Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

February 18, 1993

TVA-SQN-TS-92-01 10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Gentlemen:

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

SEQUOYAH NUCLEAR PLANT (SQN) - REVISION 2 TO ENCLOSURE 2 OF REQUEST FOR LICENSE AMENDMENT TO TECHNICAL SPECIFICATIONS (TS) - SPENT FUEL STORAGE POOL CAPACITY INCREASE

The enclosed pages reflect revisions to the subject licensing amendment request submitted on March 27, 1992, and supplemented by letters dated May 11, May 28, September 8, and October 8, 1992. These revisions do not have a significant effect on any previous analysis or calculation performed. There are no associated decreases in the previously stated margins of safety in the safety evaluations of the pertinent areas, namely, seismic, criticality, radiological, thermal-hydraulic, or mechanical accidents. Therefore, there is no effect on the proposed no significant hazards consideration determination previously provided. A brief description of the revisions to the subject enclosure is provided as follows:

1. Pages 1-2 and 3-2: These changes clarify that a total of 17 storage cells out of 2091 total cells will be constructed 8 inches shorter than the normal 168 inches in order to clear the gate guide and support plates mounted on two pool walls. These 17 cells are distributed among two peripheral rack modules and will facilitate the installation process by eliminating the need to modify hardware on the pool walls. While this design detail is important from the point of view of installation compatibility and fuel placement, the shortening has no consequence on any of the licensing criteria or related safety evaluation statements made in the Enclosure 2 modification report.

2. Pages 2-2 and 2-3: These clarifications are offered to improve understanding of the rack geometry. The revisions on these pages are consistent with the dimensions used in the critical safety analyses described in Chapter 4 of Enclosure 2 to our March 27, 1992 submittal, and therefore there are no changes in the design basis or in the previously stated margins of safety.

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3. Pages 2-3 and 3-4: The clarifications on these pages eliminate the references to fixed height or nonadjustable pedestals. Use of remotely adjustable support legs on all modules was made possible by the decision to shorten the length of 17 cells as mentioned in the preceding Item 1. The fixed pedestals, which would have been made from 304 plate stock, are being replaced with the higher strength SA564-630 stainless material used in the adjustable height supports. Therefore, the changeover to complete use of the adjustable pedestal increases the safety margin.

4. Pages 2-9 and 2-10: These clarifications recognize that during installation there will be lifts of approximately four inches above the pool liner, which will exceed 20 percent of the crane's rated capacity of 80 tons. The NUREG 0612 provisions are intended to deal with "uncontrolled lowering" of heavy loads. Elevating a rack for four inches (so as to clear floor obstructions while "tucking") is not a lift operation involving the potential of uncontrolled lowering. In fact, in certain high seismic plants (such as San Onofre), the uplift of a rack leg may be on the order of four inches under SSE conditions. We have ensured that a postulated drop of a loaded rack from a four-inch height during the tucking operation will not inflict primary structural damage on the pool by demonstrating that the impact load from such a rack drop will not exceed the peak pedestal loading from the most severe seismic event for which the racks are designed. In summary, the movement of a lightly loaded rack, where the rack is at only four inches above the liner, does not fall within the purview of NUREG 0612. The four-inch height is merely a clearance dimension to avoid collision with floor obstructions.

5. Pages 5-24 and 5-25: Typographical corrections were made in Tables 5.5.1 and 5.5.2, respectively. These have no effect on the thermal-hydraulic safety evaluation conclusions.

6. Page 2-9: The clarification to item (v) on this page is to describe the specific areas where it is appropriate to limit the rate of horizontal load movement.

Please direct questions concerning this submittal to C. R. Davis at (615) 751-7509.

Sincerely,

Mark J. Burzynski

Mark J. Burzynski
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Enclosure
cc: See page 3

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site. This licensing document has been prepared by TVA and its contractor, Holtec International.

Twelve free-standing poisoned rack modules positioned in the spent fuel pool with a prescribed and geometrically controlled gap between them will contain a total of 2091 storage cells. The design and construction of the storage cells is described in Section 3 of this document. As stated in Section 3, the design and construction of all cells are essentially identical, although their physical location in a rack gives them some special attributes. Those storage cells which are located on the periphery of a rack module are referred to as flux-trap cells*, and the interior ones are of the so-called non-flux trap type. A great majority of the "flux trap" cells and some non-flux trap cells are suitable for storing fresh fuel (up to 5% enrichment) as depicted in Section 4.0, Figures 4.2.1 and 4.2.2. These fresh fuel cells are surrounded by other non-flux trap cells which have a burnup restriction on the fuel which they can store. Consistent with the concept of multi-region storage, the placement of fuel with a given burnup in the allowable location is administratively controlled. No credit is taken for soluble boron in normal refueling and full core offload storage conditions.

In addition to the twelve modules in the spent fuel pool, TVA plans to install one 15x15 module (225 cells) in the cask region, as further described in Section 2 of this report. This rack will be identical in construction to the aforementioned spent fuel pool racks, except that it will be positioned on pedestal "tables" (in contrast to "bearing pads" for the spent fuel racks) so as to permit the use of the standard fuel handling tools. This 15x15

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* A flux trap construction implies that there is a water gap between adjacent storage cells such that the neutrons emanating from a fuel assembly are thermalized before reaching an adjacent fuel assembly.

later date. If this rack is included in the storage capacity, then the present reracking application will increase the licensed storage capacity at Sequoyah from 1386 to 2316 cells.

2.2 Mixed Zone Three Region Storage (MZTR):

The high density spent fuel storage racks in the Sequoyah pool and cask pit will provide storage locations for up to 2316 fuel assemblies and will be designed to maintain the stored fuel, having an initial enrichment of up to 5 wt% U-235, in a safe, coolable, and sub-critical configuration during normal discharge and full core offload storages and postulated accident conditions.

All rack modules for Sequoyah spent fuel pool are of the so-called "free-standing" type inasmuch as the modules are not attached to the pool floor and they do not require any lateral braces or restraints. These rack modules will be placed in the pool in their designated locations using a specifically designed lifting device, and the support legs will be remotely leveled using a telescopic removable handling tool. The leveling operations will be done with the support legs lifted off the floor. Except for the crane, no additional lifting equipment will be needed while leveling the rack modules.

As described in detail in Section 3, all modules in the Sequoyah pool are of "non-flux trap" construction. The baseplates on all rack modules extend out beyond the rack module wall such that the contiguous edges of the plates act to set a geometric separation between the facing cells of adjacent ~~in the~~ modules. The baseplate projection 2
in the north-south direction ~~is~~ exceeds 1" ~~which~~ and establishes a 2" (min.) separation between the modules in the north-south direction. Providing for a total non-straightness in the facing baseplate edges of 1/8 inches, the minimum separation of 2 inches is consistent with 2.125" (nominal) N-S spacing indicated in Figure 2.1.2 for the emplacement of the racks in the pool. Similarly, to

ensure a nominal module-to-module gap of 1.5 inch, the baseplates are fabricated to project slightly more than 1.1/16" in the east-west direction. The baseplates on the module sides facing the pool walls, however, are trimmed off to within 1/4" of the rack wall. 2

The geometric separation between the modules created by the baseplate serves to establish a "flux trap" space between the adjacent modules. In other words, although there is a single panel of the neutron absorber between two fuel assemblies stored in the same rack, there are two poison panels with a specified water flux trap (north-south: 1.875 ± 1/8"; east-west: 1.25 ± 1/8") between them for fuel assemblies located in cells in two facing modules. Out of these flux trap locations and peripheral cell locations (cells adjacent to pool walls), a certain number of storage cells are designated for storing fresh fuel. In this manner, a sufficient number of locations without any burnup restriction (Region 1 cells) are identified to enable unrestricted full core offload of the Sequoyah reactor in the spent fuel pool. These so-called Region 1 cells are identified in Figures 4.2.1 and 4.2.2. of this report. The remaining storage cells have enrichment/burnup restrictions. Appropriate restrictions on the enrichment/burnup of the stored fuel in Region 2 and Region 3 cells are presented in Section 4. 2

~~Most~~ All rack modules are supported by four legs which are remotely adjustable. Racks with adjustable pedestals can easily be made co-planar with each other. The rack module pedestals are engineered to accommodate variations in the flatness of the pool floor. ~~To avoid interference with wall mountings, certain racks have pedestals of fixed height so as to reduce the overall height of the rack.~~ The support legs also provide an under rack plenum for natural circulation of water through the storage cells. The placement of the rack pedestals in the spent fuel pool has been designed to preclude any support legs from being located over existing obstructions on the pool floor. 2 2

The Auxiliary Building has one overhead crane which rides on rails that traverse the entire fuel handling area of the building. The crane has a main hook rated at 80 tons (designed at 125 tons). In addition there is an auxiliary hoist on the overhead crane rated at 10 tons.

Pursuant to the defense-in-depth approach of NUREG-0612, the following additional measures of safety will be undertaken for the reracking operation.

(i) The crane and hoist will be given a preventive maintenance checkup and inspection within 3 months of the beginning of the reracking operation.

(ii) Except for the lifts described in item (x) on the following page, the crane hook will be used to lift no more than 20% of its rated capacity of 80 tons at any time during the reracking operation. (The maximum weight of any module and its associated handling tool is less than 15 tons). 2

(iii) The old fuel racks will be lifted no more than 6" above the pool floor and held in that elevation for approximately 10 minutes before beginning the vertical lift.

(iv) The rate of vertical lift will not exceed 6' per minute.

(v) The rate of horizontal movement will not exceed 6' per minute when moving loads over any region of the spent fuel pool or cask pit area. 2

(vi) Preliminary safe load paths have been developed. The "old" or "new" racks will not be carried over any region of the pool containing fuel.

(vii) The rack upending or laying down will be carried out in an area which does not encroach on any space ascribed to safety related equipment.

(viii) All crew members involved in the reracking operation will be given training in the use of the lifting and upending equipment. The training seminar will utilize videotapes of the actual lifting and upending rigs on the <u>actual</u> modules to be installed in the pool. Every crew member will be required to pass a written examination in the use of lifting and upending apparatus administered by the rack designer.

(ix) In addition to the video and in-class training, the rack installation crew will be given "hands-on" rack handling experience prior to executing any handling operation over the fuel pool. The unloading, rigging, upending, and staging of the racks, upon their arrival at the Sequoyah site, will be carried out by the installation crew. As a result, the crew members will acquire considerable handling "feel" of the racks before bringing the hardware to the refueling floor level of the Auxiliary Building.

(x) It is noted that the fuel handling bridge crane cannot access some storage cells due to obstructions. Therefore, it will be necessary to load the inaccessible cells with fuel when the rack is staged a certain distance (approximately 20") from the pool wall. Having loaded these cells, the module will be lifted approximately 4" above the pool liner, and laterally transported to its final designated location. A fuel shuffling and rack installation sequence will be developed to ensure that all heavy load handling criteria of NUREG-0612 are satisfied. The rack handling rigs is designed with consideration of the rack module weight along with the contained fuel assembly mass.

The fuel racks will be brought directly into the Auxiliary Building through the access door which is at ground level. This direct access to the building greatly facilitates the rack removal and installation effort.

A preliminary fuel reshuffle scheme for the spent fuel pool has been developed by TVA which is predicated on the following criteria:

(1) No heavy load (rack or rig) with a potential to drop on a rack has less than 3 feet lateral free zone clearance from active fuel.

(2) All heavy loads are lifted in such a manner that the C.G. of the lift point is aligned with the C.G. of the load being lifted.

(3) Turnbuckles are utilized to "fine tune" the verticality of the rack being lifted.

3.2 Mixed Zone Three Region Storage

All rack modules designed and fabricated for the Sequoyah spent fuel pool are of the so-called "non-flux trap" type. In the non-flux trap modules, a single panel of Boral is interposed between two fuel assemblies. The poison material utilized in this project is Boral, which does not require lateral support to prevent slumping due to the inherent stiffness. However, accurate dimensional control of the poison location is essential for nuclear criticality and thermal-hydraulic considerations. The design and fabrication approach to realize this objective is presented in the next sub-section. 2

3.3 Anatomy of Rack Modules

As stated earlier, the storage cell locations have a single poison panel between adjacent austenitic stainless steel surfaces. The major components of the rack module are: (a) the storage box subassembly, (b) the baseplate, (c) the thermal neutron absorber material, and (d) support legs. A synopsis of the anatomy of the rack module is provided in the following, which explains the physical arrangement of the major constituent parts of a Sequoyah rack module.

(a) The rack module manufacturing begins with fabrication of the box. The "boxes" are fabricated from two precision formed channels by seam welding in a machine equipped with copper chill bars and pneumatic clamps to minimize distortion due to welding heat input. Figure 3.3.1 shows the box.

The design and construction of all 2091 ~~module~~ storage cells are essentially identical with the exception of 17 cells distributed along the periphery of 2 modules which are 8-inches shorter than the normal 168-Inches in order to avoid obstructions on the pool walls.

(c) The thermal neutron absorber material: As mentioned in the preceding section, Boral is used as the thermal neutron absorber material.

(d) Support Legs: Adjustable support legs are shown in Figure 3.3.4. The top portion is made of austenitic steel material. The bottom part is made of SA564-630 stainless steel to avoid galling problems.

Each support leg is equipped with a readily accessible socket to enable remote leveling of the rack after its placement in the pool. Lateral holes in the support leg provide the requisite coolant flow path.

An elevation cross-section of the rack module shown in Figure 3.3.5 shows two box cells in elevation. The Boral panels and their location are also indicated in this figure. The boral panels are vertically positioned such that the entire enriched fuel portion of the fuel assembly is enveloped in the longitudinal direction by the thermal neutron absorber material. It is noted that the top of the boxes are flared prior to welding to provide a smooth lead-in contour for the fuel assembly.

The joint between the composite box arrays and the baseplate is made by single fillet welds which provide a minimum of 7" of connectivity between each cell wall and the baseplate surface.

As shown in Figure 3.3.4, the support leg is gusseted to provide an increased section for load transfer between the support legs and the cellular structure of interconnected boxes above the baseplate. Use of the gussets also minimizes heat input induced distortions of the support/baseplate contact region.

~~Non-adjustable pedestals are built up from austenitic stainless steel plate sections.~~ 2

3.4 Welding Types and Processes

The basic types of welds are Tungsten Inert Gas (GTAW or TIG) and Metal Inert Gas (GMAW or MIG). Both fusion and filler metal added TIG arc welds and MIG welds are used. The welds are either

Table 5.5.1

POOL BULK TEMPERATURE AND HEAT LOAD DATA

Case No.	Coincident Cooler Duty, 10^6 Btu/hr.	T_{max} Max. Pool Bulk Temp., °F	Time Coincident to T_{max}, hrs. (after reactor shutdown)	Coincident Evaporation Heat Loss, 10^6 Btu/hr.
1a	39.326	138.02	332	0.378
1b	~~[illegible]~~ 36.522	174.91	336	3.061
2	43.501	142.59	332	0.521
3	47.230	146.65	331	0.674

Table 5.5.2

TIME-TO-BOIL FOR VARIOUS DISCHARGE SCENARIOS [1]
(WITH NO MAKE-UP WATER)

Case Number	Time-to-Boil (hours)	τ^* (Hours) [2]
1a	5.50	~~34~~ 36
1b	3.42	~~36~~ 34
2	4.71	33
3	4.12	30

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[1] Time coordinate starts from the instant of loss of cooling.

[2] τ^* is the time elapsed subsequent to the loss-of-cooling when the pool water level drops to within 10′ of the top of the active fuel stored in the fuel racks.