March 13, 2003

Mr. J. A. Scalice
Chief Nuclear Officer
and Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 1, SAFETY EVALUATION OF TOPICAL REPORT NO. 24370-TR–C-001, "ALTERNATE REBAR SPLICE - BAR-LOCK MECHANICAL SPLICES" (TAC NO. MB5371)

Dear Mr. Scalice:

On March 18, 2002, the Tennessee Valley Authority (TVA, the licensee) submitted Westinghouse Topical Report No. 24370-TR–C-001, "Alternate Rebar Splice - Bar-Lock Mechanical Splices" to the staff, supplemented by a letter dated December 10, 2002.

The staff has reviewed Topical Report No. 24370-TR–C-001, "Alternate Rebar Splice - Bar-Lock Mechanical Splices" and found the Topical acceptable. The enclosed Nuclear Regulatory Commission (NRC) safety evaluation contains the staff's determination. However, this acceptance applies only to the Bar-Lock coupler assembly using American Society for Testing Maintenance A615 Grade 60 material in the #6 and #8 sizes for use on non-containment (i.e., shield building) applications at TVA's Sequoyah Units 1 and 2.

In accordance with the guidance provided on the NRC web site, we request that TVA publish an accepted version of this topical report within 3 months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed safety evaluation between the title page and the abstract. It must be well indexed such that information is readily located. Also, it must contain in appendices historical review information, such as questions and accepted responses, and original report pages that were replaced. The accepted version shall include an "-A" (designated accepted) following the report identification symbol.

If the NRC's criteria or regulations change so that the conclusions in this letter are invalidated, thus making the topical report unacceptable, TVA will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the topical report without revision of the respective documentation.

If you have any questions concerning this matter, please contact Eva Brown at (301) 415-2315.

Sincerely,

/***RA***/

Raj K. Anand, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-327

Enclosure: Safety Evaluation

cc w/encl: See next page

If the NRC's criteria or regulations change so that the conclusions in this letter are invalidated, thus making the topical report unacceptable, TVA will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the topical report without revision of the respective documentation.

If you have any questions concerning this matter, please contact Eva Brown at (301) 415-2315.

Sincerely,

/***RA***/

Raj K. Anand, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-327

Enclosure: Safety Evaluation

cc w/encl: See next page

DISTRIBUTION:

PUBLIC	PDII-2 Reading File	RAnand	EBrown	AHowe
OGC	KManoly	JMa	BClayton (Hard Copy)	
ACRS	SCahill, RII	RTellson, RII		

ADAMS Accession No.ML030720220

OFFICE	PDII-2\PM	PDII-2\PM	PDII-2\LA	PDII-2\SC
NAME	EBrown	RAnand	BClayton	AHowe
DATE	3/11/03	3/11/03	3/11/03	3/12/03

Official Record Copy

Mr. J. A. Scalice
Tennessee Valley Authority

SEQUOYAH NUCLEAR PLANT

cc:
Mr. Karl W. Singer, Senior Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. James E. Maddox, Acting Vice President
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Richard T. Purcell
Site Vice President
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

General Counsel
Tennessee Valley Authority
ET 11A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. Robert J. Adney, General Manager
Nuclear Assurance
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Mark J. Burzynski, Manager
Nuclear Licensing
Tennessee Valley Authority
4X Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Pedro Salas, Manager
Licensing and Industry Affairs
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

Mr. D. L. Koehl, Plant Manager
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

Senior Resident Inspector
Sequoyah Nuclear Plant
U.S. Nuclear Regulatory Commission
2600 Igou Ferry Road
Soddy Daisy, TN 37379

Mr. Lawrence E. Nanney, Director
Division of Radiological Health
Dept. of Environment & Conservation
Third Floor, L and C Annex
401 Church Street
Nashville, TN 37243-1532

County Executive
Hamilton County Courthouse
Chattanooga, TN 37402-2801

Ms. Ann P. Harris
341 Swing Loop Road
Rockwood, Tennessee 37854

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR SAFETY EVALUATION OF TOPICAL REPORT NO. 24370-TR–C-001,

"ALTERNATE REBAR SPLICE - BAR-LOCK MECHANICAL SPLICES"

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-327

1.0 INTRODUCTION

In a letter dated March 18, 2002, Tennessee Valley Authority's (TVA, the licensee) Sequoyah Nuclear Plant (SQN) submitted a topical report for an alternate methodology for splicing reinforcing bars in concrete for nuclear safety-related applications at SQN. The topical report proposes that a Bar-Lock coupler system is now available for splicing reinforcing bars. Presently, the SQN licencing basis does not address the use of this type of reinforcing bar splice. This topical report describes a qualification testing program and test results for the Bar-Lock coupler system. On July 9, 2002, and October 24, 2002, meetings were held between the U.S. Nuclear Regulatory Commission staff (the staff) and TVA. Subsequently, the staff issued a request for additional information dated December 4, 2002. The licensee provided response to the additional information in a letter dated December 10, 2002.

2.0 TEST PROGRAM

Bechtel Corporation and Idaho National Engineering and Environmental Laboratory (INEEL) developed and performed a testing program for the Bar-Lock coupler system to assess its performance characteristics. TVA was heavily involved in the Bechtel/INEEL test program, and reviewed and approved the specifications, procedures and test plans associated with the procurement, testing, and installation of the Bar-Lock couplers. TVA civil engineers attended the vendor training session. TVA Engineering and Quality Assurance (QA) personnel witnessed the preparation of several test assemblies, and the testing of several specimens. TVA reviewed and approved the testing program and performance analysis, prepared by INEEL.

The reinforcing bar used in the Bar-Lock coupler assembly testing program was American Society for Testing and Maintenance (ASTM) A615 Grade 60 material in #6 and #8 sizes. The mechanical properties for the reinforcing bars were tested in according to ASTM Designation A 370-96, Standard Test Methods and Definitions for Mechanical Testing of Steel Products; and ASTM Designation E 8-99, Standard Test Methods for Tension Testing of Metallic Materials.

The component parts of each Bar-Lock coupler consist of a steel tube, “lock-shear” bolts, and serrated rails. The steel tube is seamless hot-rolled in conforming to ASTM A-519, with minimum tensile strength in excess of 100 kilopound per square inch (ksi). The lock-shear bolt was made from American Iron and Steel Institute (AISI) 41L40 material, and were through-hardened over the entire length and further induction-hardened at the conical bolt tip. The serrated rails were made of ASTM CD1018 material, and were machined and then carburized to a depth of 0.032 inch

The test specimen assemblies were made by steel construction workers using Bar-Lock’s assembly instructions in a normal field environment. Assembly of the test specimens was monitored by Bechtel Quality Control (QC) personnel. The Bar-Lock’s assemblies were tested in the same machine that had tested the mechanical properties of the reinforcing bars and in conformance with the same ASTM A 370-96 and E 8-99 standards.

Two reinforcing bar sizes (#6 and #8) of Bar-Lock coupler assemblies were statically tested. The test was conducted using forty specimens of each of the two sizes of coupler assemblies. The static test was performed according to the requirements of American Society of Mechanical Engineers (ASME) Section III, Division 2, “Code for Concrete Reactor Vessels and Containment,” (the Code) Section CC-4333.2.3(a), Static Tensile Tests for Mechanical Splices. Forty specimens of each of the two sizes of the Bar-Lock coupler assemblies were tested for cyclic loadings. The cyclic test was performed according to the requirements of ASME Section III, Division 2, “Code for Concrete Reactor Vessels and Containment,” Section CC-4333.2.3(b), Cyclic Tensile Tests for Mechanical Splices. The Code requires that three specimens of the bar-to-bar splice for each reinforcing bar size shall withstand 100 cycles of stress variation from 5 percent to 90 percent of the specified minimum yield strength of the reinforcing bar. In an effort to improve the cyclic durability assessment, after 100 cycles of loading required by the Code, several specimens were randomly selected to receive an additional 1000 cycles, and several other specimens were statically loaded to failure.

3.0 TECHNICAL EVALUATION

The Code requires six splice specimens for each bar size to be tensile tested statically to failure and three to be tested cyclically. The Code requires that the average tensile strength of the splices shall not be less than 90 percent of the actual tensile strength of the reinforcing bar being tested, nor less than 100 percent of the specified minimum tensile strength. Table CC-4334-1, “Tensile Requirements for Mechanical Reinforcing bar splices and Welded Joints,” of the Code lists a minimum yield strength of 60 ksi and minimum tensile strength of 90 ksi for ASTM 615 Grade 60 reinforcing bars.

The INEEL report states that the average tensile strength of the 40 #6 Bar-Lock’s assemblies is 106.2 ksi, which is 98.8 percent of the average #6 bar actual tensile strength. The average tensile strength of the 40 #8 Bar-Lock’s assemblies is 109.0 ksi, which is 99 percent of the average #8 bar actual tensile strength. None of the 80 specimens tested cyclically failed in any manner (e.g., bar break, or bar slip within the coupler). For those specimens that received additional 1000 cycles of loading, no obvious physical degradation was observed. For those specimens that passed 100 cycles of loading and then statically loaded to tensile failure, the measured tensile strengths were essentially the same as those tested statically to failure without the 100 cycles of loading. The report also states that no practical differences were

observed in the general character of the stress-strain curve of any of the 80 specimens tested statically, and no measurable slip was detected during the cyclic tests.

The staff finds the QA/QC program for the test specimens adequate. The phenomena of no measurable slip and the similarity in the stress-strain curves of the specimens tested demonstrate that the Bar-Lock's assembly has delivered predictable results and qualifies as a viable reinforcing bar splicing system. The licensee has tested more specimens than that required by the Code, which increases the confidence level for the acceptance of the Bar-Lock's assembly. The static and cyclic test methods and results have met the requirements of the Code. The additional tests of the 1000 cycles of loading and of the tensile test to failure after the 100 cycles of loading exceed the Code requirements.

4.0 CONCLUSION

Based on the information provided by the licensee, the staff determined that the licensee has developed and performed a reasonable test program for the Bar-Lock coupler assemblies, and that the test data demonstrate the adequacy of the proposed alternate methodology for connecting (splicing) reinforcing steel bars for nuclear-safety-related applications at the Sequoyah plant.

Principal Contributor: John Ma, NRR

Date: March 13, 2003