February 20, 2004

10 CFR 50.12

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - REQUEST FOR EXEMPTION FROM 10 CFR 50.68, "CRITICALITY ACCIDENT REQUIREMENTS," IN ACCORDANCE WITH 10 CFR 50.12, "SPECIFIC EXEMPTIONS," FOR HANDLING OF SPENT FUEL

Pursuant to the provisions of 10 CFR 50.12, TVA requests an exemption from a requirement specified in 10 CFR 50.68, "Criticality Accident Requirements," concerning plant procedure requirements for handling and storage of fuel assemblies in unborated water. If granted, this exemption will allow handling and storage of spent nuclear fuel in a 10 CFR, Part 72 licensed spent fuel storage container in the SQN spent fuel pool (SFP).

TVA identified the need for this exemption request through its ongoing efforts to identify and benefit from lessons learned at other nuclear stations. Specifically, on October 8, 2003, Pacific Gas and Electric (PG&E) requested an exemption from 10 CFR 50.68(b)(1), "Criticality Accident Requirements," for Diablo Canyon Power Plant, Units 1 and 2 operating licenses, as part of Diablo Canyon's efforts to develop and operate an independent spent fuel storage installation. PG&E's exemption request noted that the special nuclear material in the form of spent fuel assemblies was an approved licensed content for storage and handling under 10 CFR, Part 72. In accordance with 10 CFR 50.12(a)(2)(ii), PG&E took the position that the application of 10 CFR 50.68(b)(1), under the fuel handling circumstances being addressed, would not serve the underlying purpose of the rule due to the low probability of accidental criticality and fulfillment of General Design Criterion 63. PG&E also maintained that compliance with 10 CFR 50.68(b)(1) would result in undue hardship as set forth in 10 CFR 50.12(a)(2)(iii). As part of NRC's exemption review, Diablo Canyon was requested to provide information concerning potential boron dilution events. On November 25, 2003, Diablo Canyon provided NRC a letter of such sources and an estimate of the boron concentration level at which criticality would occur in the dry fuel storage container when submerged in the SFP specific to Diablo Canyon spent fuel assemblies.

NRC recently completed its review and approved Diablo Canyon's exemption request (NRC letter to Diablo Canyon dated January 30, 2004, "Diablo Canyon Nuclear Power Plant, Units No. 1 and 2 - Exemption From the Requirements of 10 CFR, PART 50, Section 50.68(b)(1) [TAC NOS. MC0992 and MC0993]"). Because TVA is on a time-critical path, TVA coordinated its efforts with PG&E personnel to ensure that its exemption request was consistent with PG&E's. TVA's exemption request provides results of potential boron dilution events, indication of events, and mitigating actions to preclude dilution of the SFP and cask pit pool as required by the NRC's recent approval letter. TVA's exemption request also cites additional special circumstances as described in 10 CFR 50.12(a)(2)(i) and (ii).

TVA's loading campaign is currently limited to spent fuel assemblies whose initial U-235 content is less than or equal to 4.1 weight percent. This weight-percent limit has the added value of minimizing the required boron concentrations, thus increasing the time constraints of the dilution event. Loading is scheduled to start May 17, 2004. NRC approval of this exemption is requested on a schedule to support the commencement of dry cask loading operations.

Enclosure 1 provides the details of TVA's exemption request and our response to the Diablo Canyon request for additional information. Enclosure 2 provides information relating to an environmental assessment and finding of no significant impact. Commitments made in this submittal are listed in Enclosure 3. These commitments ensure that the necessary measures are taken to preclude or have the capacity to mitigate a dilution event, prior to spent fuel loading/unloading of the dry cask storage system.

Please direct questions concerning this issue to me at (423) 843-7170 or J. D. Smith at (423) 843-6672.

Sincerely,

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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

SEQUOYAH NUCLEAR PLANT (SQN) – REQUEST FOR EXEMPTION FROM 10 CFR 50.68, "CRITICALITY ACCIDENT REQUIREMENTS," IN ACCORDANCE WITH 10 CFR 50.12, "SPECIFIC EXEMPTIONS," FOR HANDLING OF SPENT FUEL

I. BACKGROUND

SQN is developing an independent spent fuel storage installation (ISFSI) to be operable by spring 2004. During a recent utility group conference call, it was brought to TVA's attention that the NRC had informed Diablo Canyon that Part 50 regulations would not allow storage and handling of spent fuel assemblies in a particular licensed spent fuel storage cask system while submerged in the spent fuel storage pool, due to the available analysis' inability to maintain subcriticality when adverse unborated conditions exist. Specifically, 10 CFR 50.68(b)(1) prohibits plant procedures from allowing the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water.

On October 8, 2003, Pacific Gas and Electric (PG&E) requested an exemption from 10 CFR 50.68(b)(1), "Criticality Accident Requirements," for Diablo Canyon Power Plant, Units 1 and 2 operating licenses as part of Diablo Canyon's efforts to develop an ISFSI. Its request noted that the special nuclear material (SNM) in the form of spent fuel assemblies was an approved licensed content for storage and handling under 10 CFR, Part 72. The dry fuel storage system was analyzed to maintain subcritical conditions via design features of the storage cask and procedures including technical specification (TS) requirements. PG&E asserted that the existence of the low probability of accidental criticality and fulfillment of General Design Criterion (GDC) 63 provided sufficient qualifications such that the application of 10 CFR 50.68(b)(1), in the particular fuel handling circumstances being addressed, would not serve the underlying purpose of the rule.

TVA understands that as part of NRC's review, Diablo Canyon was requested to provide additional information concerning potential boron dilution events and mitigating actions. On November 25, 2003, Diablo Canyon provided NRC with such sources and an estimate of the boron concentration level at which criticality would occur specific to Diablo Canyon spent fuel assemblies. Mitigating actions were developed and presented for the unlikely occurrence of a boron dilution event during activities involving dry cask storage.

SQN has chosen to use the same licensed cask system as Diablo Canyon, Holtec International's HI-STORM 100 Cask System with the multi-purpose canister (MPC) designed to hold 32 spent fuel assemblies for IFSFI deployment, commonly referred to as the MPC-32 (Reference 1). The approved criticality analysis of the MPC-32 (Chapter 6, Reference 1) currently presents only those boron concentration levels necessary to maintain a k-effective (k_{eff}) less than 0.95. However, these k_{eff} values for the cask were calculated with the following conservative assumptions: (1) all fuel assemblies in the cask authorized for loading are unirradiated and at the highest permissible enrichment; (2) no credit is taken for fuel-related burnable neutron absorbers; (3) no credit for fuel burnup is assumed; (4) only 75 percent of the B-10 content for the fixed neutron absorber (Boral) is credited; and (5) when the cask is flooded with a moderator (i.e., borated water), the moderator temperature and density correspond to the highest reactivity within the expected operating range. Nonetheless, as a result of this choice and due to the closely related spent fuel conditions of Diablo Canyon, SQN has determined the need for a specific exemption to allow handling and storage of spent nuclear fuel in the licensed storage cask when submerged in the cask pit pool (CPP) adjoined to the spent fuel pool (SFP).

II. REQUEST

Pursuant to 10 CFR 50.12(a), "Specific Exemption," TVA hereby request an exemption from the specific requirement of 10 CFR 50.68, "Criticality Accident Requirements," Section (b)(1) "*Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water*." TVA requests this exemption for SQN Units 1 and 2 for the handling and storage of the 10 CFR, Part 72 licensed contents of the Holtec International HI-STORM 100 Cask System.

III. REGULATORY REQUIREMENTS

A. 10 CFR 50.68 provides specific requirements to be met as an alternative to meeting the requirements of 10 CFR 70.24, "Criticality Accident Requirements." In order to assist in understanding TVA's exemption request involving the storage and handling of spent fuel, the relevant list of 10 CFR 50.68(b) requirements is provided below:

1. Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water.

2. Not relevant to the exemption request – (applies to fresh fuel in fresh fuel storage racks).

3. Not relevant to the exemption request – (applies to fresh fuel in fresh fuel storage racks).

4. Not relevant to the exemption request – (applies to spent fuel in spent fuel racks only [provided for background information]). If no credit for soluble boron is taken, the k_{eff} of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. If credit is taken for soluble boron, the k_{eff} of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k_{eff} must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

5. Not relevant to this exemption request – (applies to nonfuel SNM only).

6. Radiation monitors are provided in storage and associated handling areas when fuel is present to detect excessive radiation levels and to initiate appropriate safety actions.

7. The maximum nominal U-235 enrichment of the fresh fuel assemblies is limited to five (5.0) percent by weight.

8. Not relevant to the exemption request – (grants regulatory flexibility [provided for background information]). The Final Safety Analysis Report (FSAR) is amended no later than the next update which §50.71(e) of this part requires, indicating that the licensee has chosen to comply with §50.68(b).

B. 10 CFR 72.124, "Criteria for Nuclear Criticality Safety," also sets criteria to be met during the operational life of the spent fuel storage system and ISFSI. Presented here for background information are those criteria:

1. *Design for criticality safety*. Spent fuel handling,

   packaging, transfer, and storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The design of handling, packaging, transfer, and storage systems must include margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the data and methods used in calculations and demonstrate safety for the handling, packaging, transfer and storage conditions and in the nature of the immediate environment under accident conditions.

2. *Methods of criticality control*. When practicable, the design of an ISFSI or MRS must be based on favorable geometry, permanently fixed neutron absorbing materials (poisons), or both. Where solid neutron absorbing materials are used, the design must provide for positive means of verifying their continued efficacy. For dry spent fuel storage systems, the continued efficacy may be confirmed by a demonstration or analysis before use, showing that significant degradation of the neutron absorbing materials cannot occur over the life of the facility.

3. *Criticality Monitoring*. A criticality monitoring system shall be maintained in each area where SNM is handled, used, or stored which will energize clearly audible alarm signals if accidental criticality occurs. Underwater monitoring is not required when SNM is handled or stored beneath water shielding. Monitoring of dry storage areas where SNM is packaged in its stored configuration under a license issued under this subpart is not required.

IV. JUSTIFICATION

10 CFR 50.12(a) allows licensees to apply for an exemption and the Commission to grant exemptions from the requirements of the regulations that are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security. Exemptions are only granted when special circumstances are present. TVA provides the following special circumstances involving spent fuel handling and dry cask storage activities.

V. SPECIAL CIRCUMSTANCES

A. *10 CFR 50.12(a)(i) Application of the regulation in the particular circumstances conflicts with other rules or requirements of the Commission . . .*

TVA believes there is an unintentional inconsistency between 10 CFR, Part 50 and 10 CFR, Part 72 subcritical requirements. The inconsistency is established via the different allowable methodologies developed to show compliance with each of these Parts' regulations. Both SQN and the cask Certificate Holder have applied these methodologies with satisfactory results given their intent, although the 10 CFR, Part 72 regulatory methodology is more limiting.

In April 2000, SQN submitted two topical reports concerning criticality analysis and boron dilution to support a subsequent TS change proposing to credit soluble boron in the SFP in accordance with 10 CFR 50.68 (Reference 2). TVA's criticality analysis referred to the guidance of an NRC internal memorandum from L. Kopp, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants, August 19, 1998." This guidance document restates the regulatory requirements for criticality analysis for storage of new and spent fuel; however, the guidance does not apply to dry fuel storage systems. TVA's criticality and dilution analyses applied an approved topical report, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology, November 1996." This methodology for spent fuel storage allows fully crediting the as-built or manufacturer's specified poison material loadings, dimensions for fixed neutron absorbing poison panels, and reactivity equivalencing (i.e., burnup credit). NRC found both SQN submitted topical reports to be acceptable for use of boron credit in the SFP.

In comparison, Holtec International submitted proposed Amendment No. 1 for the HI-STORM 100 Cask System Docket 72-1014 in August 2000. This amendment included the addition of the new multi-purpose canister, MPC-32. The requirements presented in the standard review plan (SRP) for dry cask storage system (NUREG-1536, "Standard Review Plan for Dry Cask Storage System") were followed for the criticality analysis. These requirements include conservative assumptions to ensure true reactivity is less than calculated. These assumptions include not crediting burnup of fuel and considering no more than 75 percent of fixed neutron absorbers available. NRC reviewed and approved the proposed changes presented in Amendment No. 1

for the HI-STORM 100 Cask System Docket 72-1014 in May 2002 (Reference 3).

As additional information, the following provides a status of the evolving criticality methodology application to dry fuel storage. NRC is currently reviewing an amendment request under 10 CFR, Part 71 that would allow some credit for fuel reactivity equivalencing (i.e., burnup credit) of the HI-STORM 100 MPC-32 under License Docket No. 71-9261. NRC has developed a schedule for technical reviews leading to safety evaluation report issuance in September 2004. This particular amendment provides a criticality analysis showing that, with certain limits on fuel burnup, subcriticality can be maintained under nonborated moderator condition in the MPC-32. The amount of available spent fuel that could be loaded is limited by this analysis even with the burnup credit. An amendment request proposing the use of this criticality analysis with the allowed burnup credit has not yet been proposed for this particular storage cask pursuant 10 CFR 72.244.

The above example shows that the methodology for calculating criticality in transport cask systems is advancing in an appropriate manner, but it has not been applied to storage cask systems because of the availability of soluble boron during the spent fuel loading and unloading activities. In addition, the effort to apply the current 10 CFR, Part 50 methodology to cask storage systems to meet 10 CFR 50.68(b)(1) requirements would require considerable time for development of an amendment package, NRC review, and rulemaking.

In summary, the allowable Part 50 criticality analysis methodology and those prescribed by NUREG-1536 are inconsistent. The conservative assumptions prescribed by NUREG-1536 for approval of the spent fuel in a cask storage system provide additional margin between the true reactivity and calculated reactivity. This inconsistency between the allowed Part 50 methodology and that prescribed by the SRP for licensing Part 72 fuel storage systems produces conflicting requirements. Specifically, licensed dry spent fuel storage systems which rely on soluble boron in the water to maintain subcritical conditions when loaded with fuel assemblies are not analyzed to meet the required 10 CFR, Part 50 regulations as is the case presented here.

B. *10 CFR 50.12(a)(ii) Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. . .*

In 1997, NRC's Executive Director of Operations wrote SECY-97-155 to inform the commissioners of the staff's action concerning exemptions from 10 CFR 70.24. Subsequently, a rule change was developed and enacted allowing licensees to comply with either 10 CFR 70.24, which, in part, requires maintenance of a criticality monitoring system in areas where SNM is handled or stored, or Paragraph (b) of 10 CFR 50.68 that in part prescribes design features to preclude inadvertent criticality events.

The regulations provide licensees a choice between detection and prevention of criticality in SNM. SQN has chosen to follow the prevention methodology during normal operation and it continues to monitor radiation levels in the area of the SFP in accordance with GDC 63 (Reference 4). Prevention of inadvertent criticality is via a combination of physical design and administrative controls, such as spent fuel rack design and Part 50 TS requirements for boron control in the SFP and CPP in keeping with GDC 62, "Prevention of Criticality on Fuel Storage and Handling" (Reference 4). SQN fuel movements occur only under strict procedural control and senior reactor operator supervision. The HI-STORM 100 Cask System meets the requirements of 10 CFR 72.124(a) and (b) by providing the incorporation of permanent neutron absorbing material, a favorable geometry, the ability to withstand postulated off-normal and accident events with no adverse effect on the criticality configuration (Reference 3), and administrative control limits commensurate with those in place currently at SQN. The radiation monitors are discussed in Section 11.4 and 12.1 of the SQN FSAR. Radiation monitors RE-90-102 and RE-90-103 continuously monitor the air space above the SFP and provide recordable readouts and high radiation level alarms in the control room. Area radiation monitors 1-RE-90-1 and 2-RE-90-1 monitor exposure rates in the SFP area and provide recordable readouts and high radiation level alarms in the control room, plus local audible and visual indicators. The combination of these monitors ensures detection of excessive radiation levels to initiate appropriate safety actions. In addition, during the transition to and during Part 72 operation, SQN will be using portable radiation instrumentation monitors during spent fuel dry cask loading and unloading campaigns to ensure that if excessive radiation levels are detected during the handling of cask system, personnel would be alerted to that fact and be able to initiate appropriate safety actions in accordance with 10 CFR 50.68(b)(6).

10 CFR 50.68(b)(1) is appropriate for storage and handling of SNM. However, the application of the regulation in this particular circumstance is not necessary to achieve the

underlying purpose of the rule for storage and handling of 10 CFR 72 licensed contents given the design characteristics of, and safety analyses for, the Holtec International HI-STORM 100 Cask System as well as the associated procedural controls including TS requirements which are designed to ensure that conditions for accidental criticality are precluded.

Additionally, in the unlikely event of a criticality event, portable radiation instrumentation monitors will provide adequate indications and alarms to ensure that personnel would initiate appropriate safety actions in accordance with 10 CFR 72.124(c).

VI. ADDITIONAL INFORMATION FOR SIMILAR EXEMPTION REQUEST

As noted above, TVA became aware of this exemption issue through a utility group conference call and has been following the regulatory dialog closely. Additional information was requested for review of Diablo Canyon's exemption request to 10 CFR 50.68(b)(1) (Reference 5). The question proposed by NRC is presented herein modified for SQN with TVA's response.

Provide an evaluation of potential boron dilution accidents with the MPC located in the SQN spent fuel pool (SFP). The specific initial conditions of interest are an MPC-32 fully loaded with 5.0 wt-percent enriched zero-burnup 17x17 SQN fuel located in the SQN SFP with 2600 ppm boron concentration in the MPC and SFP water. For the dilution event with the highest flow rate of unborated water into the SFP, the staff needs to know the approximate time needed to reduce the boron concentration from 2600 ppm to a value resulting in criticality in the MPC (k_{eff} = 1.0). TVA should include the following information in their response:

- *Boron concentration at criticality in the MPC.*
- *Most limiting dilution path (i.e., maximum flow rate of unborated water into the SFP).*
- *Time to reach boron concentration for criticality in the MPC.*
- *Summary of alarms, indicators, controls, and procedures to aid and alert operators and terminate dilution events.*
- *Summary of training provided to operators on identification and termination of dilution events.*

SQN RESPONSE

Holtec International's HI-STORM 100 Cask System relies upon differing minimum soluble boron concentration in the water of select MPC's for differing levels of fuel enrichment to maintain k_{eff} less than 0.95. Specific details of fuel enrichment, soluble boron concentration, and MPCs are provided in the Certificate of Compliance (COC) No. 1014, Appendix A, "Technical Specification for the HI-STORM 100 Cask System" (Reference 3). TVA has considered NRC's question and provides the following description and evaluation to a potential boron dilution event with the MPC located in the SFP. Based on the results herein, a potential boron event would be detected and mitigated prior to the boron depletion limit of 1900 parts per million (ppm); therefore is not considered to be a credible event.

Approved Content and Critical Boron Concentrations:

SQN's spent fuel and non-fuel hardware (i.e., non-fissile material) is bounded by the spent fuel and non-fuel hardware analyzed and represented in COC No. 1014, Appendix B, "Approved Content and Design Features." Start-up neutron sources in fuel assemblies have been evaluated as part of the criticality analysis and are permitted in the HI-STORM 100 Cask System.

The TS requirements for the HI-STORM 100 Cask System includes a minimum boron concentration of 1900 ppm boron when spent fuel assemblies with enrichments less than or equal to 4.1 wt-percent U-235 are loaded into an MPC-32. When fuel assemblies are enriched to greater than 4.1 wt-percent U-235 and less than or equal to 5.0 wt-percent U-235 and loaded into an MPC-32, the minimum boron concentration is limited to 2600 ppm. These TS requirements ensure that k_{eff} is maintained less than 0.95. Surveillance requirements in the TS require the boron concentration in the MPC water to be verified by two independent measurements within 4 hours prior to commencing any loading or unloading of fuel; and verified when one or more fuel assemblies are installed if water is to be added or re-circulated through the MPC; and verified every 48 hours thereafter while the MPC is in the SFP when one or more fuel assemblies are installed. Operating procedures will require the SFP boron concentration to be greater than 2600 ppm, independent of fuel enrichment, for dry cask storage operations.

In lieu of performing a site-specific criticality analysis, TVA presents the estimated boron value provided in Reference 5. Diablo Canyon's response to NRC regarding a boron concentration at which criticality occurs in the MPC was estimated to be 1720 ppm. This boron concentration value was extrapolated from data generated by Holtec International using Diablo Canyon specific fuel and different but bounding fuel in the HI-STORM 100 FSAR. SQN and Diablo Canyon presented criticality analysis in References 2 and 6, respectively, that presented evidence that both plants use a form of Westinghouse Electric Company 17x17 fuel. Considering only a 3 percent difference in the maximum k_{eff} values for 5.0 wt-percent U-235 Westinghouse 17x17 fuels presented in the HI-STORM 100 FSAR, a credible conclusion can be drawn that criticality in the MPC-32 for Westinghouse 17x17 fuel occurs near or below a boron concentration of 1800 ppm when applying the conservative criticality methodology in the HI-STORM 100 FSAR. Moreover, because SQN is limiting the fuel enrichment to less than or equal to 4.1 wt-percent U-235, critical boron concentration would be even less.

Boron Dilution Analysis Preface:

SQN will limit the fuel to enrichment less than or equal to 4.1 wt-percent U-235 for dry cask storage, thus the minimum requirement of 1900 ppm soluble boron is considered in the analysis (Commitment No. 1). The objective of the dilution analysis is to confirm that design feature, instrumentation, administrative procedures, and sufficient time are available to detect and mitigate boron dilution in the SFP before the boron concentration is reduced below the value assumed in the MPC criticality analysis which credits boron to remain below the design basis criticality limit (k_{eff} = 0.95).

Potential Dilution Sources:

SQN has reviewed plant drawings to identify potential dilution sources and performed a plant walk-down to verify the drawing review. The identified dilution sources were used in the dilution analysis (Reference 7). Seismically qualified systems are excluded from the analysis for consideration of pipe rupture. Plant systems representing credible bounding dilution sources and flow rates are:

Sources:	**Flow Rate**
Demineralized Water System,	
- Small dilution event (e.g., pump seal leak, possible evaporation)	5 gpm (gallons per minute)
- Open isolation valve to SFP cooling system	250 gpm
Fire Protection System	
- Unattended hose station	150 gpm

Component Cooling Water System - Heat exchanger tube break	< 250 gpm
Raw Service Water System - Pipe break	463 gpm
Raw Cooling Water (RCW) System - Pipe break with one pump in service	3400 gpm

Dilution Event:

The dilution analysis (Reference 7) used the above established flow rates and includes the following assumptions:

1. Boron concentration starts at the minimum ISFSI TS value of 2600 ppm for 5.0 wt-percent fuel.

2. The initial volume of the pool is 398,128 gallons, which includes both the spent fuel and cask pit pools volume minus the SFP storage racks volume and all available fuel assembly volumes.

3. The starting level of the pool is set 7.5 inches above the low alarm set-point at elevation 725'-11.5". This is the nominal operating point accounting for margin to prevent a low-level alarm prior to placing the cask in the CPP and the change in pool elevation when the transfer cask is in the pool.

4. For sources that are spilled on the floor, the 2-inch curb surrounding the pool that water must overcome before entering the pool is not credited as a mitigating factor.

5. Spill paths that would detract from water entering the pool (i.e., floor drains) are not credited as a mitigating factor.

6. Dilution times are based on a feed and bleed operation with instantaneous complete mixing.

7. The SFP high-level alarm with set-point at elevation 726'-9" is considered the first alarm for operator's response.

The following table presents the results of the dilution analysis for the creditable events.

SOURCE	FLOW RATE (GPM)	TIME		
		SFP HIGH ALARM	REACH 1900 PPM	REACH 1800 PPM
Demineralized Water System				
Small event	5	414 min	17.2 days	20.3 days
Open valve	250	8.3 min	8.3 hrs	9.7 hrs
Component Cooling Water System				
Heat exchanger tube break	< 250	Bound by Demin Water	Bound by Demin Water	Bound by Demin Water
Fire Protection System				
Unattended hoses	150	13.8 min	13.8 hrs	16.2 hrs
Raw Service Water System				
Pipe break	463	4.5 min	4.5 hrs	5.2 hrs
RCW System				
Pipe break	3400	< 1 min	36.7 min	43.0 min

Small Dilution Event:

A slow, long-term dilution event, where nonborated water enters the pool, and pool outflow is small enough to go essentially unnoticed, could occur if a seal in the piping, pumps, or possibly the pool liner were to leak. Normal makeup operations (with demineralized water) would continue on a regular basis at a slightly higher frequency than that required without leakage. Pool level is maintained within normal operation range for the spent fuel activities. The maximum flow rate that could be leaving the SFP systems unnoticed is assumed to be 5 gpm. This is on the same order as possible evaporative losses.

With a leak rate of 5 gpm, the SFP makeup would be required every 32.3 hours between low and high level alarms. SFP boron concentration could become slowly depleted if an equivalent amount of unborated inleakage were to occur. It requires more than 17 days with a nonborated source to achieve a boron dilution of 1900 ppm ($k_{eff} \approx 0.95$) and 20.3 days to reach 1800 ppm ($k_{eff} \approx 1.0$). This condition would be detected by a sampling surveillance, which is conducted prior to initiating fuel loading or unloading operations and once every 48 hours thereafter.

Large Dilution Event:

1. The CPP with an empty MPC is initially at Elevation 726’-7” with 2600 ppm boron concentration. The conditions are considered normal.

2. A nonborated source of water begins to enter the SFP, including the CPP, raising the level and directly diluting the boron concentration as no water outlet exists as yet. This condition may or may not have a coincident indication or alarm condition, depending on the source and magnitude of flow rate into the SFP.

3. The SFP high level alarm (Elevation 726’-9”) is the first indication of abnormal conditions. This occurs after 2071 gallons of nonborated water have been introduced into the pool. At this point, the boron concentration would be reduced to 2586.5 ppm.

4. SFP ventilation ducts (Elevation 727’-1”) begin flooding as pool level increases. At this point, 6153 gallons of undiluted water have been introduced into the pool and boron concentration is reduced to 2560 ppm.

5. At this point, “feed and bleed (with instantaneous mixing)” of the SFP volume is considered as the continuing inflow of nonborated water now has the simultaneous escape of an equal quantity of borated SFP water.

6. SFP ventilation ducts are completely flooded (Elevation 728’ 11-1/2”) and water now begins to flood the sheet-metal ducts exterior to the SFP in the auxiliary building gas treatment (ABGT) room. At this point, 29,125 gallons of nonborated water have been introduced into the pool and the boron concentration has been reduced to 2416 ppm.

7. Sheet-metal ducts continue to accumulate water. The ducts will leak through the bolted joints and at some point collapse due to excessive loads and spill large quantities of SFP water onto the floor of the auxiliary building. The water level would have to rise about 28 inches for a length of about 40 feet of the duct before flowing into the ABGTS fan housing.

8. If this scenario continues, at the point when the SFP boron concentration reaches 1900 ppm, more than 124,876 gallons (about one million pounds) of SFP water would have been spilled into the ventilation system sheet-metal ductwork. This would activate the local high level

alarms in the building's drain collection system tanks which have a 23,000 gallon capacity.

This scenario is interrupted by either depletion of the available dilution water source inventory or operator actions to arrest the flow of nonborated water into the SFP.

Administrative Controls:

High SFP alarm initiation times are supplied in the above table, and in all cases annunciation would occur in less than 15 minutes with exception to the small leak. Also, annunciation alarms exist in the control room for detection of a system pressure loss in the fire protection system and a low level indication in the demineralized water tank. As such, operators will be able to identify and terminate any boron dilution source well within one hour of receiving an alarm. SQN has two RCW booster pumps with each having a full rate capacity of 3400 gpm. For dry cask storage activities, SQN will tag-out one pump, reducing the flow rate potential (Commitment No. 2). Nevertheless, one RCW booster pump has the capacity to dilute the SFP in less than 37 minutes. To promptly mitigate this event, a dedicated person will be assigned to continuously monitor the area for a dilution event when the MPC is capable of being diluted (Commitment No. 3). The dedicated person will have direct communication with the control room to notify Operations of a dilution event (Commitment No. 3).

Prior to initial dry cask operations, applicable operation procedures will be enhanced to explicitly address reaction of these alarms by identifying each potential dilution path and mitigation steps during dry cask operations (Commitment No. 4). Specific to the RCW system, Operation's procedure will require opening the RCW booster pump's breaker to reduce the flow of water and isolate supply valve. SQN operators have simulated their response to the notification of a dilution event from the RCW booster pump. This simulation shows that the pump's breaker can be opened and the supply valve can be shut within 10 minutes of the notification.

While the MPC is in the CPP, temporary administrative control will be implemented to minimize the potential for a boron dilution event. In addition to tagging out the RCW booster pump, normal make-up flow paths to the SFP will be isolated and tagged out. These include the primary water and demineralized water systems (Commitment No. 2). The fire protection system hose station is typically available for emergency fire situations only and maintained with a closed valve on the hose and a closed valve at the hose connection. However, it can be used during abnormal conditions to add volume to the SFP. Adding water to SFP using the fire protection system is controlled by procedure. This procedure will be revised to address the use of this system for SFP make-up (Commitment No. 4). Potential dilution sources which would flow on the floor prior to entering the SFP cannot be isolated during normal plant operations. These include the raw service water and RCW systems. The raw service water system provides the cooling water to chiller package for chemistry lab equipment. The RCW system provides cooling water to the chiller package for the ice condenser and other plant equipment. As mentioned above, continuous monitoring of the RCW system and refueling area during loading/unloading operations enables immediate actions to secure the dilution event if necessary.

A separate piping section of the demineralized water system is necessary for cask decontamination and rinsing dry cask storage equipment. Rinsing and decontamination of the MPC and dry cask equipment is administratively controlled to ensure the minimum TS limit of 2600 ppm boron for 5 wt-percent U-235 is not exceeded. The actual administrative limit for SFP boron concentration during cask loading operations will be increased from the ISFSI TS limit of 2600 ppm to greater than 2625 ppm to provide margin for potential dilution from rinsing operations, which is estimated to take less than 3500 gallons (Commitment No. 5).

Training:

Changes made to the operator's procedures to address SFP boron dilution events during dry cask operations will be included in operator training to ensure operators can effectively identify and terminate sources of unborated water into the SFP in a minimum amount of time prior to reaching 1900 ppm. The training will emphasize the importance of avoiding any inadvertent additions of unborated water to the SFP, responses to be taken for notification or alarms that may be indicative of a potential boron dilution event during cask loading and fuel movement in the SFP, and identification of the potential for a boron dilution event during decontamination rinsing activities and abnormal SFP make-up with the fire protection system (Commitment No. 4).

The person responsible for continuous monitoring of the RCW booster pumps and refueling area will be briefed of their responsibility to identify dilution events from the potential sources and immediately contact the main control room to respond, prior to assuming their role as part of the perquisites in the loading/unloading procedure (Commitment No. 3).

Conclusions:

As described above, Diablo Canyon submitted additional information estimating the criticality of the MPC-32 to occur at a boron concentration level of 1720 ppm when using fresh 5.0 wt-percent enriched zero burnup Westinghouse 17x17 Diablo Canyon fuel. SQN fuel is similar but not identical. The second most limiting dilution path occurs as the result of rupture to the raw service water system. Based on the association of plant fuels and estimating boron concentration at criticality of 1800 ppm, the total dilution time is approximately 5.27 hours. Therefore, the operators would have approximately 5.2 hours to identify and terminate the source of unborated water into the SFP from the SFP high level alarm. Using the ISFSI TS limit of 1900 ppm boron as the limiting boron concentration, operators would have 4.4 hours to identify and terminate the source of unborated water into the SFP from the SFP high-level alarm. SQN Operations indicated that it can identify and terminate any boron dilution sources well within one hour. Accordingly, adequate time would be available for completion of these actions with significant margin. The most limiting dilution path, RCW system, results in dilution of the SFP from 2600 ppm to 1900 ppm in less than 37 minutes. To ensure that a dilution event from this system is terminated promptly, continuous monitoring by a dedicated person of the area will take place.

VII. FINAL CONCLUSION

TVA has provided the above additional information pertaining to the boron concentration level near criticality in the MPC-32; sources which could result in boron dilution, annunciation and boron depletion times; and mitigating actions including tagging of equipment, revisions of operating procedures, and training personnel to ensure boron dilution is halted with sufficient boron concentration margin in the unlikely occurrence of a boron dilution event.

TVA has provided information pertaining to the conservative assumptions used in the Holtec International criticality analysis including other forms of SNM allowed in the storage cask.

Special circumstances pursuant to 10 CFR 50.12(a)(i) are present to show that not all aspects of spent fuel storage and handling under 10 CFR 50.68 were considered under the regulation, and that an unintended regulatory conflict exists between acceptable criticality methodologies. Also, special circumstances pursuant to 10 CFR 50.12(a)(ii) are present to show that application of the regulation in this particular circumstance is not necessary to achieve its underlying purpose: (1) in view of the administrative features and design characteristic of the dry fuel storage system to preclude criticality; (2) SQN's compliance with the criticality preventive requirements of 10 CFR 50.68(b) for spent fuel stored and handled in the SFP, rather than the criticality awareness of 10 CFR 70.24; and (3) SQN's continued monitoring of radiation level in the area in accordance with GDC 63, "Monitoring fuel and waste storage."

For the reasons stated above, TVA concludes that the proposed exemption does not present an undue risk to the health and safety of the public and is consistent with the common defense and security.

VIII. REFERENCES

1. Holtec International, Certificate of Compliance No 1014, HI-STORM 100 Cask System Final Safety Analysis Report No. 2002444

2. TVA letter to NRC dated April 21, 2000, "Sequoyah Nuclear Plant (SQN) – Holtec International Topical Reports"

3. NRC letter to MR. K. P. Singh dated July 18, 2002, "Amendment No. 1 to Certificate of Compliance No. 1014 for the Holtec International HI-STORM 100 Cask System to Add Additional Contents to the Package,"

4. SQN Final Safety Analysis, Chapter 3, Amendment 17

5. Pacific Gas and Electric Company letter DCL-03-150 to NRC dated November 25, 2003, "Response to NRC Request for Additional Information Regarding Potential Boron Dilution Events with a Loaded Multi-Purpose Canister in the DCPP Spent Fuel Pool (TAC No. L23399)"

6. Pacific Gas and Electric Company letter DCL-01-096 to NRC dated September 13, 2001, "License Amendment Request 01-02, Credit For Soluble Boron In The Spent Fuel Pool Criticality Analysis"

7. TVAN Calculation SQS2-0227, "Spent Fuel Pool Boron Dilution Analysis during Dry Cask Storage Activities"

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

Environmental Assessment Information

The following information is provided in support of an environmental assessment and finding of no significant impact for the proposed exemption. This information reflects the information and findings of TVA's Environmental Assessment for the construction and operation of the independent spent fuel storage installation (ISFSI) at Sequoyah Nuclear Plant (SQN), dated April 18, 2000, as supplemented on June 3, 2002.

Identification of the Proposed Action

TVA requests an exemption from the requirements of 10 CFR 50.68, "Criticality Accident Requirements," for storage and handling the 10 CFR, Part 72 licensed contents of the Holtec International HI-STORM 100 Cask System.

The Need for the Proposed Action

Specifically, 10 CFR 50.68(b)(1) sets forth the following requirement that must be met, in lieu of a monitoring system capable of detecting criticality events:

"*Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water*."

10 CFR 50.12(a) allows licensees to apply for an exemption and the Commission to grant exemptions from the requirements of the regulations that are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and it is not necessary to achieve the underlying purpose of the rule and other conditions are met.

TVA is requesting the proposed exemption from the requirement of Part 50 because compliance with regulation in the particular circumstances conflicts with other rules or requirements of the Commission, and application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. A detailed discussion of the special circumstances is contained in Enclosure 1.

Environmental Impacts of the Proposed Action

All activities under consideration associated with the exemption occur within a radiological controlled area. TVA has determined that the requested exemption will not significantly increase the probability or consequences of accidents, that no changes are being made in the types or amounts of effluents that may be released off site, and that there is no significant increase in occupational or public radiation exposure as a result of the proposed activities. Therefore, there are no significant radiological environmental impacts associated with the proposed exemption.

In regards to potential nonradiological environmental impacts, TVA determined that the proposed activities had no potential to affect any historic sites. It does not affect nonradiological plant effluents and has no other environmental impact. Therefore, there are no significant nonradiological environmental impacts associated with the requested exemption.

Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the requested exemption, the Commission could consider denial (i.e., the "no-action" alternative). Denial of the exemption would result in no change to the current environmental impacts. TVA considers the "no-action" alternative to impact TVA's ability to provide affordable, competitive, and reliable power since SQN power operations would be impacted in the near future.

Alternative Use of Resources

The requested exemption does not involve the use of any different resources than those previously considered in the Final Environmental Statement for the Sequoyah Nuclear Plant Units 1 and 2, dated February 13, 1974, and subsequently reviewed under TVA's Environmental Assessment for the ISFSI dated April 18, 2000, as supplemented on June 3, 2002. Accordingly, the proposed action is not a major federal action significantly affecting the quality of the environment.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

List of Regulatory Commitments

The following commitments have been identified in this submittal and are incorporated into our commitment management program:

1. Fuel assembly enrichment will be limited to less than or equal to 4.1 wt-percent U-235.

2. The normal make-up flow path to the SFP from the demineralized water and primary water system and one raw cooling water booster pump will be tagged out.

3. A dedicated person will be trained for the duty of continuously monitoring the raw cooling water booster pump area and refueling area for dilution events when the MPC is capable of being diluted and to have direct communication with the control room.

4. Plant operating procedures will be enhanced and training provided to address the use of the fire protection system for SFP make-up and reaction to a notification or alarms ensuring that operators can identify and terminate any dilution sources during the dry cask storage loading and unloading operations.

5. The spent fuel pool will be maintained with a boron concentration of greater than 2625 parts per million during dry cask loading/unloading operations.