82-12, dated 2/12/82)

PARAMETER/No. OF CHANNELS

APRM Power
SRM Countrate
IRM Percent Range
Rx Water Level
Rx Pressure
Control Rod Position
Recirc Drive Flow A&B
CRD Flow
Feedwater Flow A&B
Steam Flow
CST Volume
Torus Level
RHR Hx Inlet/Outlet Temp. A&B
Drywell Pressure
Drywell-Torus Delta Press
Torus Water Temp
Drywell Area Temp
Reactor Bldg. Atmospheric Delta Press
ARM
Stack Gas Flow Rate
Off-Gas Flow
Off-Gas Activity
Stack Gas Activity
Rx. Bldg. Ventilation Monitor
Refuel Floor High Rad. ARM
Containment Rad. Monitor
Containment Act. Monitor
Wind Speed
Wind Direction
Upper/Lower Delta Temp
Rx Temp. Recirc Loop Inlet A&B

SECTION 3.0

SPDS ALARMS

3.0 SPDS ALARMS

The major emphasis during the definition of the SPDS alarms will be to provide an aid to the operating personnel and not a system that would compete with the control board instrumentation for their attention. Thus, a relatively small number of parameters are likely to be selected for alarm.

SPDS alarm setpoints will generally be set beyond those alarms at the control board or set for parameters that do not have existing main control board alarms. Thus, an alarm on ths SPDS might indicate the parameter had degraded beyond the control board alarm setpoint and that any action an operator may have taken upon initiation of the control board alarm had apparently not been adequate. The SPDS will provide a convenient way to add alarm capability.

The alarm assignment is considered to be machine specific. When the machine specific operating environment and the capabilities for establishing alarm regimens is known, listings and alarm value tables will be prepared. Alarm setpoint change flexibility and authorization will also be provided.

SECTION 4.0

REPORTS

4.0 REPORTS

The Vermont Yankee SPDS will be designed as an aid for the operating personnel in their task of operating the plant. Hard copy terminals may be installed in the Control Room even though the trending capability of the color graphic monitors will be suitable for normal and emergency activities. To provide the capability to access the information stored in the SPDS, a hard copy terminal will be installed in the adjacent Technical Support Center (TSC) in addition to a color graphic monitor. Circuits for interactive data will also be connected to the Emergency Off-Site Facility under construction in Brattleboro.

A alpha-numeric "snapshot" of the raw data for selected process points can be accessed at all printer terminals. Although the formatted handling of this data is known to be machine specific, the Vermont Yankee SPDS will require a minimum of four major printed reports as follows:

1. Signal Value

   This report will list the current engineering value, units, point mnemonic, point description, and rate of scan for all existing SPDS input signals. The current engineering values will be those at the one specific time printed at the top of the report.

2. Critical Safety Functions

   A data report will be available for any one of the five Critical Safety Functions (CSF): Reactivity, Coolant Inventory, Core Heat Removal, Radioactivity and Containment Integrity. Each report will list the point ID number for the parameters in the CSF, its current engineering value at the time printed in the heading, the units, mnemonic, description, and scan rate. The report will also list each alarm for that CSF and the current engineering value.

3. Alarm Points

   This report will list the point ID number, time, current engineering value, mnemonic, and description for all the existing SPDS alarms.

4. Point Scan Monitor

   This report will list the current time, current engineering value, units and the mnemonic for any single SPDS parameter. The report will be continuously updated at its designated scan rate thus giving a listing of the current values during the period of the report. The highest and lowest engineering values will also be identified as the report is printed.

SECTION 5.0

INSTRUMENTATION AND CONTROLS

5.0 INSTRUMENTATION AND CONTROLS

The Vermont Yankee SPDS computer will have the capability to process both analog and digital input signals, and will be designed with adequate spare capacity. Some will originate from safety-grade instrumentation (see Table 2.1) and some from non-safety grade instrumentation. Appropriate signal isolation and signal conditioning will be applied to each input signal. The Final Safety Analysis Report (FSAR) will address the DAS I/O signal conditioning and signal isolation equipment. Specifically, the SPDS FSAR will:

- Describe the environs withstand capability of all devices (Qualification results).
- Describe qualification test plan and results.
- Describe device level test methodology resulting in an evaluation to use this DAS device (including perturbations, test severity, equipment configuration, and diagrams).
- Describe results of planned tests.
- State pass/fail criteria applied to test cycle(s).
- Provide engineering proof that safety grade Class 1E system equipment will not be affected by SPDS generated interference phenomena: EMI, RFI, common mode, electrostatic coupling or crosstalk.

SECTION 6.0

COMPUTER PROCESSING HARDWARE

6.0 COMPUTER PROCESSING HARDWARE

The performance capabilities of this equipment and the interactions between its peripheral equipment is regarded to be machine specific. Details of system architecture and machine firmware protocols are not known at this time. The design details for this section will be submitted with the Final Safety Analysis Report.

SECTION 7.0

SOFTWARE

7.0 SOFTWARE

The software will consist of a real-time, multi-tasking operating system and integrated packages of application support software. The application support software will consist of data acquisition, engineering units conversion, alarming, data base, graphic displays and reports.

The operating system will be real-time, communication-oriented and capable of multi-tasking. The system will provide for inter-task communication and an error logging service which logs the time, type and location of all parity errors. It will allow user written programs to be compiled, assembled, and line-edited on-line.

A utility library will be provided which includes mathematical functions and executive services routines, including complete task control, I/O control, multiplex conversion, informational and conversion services callable from high level languages.

Program development and communication services will also be supported including:

- o high and low level graphics software for any display generator;
- o file utility processor for sequential and direct access files;
- o object library update; and
- o utility job control procedure for software development.

Diagnostic programs will be included to detect bit errors, peripheral failures (both hard and soft) and CPU integrity. These programs will run continually in the computer memory.

The following design standards and practices will be used:

- o standard software (i.e., readily available, general purpose) will be used whenever practical;
- o system operation will be controlled by table structures whenever possible to maximize flexibility; and
- o all codes will be documented with appropriate comments to the level of detail necessary to define the function being performed.

SECTION 8.0

VERIFICATION AND VALIDATION

8.0 VERIFICATION AND VALIDATION

Verification and Validation (V&V) refers to the program applied during development and implementation of the SPDS that will ensure that the system being built does the right job and does the job right. The program will consider requirements reviews, design reviews, and validation testing and documentation.

Verification will involve independent requirements review and design reviews. These reviews will consist of evaluating the following:

1. Determination of human factors requirements for effective man/machine interfacing.

2. Establishment of the SPDS hardware environment, including signal conditioning, signal isolation, computer hardware, software, power sources and communications.

3. Definition of the SPDS inputs, outputs, and historical data base requirements.

4. Determination if the right problem is being solved by the SPDS and if the SPDS is consistent with the Vermont Yankee Emergency Operating Procedures.

The objective of the verification reviews will be to compare the hardware and software design against the SPDS and NRC requirements.

A validation testing effort will certify that the SPDS will operate in accordance with its design specifications. It will provide assurance that the final system complies with the system requirements document through a testing and evaluation process. The V&V program will be defined during the vendor contract negotiations and will be included in the SPDS Final Safety Analysis Report.

The level of V&V to be performed will be consistent with the view of the SPDS as a Control Room operational aid. It will be considered a surveillance tool designed primarily to assist the operator. Its function will not be essential for plant operation and it will not be a safety-related device.

SECTION 9.0

SCHEDULES

9.0 SCHEDULES

In previous correspondence, Vermont Yankee has pledged to work closely with our NRC Project Manager in finalizing the specific detailed schedule for each of the NUREG 0737, Supplement 1, items. This cooperative effort has resulted in mutually acceptable program plans for the Emergency Operating Procedures, the Detailed Control Room Design Review, the Reg. Guide 1.97 Assessment, and a new Emergency Response Facility. Each of these individual 0737 tasks are currently on schedule and can now provide a meaningful contribution to the finalization of the SPDS design.

We have evaluated the present plant computer and its peripheral equipment for suitability to perform the SPDS task. The existing computer performs a data acquisition system (DAS) function without any assigned control functions and limited calculation tasks on BWR software routines which monitor reactor fuel status. Memory limitations, data trend, expansion, communication, off-line calculation, a lack of CRT compatibility and approaching computer obsolescence problems have been identified. We have determined that the present General Electric supplied Honeywell GE-PAC-4020 must be maintained available to support the plant through the next two refueling outages, but will be phased out in a series of upgrades utilizing equipment substitutions. Our present schedule is to complete Phase I during the refueling outage in 1987 and complete Phase II during the 1988 refueling outage. The SPDS installation would be completed concurrent with Phase II. Performance validation and verifications will be imposed on the new equipment as it is initialized and brought on-line. The computer itself will be replaced with a state-of-the-art host central processor unit and will be configured to support all the tasks now accomplished by the existing Honeywell computer. Additional DAS analog and digital signal conditioning input/output devices will support both the SPDS and the replacement process computer.

At the present time, Vermont Yankee is in the process of evaluating six proposals for qualified consultant assistance in pre-planning a comprehensive SPDS/Process Computer Replacement design approach which proceeds from analysis of the end user's information needs. It is our intent to carefully and clearly define what will be required of the system from an operational or user prospective prior to contract award including:

- Who will use the system?
- What should the system do?
- Where will the system be used?
- When will the system be used?
- How can advantage be taken of other existing industry systems?
- What lessons have been learned from others?

Our previous experience as a member of the Northeast Consortium and direct communication with other utilities have indicated a priority need to identify all system functions, tasks and objectives early in the procurement process. We are aware of many others who have attempted to contract and install a system without this pre-planning and, as a result: (1) have installed systems which simply did not work; (2) contracted with system suppliers who have since defaulted on those contracts; (3) were forced to renegotiate vendor contracts because of extensive system design changes; or (4) are now redesigning second generation systems because the original efforts and/or requirements were either premature or failed to adequately consider end user needs.

Vermont Yankee has elected to follow a procurement process similar to that presented in EPRI NP-3701, Computer Generated Display System Guidelines. We intend to integrate the SPDS system with the other in-progress 0737 tasks and future scheduled plant outages. It is also our belief that SPDS and replacement of our plant process computer are dependent tasks which share common components and must proceed concurrently. We believe we have established a schedule and program that is both reasonable and consistent with other utilities regarding SPDS and plant process computer replacement.

SPDS/PC/ERF PROJECT SCHEDULE