TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

January 5, 1984

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of) Docket Nos. 50-390
Tennessee Valley Authority) 50-391

Please refer to my letter to you dated April 15, 1983 which provided TVA's response to Supplement 1 to NUREG-0737 (Generic Letter 82-33) for the Watts Bar Nuclear Plant (WBN). In accordance with section 4.2a of the supplement, TVA committed to prepare, and to submit for NRC review, a safety analysis for the Safety Parameter Display System (SPDS) describing the basis on which the selected parameters are sufficient to assess the safety status of the plant. Enclosed is the WBN SPDS safety analysis.

A WBN specific SPDS implementation plan, as mentioned in section 4.2a of the supplement, is being prepared in accordance with the guidelines presented by NRC representatives at the February 24, 1983 NRC/Licensee workshop held in Atlanta, Georgia. It is anticipated that the WBN implementation plan (verification and validation program details) will be very similar to that prepared and recently submitted for the Sequoyah Nuclear Plant (SQN). However, TVA intends to utilize the experience gained in implementing the SQN verification and validation program in its final development of the WBN program. Implementation of the SQN program has not progressed to the extent which presently would allow scheduling of the WBN submittal. However, it is TVA's position that submittal and approval of the WBN implementation plan is not required before the unit 1 fuel load date.

If you have any questions concerning this matter, please get in touch with D. B. Ellis at FTS 858-2681.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 5th day of January 1984

Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure

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cc: See page 2

cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

ENCLOSURE

WATTS BAR NUCLEAR PLANT SAFETY PARAMETER DISPLAY SYSTEM (SPDS) WRITTEN SAFETY ANALYSIS

I. INTRODUCTION

Purpose - This Watts Bar Nuclear Plant (WBN) SPDS Safety Analysis has been prepared to describe the basis on which the selected parameters are sufficient to assess the safety status of the critical safety functions for a wide range of events.

Scope - This document responds to the SPDS requirements set forth in supplement 1 to NUREG-0737, item 4.2a, page 8, which states (in addition to the requirement described above):

"The minimum information to be provided shall be sufficient to provide information to plant operators about:

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

Organization - This safety analysis describes the "barrier concept" philosophy and how the satisfaction of certain "critical safety functions" which have been developed is sufficient to accomplish the goal of "defense in depth." This document will discuss how the SPDS satisfies the "defense in depth" criterion, and that the parameters selected are sufficient to satisfy the requirements of Supplement 1 to NUREG-0737.

II. PHILOSOPHY

The Barrier Concept

It has long been recognized that if the radioactive material in the core of a nuclear power reactor were to be released to the environment, a serious threat to the health and safety of the general public could result. Hence, a fundamental goal of nuclear safety has been and continues to be the prevention of uncontrolled releases of radioactive materials from nuclear power plants. In order to accomplish this goal, the concept of "defense in depth" was adopted from the very start of the commercial development of nuclear energy. "Defense in depth" for nuclear power plant operation means the provision of multiple barriers to prevent the release of radioactive material.

The barriers that are provided in every nuclear power plant installation consist, at the minimum, of the following:

1. the fuel matrix and fuel clad,
2. the reactor coolant system (RCS) pressure boundary,
3. containment, and
4. distance.

The first three of these are direct physical barriers to the transport of radioactive materials, and together provide the required "defense in depth." The RCS pressure boundary blocks the transport of radionuclides that escape through the fuel rod barriers and those that are produced outside of the fuel rods themselves. Containment blocks the release of radionuclides that pass through the RCS pressure boundary and those few radionuclides that form outside the reactor coolant system. In its most general form, "containment" includes the main containment vessel, the boundaries of those systems which penetrate the main containment vessel (the steam and feedwater systems and various auxiliary systems), and the boundaries of the separate waste storage facilities (waste gas storage tanks, spent fuel storage, and the like). Finally, by locating the plant in a remote area (the "distance barrier"), the threat to the general public of released radioactive material is mitigated by decay, dilution and dispersion of the material in transit, and, as a final mode of protection, by providing a plan for evacuation of the population in downwind areas.

The philosophy of "defense in depth" assumes that as long as the fuel cladding, RCS pressure boundary, and containment barriers remain intact, the nuclear power plant poses no threat to the health and safety of the general public. Therefore, the nuclear safety goal of nuclear power plant operations is to ensure that as many as possible of the three physical barriers remain intact at all times and under all circumstances that may exist.

<u>Critical Safety Functions</u> - For each of the barriers, there is a set of functions which must be performed on a continuing basis if the barrier is to remain intact, or if its integrity is to be restored. The full set of functions that must be performed in order to fully safeguard the general public from possible consequences of nuclear power plant operation is referred to as the complete set of "critical safety functions." The relationship between the physical barriers and the critical safety functions which protect them is shown in table 1.

For the purposes of developing an SPDS for control room personnel, only three of the identified four physical barriers need to be considered. The protection of the "distance" barrier is assumed to be inclusive in the site emergency plan.

The control systems, augmented by trained operators, responding to annunciator alarms and backed by Watts Bar technical specifications, serve to ensure that small departures from preferred operating conditions are rectified before any challenge to the critical safety function(s) develops. The set of critical safety functions that is sufficient to protect the three physical barriers are, in order of importance:

1. Maintenance of Subcriticality
2. Maintenance of Core Cooling
3. Maintenance of Heat Sink
4. Maintenance of Reactor Coolant System Integrity
5. Maintenance of Containment Integrity
6. Control of Reactor Coolant Inventory

Table 1 shows that these six safety functions are more than adequate to protect the "defense in depth" physical barriers. Table 2 shows that the critical safety functions are sufficient to satisfy the requirements of supplement 1 to NUREG-0737.

III. PARAMETERS

The aspects of each critical safety function (listed in Table 3) must be monitored to ensure that the protection provided by the critical safety functions remains intact. Specific parameters were selected which monitor the aspects of each of the critical safety functions (listed in Table 3), thereby maintaining the greatest possible number of barriers to the release of radiation to the public (see Table 4). The parameters listed in table 4 are sufficient to determine the status of each critical safety function.

IV. CONCLUSION

These six critical safety functions are sufficient to satisfy the "defense in depth" concept. They are also sufficient to assess the safety status of the five conditions or functions listed as SPDS requirements in supplement 1 to NUREG-0737. The parameters selected as inputs to the SPDS are sufficient to satisfy the critical safety functions. Therefore, the parameters selected are sufficient to assess the safety status as required by Supplement 1 to NUREG-0737 for a wide range of events, which include symptoms of severe accidents.

TABLE 1

RELATIONSHIP OF CRITICAL SAFETY FUNCTIONS TO PHYSICAL BARRIERS

	BARRIERS		
Critical Safety Functions	Fuel Matrix and Fuel Cladding	RCS Pressure Boundary	Containment Vessel
Subcriticality (S)	X		
Core Cooling (C)	X		
Heat Sink (H)	X	X	
RCS Integrity (P)		X	
Containment Integrity (Z)			X
RCS Inventory (I)	X	X	

TABLE 2

SUFFICIENCY OF CRITICAL SAFETY FUNCTIONS TO MEET REQUIREMENTS OF SUPPLEMENT 1 TO NUREG-0737

Requirements listed in Supplement 1 to NUREG-0737	Critical Safety Functions
Reactivity Control	Subcriticality
Reactor Core Cooling and heat removal from the primary system	Core Cooling Heat Sink RCS Inventory
Reactor Coolant System Integrity	RCS Integrity
Radioactivity Control	All 6 critical safety functions
Containment	Containment Integrity

TABLE 3

Critical Safety Function	Aspect
Subcriticality	Minimize energy release in the fuel by ensuring only decay heat is being added to the reactor coolant system.
Core Cooling	Provide adequate heat removal from the fuel by ensuring proper thermodynamic conditions for heat transfer thereby preventing the release to radioactivity from the fuel to the reactor coolant system.
Heat Sink	Provide adequate heat removal from the fuel by ensuring proper thermodynamic conditions for heat transfer to secondary side thereby preventing the release of radioactivity from the fuel to the reactor coolant system.
Integrity	Prevent overpressurization of the reactor coolant system thereby protecting the integrity of the reactor pressure vessel.
Containment	Prevent the overpressurization of the containment vessel and monitor the radiation release paths thereby ensuring the integrity of the containment structure. In the more general sense of containment, the radiation release paths must be monitored to prevent the uncontrolled release of radiation to the environment.
Inventory	Provide adequate reactor coolant system inventory for effective heat removal and pressure control.

TABLE 4

PARAMETERS SUFFICIENT TO ASSESS SAFETY STATUS
OF CRITICAL SAFETY FUNCTIONS

Critical Safety Function	Parameter(s)
Maintenance of Subcriticality	Nuclear flux-power range, intermediate range startup rate and source range startup rates
Maintenance of Core Cooling	Core exit temperature RCS Subcooling (RCS temperature and pressure) Reactor vessel level
Maintenance of Heat Sink	Steam generator pressure Steam generator level Feedwater flow
Maintenance of RCS Integrity	RCS temperature RCS pressure
Maintenance of Containment Integrity	Containment pressure Containment sump level Containment radiation Shield building radiation Auxiliary building radiation Steam generator blowdown radiation Condenser vacuum exhaust radiation
Maintenance of RCS Inventory	Pressurizer level Reactor vessel level