Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

John A. Scalice
Site Vice President, Watts Bar Nuclear Plant

March 13, 1997

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

Gentlemen:

In the Matter of) Docket No. 50-390
Tennessee Valley Authority)

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - GENERIC LETTER 88-20, SUPPLEMENT 4 - INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE) - REVISED SEISMIC SCOPE - (TAC NO. M83693)

The purpose of this letter is to inform the NRC that TVA plans to reduce the scope of the seismic evaluation for the IPEEE program from a "focused scope" review to a "reduced scope" review.

In letters dated December 20, 1991 and January 20, 1994, TVA responded to the subject generic letter for WBN and committed to perform a "focused scope" evaluation for the seismic portion of the IPEEE using Seismic Margin Analysis developed by Electric Power Research Institute and submit the results 120 days following the end of the Unit 1 Cycle 1 outage. WBN has reevaluated the IPEEE Program plan since Unit 1 began commercial operation in May 1996. In particular, WBN has assessed the impact of the following significant new information that has become available since 1991:

- The recent licensing of WBN (November 95) to conservative seismic criteria.
- New information regarding significant reductions in seismic hazard predictions at Eastern United States sites.
- Insights now available from the completion of the Sequoyah Nuclear Plant IPEEE Program.
- Industry lessons learned from other IPEEE programs performed to date.

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The enclosure provides details of the modified WBN program and justification for the reduction in scope.

The existing milestone for completion of TVA's commitment for WBN, remains unchanged. If you should have any questions, please contact P. L. Pace at (423) 365-1824.

Sincerely,

J. A. Scalice

Enclosure

cc (Enclosure):

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
"REDUCED SCOPE"

INTRODUCTION

Reference 1 provided TVA's response to Generic Letter (GL) 88-20, Supplement 4, which requested licensees to perform an IPEEE program. WBN committed to perform a "focused scope" evaluation for the seismic portion of the IPEEE using the Seismic Margins Assessment (SMA) developed by the Electric Power Research Institute (EPRI). In Reference 2, WBN indicated that available resources were focused on activities in support of initial fuel load and startup and also revised the commitment date for submission of the IPEEE results to 120 days after the first refueling outage for Unit 1. Reference 3 accepted TVA's schedule and acknowledged that the Seismic Corrective Action Program, resulted in numerous modifications to ensure plant ruggedness for seismic events. Similar reviews and modifications were also conducted in the fire protection area. In Reference 4, TVA acknowledged its intent to incorporate the program modifications of GL 88-20, Supplement 5, into the site IPEEE Program.

WBN has reevaluated the IPEEE program plan since Unit 1 began commercial operation in May 1996. In particular, WBN has assessed the impact of the following significant new information that has become available since 1991:

- The recent licensing of WBN (November 95) to conservative seismic criteria.
- New information regarding significant reductions in seismic hazard predictions at Eastern United States sites.
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In reassessing the seismic event, WBN plans to utilize a cost-effective process and to utilize existing programs and information to the maximum extent possible. The licensing of WBN included extensive seismic investigations and walk downs of systems, structures, and components. Attachment 1 contains a brief discussion of the seismic design background, including a description of the important Seismic Corrective Action Programs (CAPs) that have been implemented. The completion of the CAPs and the resulting modifications have demonstrated that WBN is a seismically rugged plant. The first part of the reassessment was to utilize the existing data from the Seismic CAP walk downs in the IPEEE Program. The second part was to determine those insights that could be provided by TVA's Sequoyah Nuclear Plant (SQN) IPEEE Program (Reference 7) and whether corresponding reductions in the level of effort for WBN were possible. Third, new seismic hazard estimates developed by Lawrence Livermore National Laboratory (LLNL) in 1993-94 and published in NUREG-1488 (Reference 5) indicate that the uncertainty in seismic hazard for most Eastern U. S. is much less than previously reported. A Nuclear Energy Institute (NEI) white paper, (Reference 6) demonstrated that the 1994 LLNL study places the

seismic hazard for "focused scope" plants in the same range as that previously associated with "reduced scope" plants. Finally, lessons learned from industry IPEEE programs indicate that the most significant findings result from the performance of seismic experience-based walk downs that identify anchorage or spatial interaction deficiencies. Attachment 2 provides TVA's assessment of the impact of the new information, including the seismic hazard data, on WBN program scope.

TVA concluded that a reduction in the scope of review for the seismic event is warranted and appropriate. In particular, TVA considers that the objectives of GL 88-20, Supplement 4, can be achieved without performing a complete "focused scope" effort at the associated ground motion level of 0.3g. This letter provides details of the modified program and justification for the reduction in scope. The fire and the other external events portions of the IPEEE Program will be completed as previously planned. The Fire-Induced Vulnerability Evaluation, (FIVE) methodology will be used to assess the fire event. Other external events (except seismic) will be assessed using the screening methodology discussed in NUREG-1407 (Reference 8). WBN remains committed to submittal of the IPEEE Final Report within 120 days following the Unit 1 Cycle 1 outage.

MODIFIED PROGRAM FOR THE SEISMIC EVENT

The modified IPEEE Program for WBN differs from that previously planned in two key aspects; namely, in the level of walk down efforts to be performed and in the seismic level to which outlier components will be evaluated. WBN will take credit for the walk downs performed for the seismic CAPs. Additional detailed walk downs will be performed only for those items identified by the Seismic Review Team (SRT) as requiring review based on SQN outliers and lessons learned, expert judgment, and industry identified items with typical low seismic ruggedness. Confirmation of the ruggedness of items not identified for additional detailed walk downs and review is provided by the walk downs discussed above and in Attachment 1 that were performed for the seismic CAPs. A general area walk through of those items will be conducted to assure continued integrity of design basis plant configuration.

The IPEEE walk downs will be performed in accordance with EPRI Report NP-6041, "Nuclear Power Plant Seismic Margin." Members of the SRT will be trained in Seismic Qualification Users Group (SQUG) walk down screening and seismic evaluation methods. Therefore, the qualifications of the SRT are unchanged from the previous program plan.

Equipment that does not screen out by the EPRI guidance of EPRI NP-6041 will be evaluated to the seismic level defined by the site set B+C Ground Response Spectra (anchored at 0.215g) rather than the level of 0.3g associated with a "focused scope" program. This approach

reflects the conclusion in Attachment 2 that the 1994 LLNL study indicates the seismic hazard and mean core damage frequency (MCDF) for WBN is more consistent with that previously identified in NUREG-1407 for the original group of "reduced scope" plants.

The proposed modified WBN IPEEE Program will result in the following changes to the previous "focused scope" IPEEE Program:

- Define seismic demand at a level that exceeds the safe shutdown earthquake (SSE) design basis by using the existing WBN set B+C spectra (anchored at 0.215g). The existing WBN set B+C spectral shape envelops the NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," shape and can be used to conservatively define seismic demand. This replaces the review level earthquake with its peak ground acceleration of 0.3g.

- Application of expert judgment in safe shutdown equipment list (SSEL) screening for outliers
  - Include SQN lessons learned.
  - Consider WBN IPE insights.
  - Consider industry insights from other IPEEE programs.

- Modified Walk Down Scope
  - Use existing CAP walk down data to extent possible and applicable.
  - Perform detailed walk down of items designated by SRT.
  - Identify need for additional confirmatory walk downs to supplement data.

- Focused Outlier Evaluations
  - Utilize expert SRT judgment with peer review to evaluate ruggedness level.
  - Calculate high confidence of a low probability of failure (HCLPF) for items the SRT is unable to screen to the seismic demand level defined by WBN set B+C spectra.

The modified program plan described above includes the use of expert peer review to validate program implementation. Therefore, the intent to use the peer review process for program validation remains unchanged from the previous program plan.

SUMMARY

The completion of the Civil/Seismic Validation Program prior to startup has demonstrated that WBN is a seismically rugged plant. Since this effort demonstrated beyond design basis seismic ruggedness, additional evaluation to the "focused scope" level of NUREG-1407 is not required to obtain the insights necessary to satisfy the intent of NUREG-1407. By utilizing the current site seismic response spectra

curves (for set B+C anchored at 0.215g) in concert with expert SRT input, insights from the SQN IPEEE and the WBN IPE, and industry lessons learned, the intent of NUREG-1407 will be achieved with the modified program described above in a cost effective and timely manner.

Supporting justification for the modified program to be performed for WBN, is summarized below:

- The 1994 LLNL study and the subsequent evaluation by NEI show that the seismic hazard and seismic MCDF for WBN are lower than that for the original "reduced scope" plants in NUREG-1407 and suggest that WBN could be reclassified as a "reduced scope" plant.

- WBN has already performed a beyond design basis assessment as part of the Civil/Seismic Validation Program before licensing.

- WBN is a newly licensed plant that has completed numerous design basis and configuration reviews, walk downs, and upgrade modifications. WBN has also been subjected to loose/damaged/missing items walk downs, anchorage evaluations, and adequacy walk downs. WBN does not have the anchorage/configuration/equipment issues associated with older operating plants.

- Industry lessons learned regarding both anchorage and spatial interactions are adequately addressed by the seismic CAPs and the planned modified program.

- WBN has been in commercial operation for less than a year and will utilize the results of the full scope evaluation from its sister plant, SQN, to focus on potential outliers.

- Conducting a seismic evaluation at 0.215g versus 0.3g peak ground acceleration (PGA) would not significantly alter the hierarchy of WBN outlier items. Essentially the same insights will be gained and the intent of the IPEEE program will be satisfied with the modified program described above.

The modified program makes the associated effort more commensurate with the seismic risk as reflected in NUREG-1488, and uses a conservative interpretation of the NEI white paper to substantiate the revised level of evaluation. The planned approach provides an efficient, timely, and cost effective method for WBN to satisfy the goals of the seismic portion of the IPEEE.

As stated in NUREG-1407, the general objectives of the IPEEE are to develop an appreciation of severe accident behavior, understand the most likely severe accident sequences that could occur at a plant, and gain a qualitative understanding of the overall likelihood of core

damage. The key outcome of an IPEEE is "...the knowledge and appropriate improvements resulting from such an examination process." A recognition of the relatively low level of seismic risk associated with WBN indicates that an additional major investigation of the plant and equipment is not warranted or cost effective. The IPEEE objectives will be achieved by implementation of the modified program for the seismic event as described and justified herein. Other aspects of the overall WBN IPEEE Program will remain unchanged.

REFERENCES

1. Letter from John H. Garrity to NRC, "Watts Bar Nuclear Plant (WBN) Units 1 and 2 - Generic Letter 88-20, Supplement 4 - Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities (TAC NO. M74488)," dated December 20, 1991.

2. Letter from William J. Museler to NRC, "Watts Bar Nuclear Plant (WBN) Units 1 and 2 - Generic Letter 88-20, Supplement 4 - Individual Plant Examination of External Events (IPEEE) - Extension Request," dated January 20, 1994.

3. Letter from Peter S. Tam of NRC to Dr. Mark O. Medford of TVA, "Watts Bar Unit 1 - Extension of IPEEE Submittal Date, Generic Letter 88-20, Supplement 4 (TAC NOS. M83693 and M83694)," dated March 4, 1994.

4. Letter from Patrick P. Carier to NRC, "Browns Ferry (BFN) and Watts Bar (WBN) Nuclear Plants - Response to NRC Generic Letter (GL) 88-20, Supplement 5: Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," dated November 6, 1995.

5. NUREG-1488, "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains."

6. Nuclear Energy Institute White Paper, "Justification for Reduction in IPEEE Program Based on Revised LLNL Seismic Hazard Results."

7. Sequoyah Nuclear Plant, "Individual Plant Examination for External Events," Final Report, June 29, 1995. Docket Nos. 50-327 and 50-328.

8. NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - Final Report."

ATTACHMENT 1

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
WBN SEISMIC DESIGN BACKGROUND

Following the initial completion of the plant in the mid 1980's, a number of technical issues arose that had the potential to effect the qualification of the plant. To address those technical issues related to seismic/structural qualification, TVA undertook a broad engineering Civil/Seismic Validation Program at WBN. This program was presented to the NRC in 1989 in a series of Corrective Action Programs (CAP) documents referred to collectively as CAPs. The program was approved by Safety Evaluation Reports (SER) for each of the CAPs. The overall program addressed the existing civil/seismic technical issues. In addition, where appropriate, advances in technology, since initial completion of the plant were incorporated in the validation effort. The methodology employed in the implementation of the CAPs was presented to and discussed with the NRC at a meeting on August 2, 1990.

The Civil/Seismic Validation Program consisted of numerous interrelated CAPs. An in-depth seismic review was a key aspect of the validation. The WBN design basis safe shutdown earthquake is Set A Ground Response Spectra with a modified Newmark shape anchored to a peak ground acceleration (PGA) of 0.18g (WBN Final Safety Analysis Report (FSAR) Section 3.7.1). The existing site specific ground response spectra , "Set B", with a PGA of 0.215g (Section 3.7 of the FSAR) was selected as the evaluation basis earthquake for the validation program. New amplified response spectra for Set B for the Category I structures was developed to support a complete evaluation of systems, structures, and components. However, if modifications or new designs were required to any systems, structures, or components, the modifications or new designs were based on the envelope of the revised original design basis spectra and the site specific (Set B) spectra. To support this commitment, Set C spectra were generated using original design basis criteria and current modeling techniques.

A brief summary of the Civil/Seismic CAPs follows:

- Reanalysis of nine Category I structures were performed using the methodology described in the Seismic Analysis CAP, and approved by NRC Inspection Report 50-390,391/89-21. The nine structures were reanalyzed using current analyses methods, upgraded structural models, and site specific response spectra (SSRS). The seismic models of the interior concrete structures (ICS) and Auxiliary and Control Building (ACB) were revised to include actual location of shear centers. Also the torsional constants in the seismic models of the ICS and North Steam Valve Room (NSVR) were revised to consider effects of warping and new analyses were performed. The upgraded building models were also used in development of the new (Set B and Set B+C) amplified response spectra. Block walls were evaluated and accepted as part of the WBN Bulletin 80-11, "Masonry Wall Design," effort.

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
WBN SEISMIC DESIGN BACKGROUND

- The Hanger and Analysis Update Program (HAAUP) addressed issues relating to piping and pipe supports which were previously identified to the NRC. TVA completed action plans for four distinct categories of piping under the HAAUP: 1) American Society of Mechanical Engineers (ASME) Large Bore Piping and Supports, 2) ASME Small Bore Piping and Supports, 3) Category I(L) Piping and Supports, 4) Instrument Lines and Supports. Potential seismic and thermal interaction of the piping categorized above was addressed in the WBN Integrated Interaction Issues Program (IIP). Additional program elements that were covered under the HAAUP include: 1) Pipe Support Component Substitution, 2) Pipe Rupture, 3) Buried Piping, and 4) Equipment Interfaces.

- The Equipment Seismic Qualification (ESQ) Program covered Category I equipment and position retention considerations for Category I(L) subcomponents in or on Category I electrical enclosures. The Category I(L) equipment was addressed in the IIP. As part of the ESQ Program, completeness and retrievabililty of qualification, documentation was established and equipment mounting conditions were evaluated. Discrepancies between design documents and as installed conditions were resolved. Extensive plant walk downs were performed and outliers were identified and resolved for these programs. Any modifications were designed as stated above.

- The major commodities (cable tray, conduit, and HVAC systems) and their supports were also reevaluated, screened and/or walked down for commodity clearance issues, location, structural adequacy, and anchorage issues. This was accomplished in accordance with their respective CAPs.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

This attachment presents detailed conclusions regarding the significant elements of each of the four sources of new information that have become available since the WBN IPEEE program plan was initially developed in 1991.

RECENT LICENSING OF WBN

Attachment 1 contains a discussion of the seismic design background and bases for WBN and a description of the Seismic CAPs completed prior to startup. Attachment 1 notes that structures, systems, and components were evaluated prior to startup for site specific ground response spectra (Set B) with a PGA of 0.215g. Set B response spectra were generated using current modeling and analytical techniques and criteria. In addition, TVA committed to use an envelope spectra of Set B and Set C (called Set B+C) for any new design or modifications. Each CAP was extensively audited and reviewed by the NRC prior to license issue.

The result of these programs is that WBN was conservatively evaluated against the seismic criteria of the Standard Review Plan (SRP). The completion of the CAPs has demonstrated that WBN is a seismically rugged plant. The net effect of the Civil/Seismic Validation Program is that WBN was evaluated for 'beyond design basis' conditions by the use of response spectra for evaluations and modifications that exceeded the original site licensing design basis spectra.

Two significant conclusions can be reached regarding the impact of startup activities on the previous IPEEE Program plan for a "focused scope" level of effort:

- Since this effort demonstrated beyond design basis seismic ruggedness, additional evaluation to the "focused scope" level of NUREG-1407 is not required to obtain the insights necessary to satisfy the intent of NUREG-1407. The evaluations performed for the seismic CAPs have provided significant insight into the relative seismic ruggedness of WBN systems and components.

- The WBN Civil/Seismic validation walk downs generally had the same attributes as IPEEE seismic screening walk downs. In addition, the plant structures and equipment were again walked down immediately before startup for any general plant configuration issues and loose/missing/damaged parts. Thus, the physical condition of WBN is excellent and the likelihood of finding significant IPEEE seismic outliers is remote. Therefore, WBN will take credit for the CAP walk downs as being applicable to the IPEEE program.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

NEW INFORMATION ON SEISMIC HAZARD

Additional sources of information related to seismic hazard and the effect on core damage frequency have become available since the WBN IPEEE Program plan was developed. The first is new seismic hazard estimates developed by Lawrence Livermore National Laboratory (LLNL) in 1993-94 and published in NUREG-1488 "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains." The second is an NEI white paper, "Justification for Reduction in IPEEE Program Based on Revised LLNL Seismic Hazard Results," that assessed the impact of the 1994 LLNL study in resolving the uncertainty in seismic hazard that existed at the time NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - Final Report," was developed. The evaluation of this additional information relative to the WBN IPEEE Program is presented below.

- Based on the 1994 LLNL seismic hazard estimates the seismic hazard is much less than previously reported. In particular, the estimated seismic hazard from the revised 1994 LLNL results indicates a lower seismic hazard for WBN than the perceived hazard based on the 1989 LLNL data for plants assigned to the "reduced scope" bin in Generic Letter 88-20, Supplement 4 and in NUREG-1407. This observation is consistent with part of the generic basis in the NEI white paper for changing "focused scope" plants to "reduced scope" plants. NEI's study shows clearly that revisions of the LLNL seismic hazard methodology since 1979 reflects a continuous decrease in the annual probability of exceeding the SSE for Eastern United States (EUS) plants. In fact, the probability of exceeding the SSE at essentially all EUS plants using the revised 1994 LLNL mean hazard results is less than the probability of exceeding the SSE at the original "reduced scope" plants using mean hazard results from the 1989 LLNL study. In addition, the NEI data showed that the probability of WBN exceeding its SSE based upon 1994 mean hazard results is less than the probability of exceeding the 0.3g NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," "focused scope" review level spectrum based on the 1989 LLNL mean hazard results.

- The NEI white paper also demonstrated that the use of the 1994 LLNL study results in a dramatic reduction in estimated Mean Core Damage Frequency (MCDF) compared to the 1989 LLNL study. The NEI white paper's analysis of core damage frequencies from NUREG-1407 shows an average value of approximately 5×10^{-5} per year, which was proposed as a risk threshold for assignment of plants into a re-binned "reduced scope" category. The MCDF values were

calculated using the mean hazard curves from both the 1994 LLNL and 1989 EPRI results. These estimated MCDF values are upper bound estimates of core damage since actual plant capacity will be significantly greater. NRC consultant draft report ERI/NRC-94-502 suggested a risk threshold of $1x10^{-5}$ per year for seismic MCDF. That report provided a fairly specific rationale for a threshold MCDF value of $2x10^{-5}$ per year, but drops the value to $1x10^{-5}$ per year value. It states that: "The $2x10^{-5}$ value is judged to be somewhat high for this purpose, since it constitutes a fairly significant contribution to the total core-damage frequency goal." Several of the NRC's seismic consultants in attendance at the October 21, 1994, "Seismic Revisit of Individual Plant Examination of External Events (IPEEE)" workshop stated that a seismic MCDF threshold value in the range of 2 to $3x10^{-5}$ per year would be more appropriate than $1x10^{-5}$ per year if a MCDF threshold approach was to be used. The suggested higher values were due mainly to recognition of the very conservative generic fragility functions used by Energy Research to develop the mean seismic core damage frequency in ERI/NRC-94-502. The MCDF for WBN using the mean seismic hazard from the 1994 LLNL and the 1989 EPRI studies is below $1x10^{-5}$ per year. Therefore, the seismic MCDF for WBN would be below the ranges of risk threshold values proposed.

The evaluation above provides justification that the seismic hazard and seismic MCDF for WBN are lower than that for the original "reduced scope" plants in NUREG-1407. This evaluation, coupled with the insights available from other sources, supports the conclusion that the intent of NUREG-1407 can be achieved without performing a "focused scope" level of review. This data suggests that a seismic evaluation to a "reduced scope" level is appropriate. WBN has chosen to perform an enhanced program beyond that for a "reduced scope" plant by continuing to apply the SMA walkdown methodology and by defining seismic demand at a level beyond the design basis PGA of 0.18g. Since the Civil/Seismic Validation Program evaluated the plant to the site specific response spectra (set B), the WBN IPEEE Program will define seismic demand in terms of the set B+C composite response spectra, which was used previously only for new designs or modifications. The B+C composite spectral shape is conservative in comparison to the NUREG/CR-0098 shape recommended by EPRI NP-6041 for IPEEE evaluations and is anchored to a PGA of 0.215g.

SEQUOYAH NUCLEAR PLANT (SQN) IPEEE PROGRAM

SQN recently completed and submitted the final report for its full scope IPEEE program to the NRC. SQN is the same basic design and type plant as WBN (Westinghouse pressurizer water reactor), and the equipment items, safe shutdown paths, and structures are very similar.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

The SQN IPEEE final report, and lessons learned, have been shared with WBN. Although no significant SQN outliers were found, the SQN potential outlier items (i.e., items outside conservative screening criteria) have been identified and will be reviewed for insights applicable to WBN. In particular, the SQN results provide insight into the relative ranking of potential outliers in terms of seismic ruggedness.

INSIGHTS FROM OTHER IPEEE PROGRAMS

Lessons learned from industry IPEEE programs indicate that the most significant findings result from the performance of seismic experience-based walk downs that identify anchorage or spatial interaction deficiencies. These potential deficiencies were addressed in the walk downs and evaluations for the Civil/Seismic CAPs described in Attachment 1. The modified program for the seismic event includes additional walk downs that will address any remaining potential for deficiencies in these areas.

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MAR 1 3 1997

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WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - GENERIC LETTER 88-20, SUPPLEMENT 4 - INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE) - REVISED SEISMIC SCOPE - (TAC NO. M83693)

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Sincerely,

J. A. Scalice

Enclosure

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
"REDUCED SCOPE"

INTRODUCTION

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TVA concluded that a reduction in the scope of review for the seismic event is warranted and appropriate. In particular, TVA considers that the objectives of GL 88-20, Supplement 4, can be achieved without performing a complete "focused scope" effort at the associated ground motion level of 0.3g. This letter provides details of the modified program and justification for the reduction in scope. The fire and the other external events portions of the IPEEE Program will be completed as previously planned. The Fire-Induced Vulnerability Evaluation, (FIVE) methodology will be used to assess the fire event. Other external events (except seismic) will be assessed using the screening methodology discussed in NUREG-1407 (Reference 8). WBN remains committed to submittal of the IPEEE Final Report within 120 days following the Unit 1 Cycle 1 outage.

MODIFIED PROGRAM FOR THE SEISMIC EVENT

The modified IPEEE Program for WBN differs from that previously planned in two key aspects; namely, in the level of walk down efforts to be performed and in the seismic level to which outlier components will be evaluated. WBN will take credit for the walk downs performed for the seismic CAPs. Additional detailed walk downs will be performed only for those items identified by the Seismic Review Team (SRT) as requiring review based on SQN outliers and lessons learned, expert judgment, and industry identified items with typical low seismic ruggedness. Confirmation of the ruggedness of items not identified for additional detailed walk downs and review is provided by the walk downs discussed above and in Attachment 1 that were performed for the seismic CAPs. A general area walk through of those items will be conducted to assure continued integrity of design basis plant configuration.

The IPEEE walk downs will be performed in accordance with EPRI Report NP-6041, "Nuclear Power Plant Seismic Margin." Members of the SRT will be trained in Seismic Qualification Users Group (SQUG) walk down screening and seismic evaluation methods. Therefore, the qualifications of the SRT are unchanged from the previous program plan.

Equipment that does not screen out by the EPRI guidance of EPRI NP-6041 will be evaluated to the seismic level defined by the site set B+C Ground Response Spectra (anchored at 0.215g) rather than the level of 0.3g associated with a "focused scope" program. This approach

reflects the conclusion in Attachment 2 that the 1994 LLNL study indicates the seismic hazard and mean core damage frequency (MCDF) for WBN is more consistent with that previously identified in NUREG-1407 for the original group of "reduced scope" plants.

The proposed modified WBN IPEEE Program will result in the following changes to the previous "focused scope" IPEEE Program:

- Define seismic demand at a level that exceeds the safe shutdown earthquake (SSE) design basis by using the existing WBN set B+C spectra (anchored at 0.215g). The existing WBN set B+C spectral shape envelops the NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," shape and can be used to conservatively define seismic demand. This replaces the review level earthquake with its peak ground acceleration of 0.3g.

- Application of expert judgment in safe shutdown equipment list (SSEL) screening for outliers
  - Include SQN lessons learned.
  - Consider WBN IPE insights.
  - Consider industry insights from other IPEEE programs.

- Modified Walk Down Scope
  - Use existing CAP walk down data to extent possible and applicable.
  - Perform detailed walk down of items designated by SRT.
  - Identify need for additional confirmatory walk downs to supplement data.

- Focused Outlier Evaluations
  - Utilize expert SRT judgment with peer review to evaluate ruggedness level.
  - Calculate high confidence of a low probability of failure (HCLPF) for items the SRT is unable to screen to the seismic demand level defined by WBN set B+C spectra.

The modified program plan described above includes the use of expert peer review to validate program implementation. Therefore, the intent to use the peer review process for program validation remains unchanged from the previous program plan.

SUMMARY

The completion of the Civil/Seismic Validation Program prior to startup has demonstrated that WBN is a seismically rugged plant. Since this effort demonstrated beyond design basis seismic ruggedness, additional evaluation to the "focused scope" level of NUREG-1407 is not required to obtain the insights necessary to satisfy the intent of NUREG-1407. By utilizing the current site seismic response spectra

curves (for set B+C anchored at 0.215g) in concert with expert SRT input, insights from the SQN IPEEE and the WBN IPE, and industry lessons learned, the intent of NUREG-1407 will be achieved with the modified program described above in a cost effective and timely manner.

Supporting justification for the modified program to be performed for WBN, is summarized below:

- The 1994 LLNL study and the subsequent evaluation by NEI show that the seismic hazard and seismic MCDF for WBN are lower than that for the original "reduced scope" plants in NUREG-1407 and suggest that WBN could be reclassified as a "reduced scope" plant.

- WBN has already performed a beyond design basis assessment as part of the Civil/Seismic Validation Program before licensing.

- WBN is a newly licensed plant that has completed numerous design basis and configuration reviews, walk downs, and upgrade modifications. WBN has also been subjected to loose/damaged/missing items walk downs, anchorage evaluations, and adequacy walk downs. WBN does not have the anchorage/configuration/equipment issues associated with older operating plants.

- Industry lessons learned regarding both anchorage and spatial interactions are adequately addressed by the seismic CAPs and the planned modified program.

- WBN has been in commercial operation for less than a year and will utilize the results of the full scope evaluation from its sister plant, SQN, to focus on potential outliers.

- Conducting a seismic evaluation at 0.215g versus 0.3g peak ground acceleration (PGA) would not significantly alter the hierarchy of WBN outlier items. Essentially the same insights will be gained and the intent of the IPEEE program will be satisfied with the modified program described above.

The modified program makes the associated effort more commensurate with the seismic risk as reflected in NUREG-1488, and uses a conservative interpretation of the NEI white paper to substantiate the revised level of evaluation. The planned approach provides an efficient, timely, and cost effective method for WBN to satisfy the goals of the seismic portion of the IPEEE.

As stated in NUREG-1407, the general objectives of the IPEEE are to develop an appreciation of severe accident behavior, understand the most likely severe accident sequences that could occur at a plant, and gain a qualitative understanding of the overall likelihood of core

damage. The key outcome of an IPEEE is "...the knowledge and appropriate improvements resulting from such an examination process." A recognition of the relatively low level of seismic risk associated with WBN indicates that an additional major investigation of the plant and equipment is not warranted or cost effective. The IPEEE objectives will be achieved by implementation of the modified program for the seismic event as described and justified herein. Other aspects of the overall WBN IPEEE Program will remain unchanged.

REFERENCES

1. Letter from John H. Garrity to NRC, "Watts Bar Nuclear Plant (WBN) Units 1 and 2 - Generic Letter 88-20, Supplement 4 - Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities (TAC NO. M74488)," dated December 20, 1991.

2. Letter from William J. Museler to NRC, "Watts Bar Nuclear Plant (WBN) Units 1 and 2 - Generic Letter 88-20, Supplement 4 - Individual Plant Examination of External Events (IPEEE) - Extension Request," dated January 20, 1994.

3. Letter from Peter S. Tam of NRC to Dr. Mark O. Medford of TVA, "Watts Bar Unit 1 - Extension of IPEEE Submittal Date, Generic Letter 88-20, Supplement 4 (TAC NOS. M83693 and M83694)," dated March 4, 1994.

4. Letter from Patrick P. Carier to NRC, "Browns Ferry (BFN) and Watts Bar (WBN) Nuclear Plants - Response to NRC Generic Letter (GL) 88-20, Supplement 5: Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," dated November 6, 1995.

5. NUREG-1488, "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains."

6. Nuclear Energy Institute White Paper, "Justification for Reduction in IPEEE Program Based on Revised LLNL Seismic Hazard Results."

7. Sequoyah Nuclear Plant, "Individual Plant Examination for External Events," Final Report, June 29, 1995. Docket Nos. 50-327 and 50-328.

8. NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - Final Report."

ATTACHMENT 1

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
WBN SEISMIC DESIGN BACKGROUND

Following the initial completion of the plant in the mid 1980's, a number of technical issues arose that had the potential to effect the qualification of the plant. To address those technical issues related to seismic/structural qualification, TVA undertook a broad engineering Civil/Seismic Validation Program at WBN. This program was presented to the NRC in 1989 in a series of Corrective Action Programs (CAP) documents referred to collectively as CAPs. The program was approved by Safety Evaluation Reports (SER) for each of the CAPs. The overall program addressed the existing civil/seismic technical issues. In addition, where appropriate, advances in technology, since initial completion of the plant were incorporated in the validation effort. The methodology employed in the implementation of the CAPs was presented to and discussed with the NRC at a meeting on August 2, 1990.

The Civil/Seismic Validation Program consisted of numerous interrelated CAPs. An in-depth seismic review was a key aspect of the validation. The WBN design basis safe shutdown earthquake is Set A Ground Response Spectra with a modified Newmark shape anchored to a peak ground acceleration (PGA) of 0.18g (WBN Final Safety Analysis Report (FSAR) Section 3.7.1). The existing site specific ground response spectra , "Set B", with a PGA of 0.215g (Section 3.7 of the FSAR) was selected as the evaluation basis earthquake for the validation program. New amplified response spectra for Set B for the Category I structures was developed to support a complete evaluation of systems, structures, and components. However, if modifications or new designs were required to any systems, structures, or components, the modifications or new designs were based on the envelope of the revised original design basis spectra and the site specific (Set B) spectra. To support this commitment, Set C spectra were generated using original design basis criteria and current modeling techniques.

A brief summary of the Civil/Seismic CAPs follows:

- Reanalysis of nine Category I structures were performed using the methodology described in the Seismic Analysis CAP, and approved by NRC Inspection Report 50-390,391/89-21. The nine structures were reanalyzed using current analyses methods, upgraded structural models, and site specific response spectra (SSRS). The seismic models of the interior concrete structures (ICS) and Auxiliary and Control Building (ACB) were revised to include actual location of shear centers. Also the torsional constants in the seismic models of the ICS and North Steam Valve Room (NSVR) were revised to consider effects of warping and new analyses were performed. The upgraded building models were also used in development of the new (Set B and Set B+C) amplified response spectra. Block walls were evaluated and accepted as part of the WBN Bulletin 80-11, "Masonry Wall Design," effort.

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WBN SEISMIC DESIGN BACKGROUND

- The Hanger and Analysis Update Program (HAAUP) addressed issues relating to piping and pipe supports which were previously identified to the NRC. TVA completed action plans for four distinct categories of piping under the HAAUP: 1) American Society of Mechanical Engineers (ASME) Large Bore Piping and Supports, 2) ASME Small Bore Piping and Supports, 3) Category I(L) Piping and Supports, 4) Instrument Lines and Supports. Potential seismic and thermal interaction of the piping categorized above was addressed in the WBN Integrated Interaction Issues Program (IIP). Additional program elements that were covered under the HAAUP include: 1) Pipe Support Component Substitution, 2) Pipe Rupture, 3) Buried Piping, and 4) Equipment Interfaces.

- The Equipment Seismic Qualification (ESQ) Program covered Category I equipment and position retention considerations for Category I(L) subcomponents in or on Category I electrical enclosures. The Category I(L) equipment was addressed in the IIP. As part of the ESQ Program, completeness and retrievabililty of qualification, documentation was established and equipment mounting conditions were evaluated. Discrepancies between design documents and as installed conditions were resolved. Extensive plant walk downs were performed and outliers were identified and resolved for these programs. Any modifications were designed as stated above.

- The major commodities (cable tray, conduit, and HVAC systems) and their supports were also reevaluated, screened and/or walked down for commodity clearance issues, location, structural adequacy, and anchorage issues. This was accomplished in accordance with their respective CAPs.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

This attachment presents detailed conclusions regarding the significant elements of each of the four sources of new information that have become available since the WBN IPEEE program plan was initially developed in 1991.

RECENT LICENSING OF WBN

Attachment 1 contains a discussion of the seismic design background and bases for WBN and a description of the Seismic CAPs completed prior to startup. Attachment 1 notes that structures, systems, and components were evaluated prior to startup for site specific ground response spectra (Set B) with a PGA of 0.215g. Set B response spectra were generated using current modeling and analytical techniques and criteria. In addition, TVA committed to use an envelope spectra of Set B and Set C (called Set B+C) for any new design or modifications. Each CAP was extensively audited and reviewed by the NRC prior to license issue.

The result of these programs is that WBN was conservatively evaluated against the seismic criteria of the Standard Review Plan (SRP). The completion of the CAPs has demonstrated that WBN is a seismically rugged plant. The net effect of the Civil/Seismic Validation Program is that WBN was evaluated for 'beyond design basis' conditions by the use of response spectra for evaluations and modifications that exceeded the original site licensing design basis spectra.

Two significant conclusions can be reached regarding the impact of startup activities on the previous IPEEE Program plan for a "focused scope" level of effort:

- Since this effort demonstrated beyond design basis seismic ruggedness, additional evaluation to the "focused scope" level of NUREG-1407 is not required to obtain the insights necessary to satisfy the intent of NUREG-1407. The evaluations performed for the seismic CAPs have provided significant insight into the relative seismic ruggedness of WBN systems and components.

- The WBN Civil/Seismic validation walk downs generally had the same attributes as IPEEE seismic screening walk downs. In addition, the plant structures and equipment were again walked down immediately before startup for any general plant configuration issues and loose/missing/damaged parts. Thus, the physical condition of WBN is excellent and the likelihood of finding significant IPEEE seismic outliers is remote. Therefore, WBN will take credit for the CAP walk downs as being applicable to the IPEEE program.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

NEW INFORMATION ON SEISMIC HAZARD

Additional sources of information related to seismic hazard and the effect on core damage frequency have become available since the WBN IPEEE Program plan was developed. The first is new seismic hazard estimates developed by Lawrence Livermore National Laboratory (LLNL) in 1993-94 and published in NUREG-1488 "Revised Livermore Seismic Hazard Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains." The second is an NEI white paper, "Justification for Reduction in IPEEE Program Based on Revised LLNL Seismic Hazard Results," that assessed the impact of the 1994 LLNL study in resolving the uncertainty in seismic hazard that existed at the time NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - Final Report," was developed. The evaluation of this additional information relative to the WBN IPEEE Program is presented below.

- Based on the 1994 LLNL seismic hazard estimates the seismic hazard is much less than previously reported. In particular, the estimated seismic hazard from the revised 1994 LLNL results indicates a lower seismic hazard for WBN than the perceived hazard based on the 1989 LLNL data for plants assigned to the "reduced scope" bin in Generic Letter 88-20, Supplement 4 and in NUREG-1407. This observation is consistent with part of the generic basis in the NEI white paper for changing "focused scope" plants to "reduced scope" plants. NEI's study shows clearly that revisions of the LLNL seismic hazard methodology since 1979 reflects a continuous decrease in the annual probability of exceeding the SSE for Eastern United States (EUS) plants. In fact, the probability of exceeding the SSE at essentially all EUS plants using the revised 1994 LLNL mean hazard results is less than the probability of exceeding the SSE at the original "reduced scope" plants using mean hazard results from the 1989 LLNL study. In addition, the NEI data showed that the probability of WBN exceeding its SSE based upon 1994 mean hazard results is less than the probability of exceeding the 0.3g NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," "focused scope" review level spectrum based on the 1989 LLNL mean hazard results.

- The NEI white paper also demonstrated that the use of the 1994 LLNL study results in a dramatic reduction in estimated Mean Core Damage Frequency (MCDF) compared to the 1989 LLNL study. The NEI white paper's analysis of core damage frequencies from NUREG-1407 shows an average value of approximately $5x10^{-5}$ per year, which was proposed as a risk threshold for assignment of plants into a re-binned "reduced scope" category. The MCDF values were

calculated using the mean hazard curves from both the 1994 LLNL and 1989 EPRI results. These estimated MCDF values are upper bound estimates of core damage since actual plant capacity will be significantly greater. NRC consultant draft report ERI/NRC-94-502 suggested a risk threshold of $1x10^{-5}$ per year for seismic MCDF. That report provided a fairly specific rationale for a threshold MCDF value of $2x10^{-5}$ per year, but drops the value to $1x10^{-5}$ per year value. It states that: "The $2x10^{-5}$ value is judged to be somewhat high for this purpose, since it constitutes a fairly significant contribution to the total core-damage frequency goal." Several of the NRC's seismic consultants in attendance at the October 21, 1994, "Seismic Revisit of Individual Plant Examination of External Events (IPEEE)" workshop stated that a seismic MCDF threshold value in the range of 2 to $3x10^{-5}$ per year would be more appropriate than $1x10^{-5}$ per year if a MCDF threshold approach was to be used. The suggested higher values were due mainly to recognition of the very conservative generic fragility functions used by Energy Research to develop the mean seismic core damage frequency in ERI/NRC-94-502. The MCDF for WBN using the mean seismic hazard from the 1994 LLNL and the 1989 EPRI studies is below $1x10^{-5}$ per year. Therefore, the seismic MCDF for WBN would be below the ranges of risk threshold values proposed.

The evaluation above provides justification that the seismic hazard and seismic MCDF for WBN are lower than that for the original "reduced scope" plants in NUREG-1407. This evaluation, coupled with the insights available from other sources, supports the conclusion that the intent of NUREG-1407 can be achieved without performing a "focused scope" level of review. This data suggests that a seismic evaluation to a "reduced scope" level is appropriate. WBN has chosen to perform an enhanced program beyond that for a "reduced scope" plant by continuing to apply the SMA walkdown methodology and by defining seismic demand at a level beyond the design basis PGA of 0.18g. Since the Civil/Seismic Validation Program evaluated the plant to the site specific response spectra (set B), the WBN IPEEE Program will define seismic demand in terms of the set B+C composite response spectra, which was used previously only for new designs or modifications. The B+C composite spectral shape is conservative in comparison to the NUREG/CR-0098 shape recommended by EPRI NP-6041 for IPEEE evaluations and is anchored to a PGA of 0.215g.

SEQUOYAH NUCLEAR PLANT (SQN) IPEEE PROGRAM

SQN recently completed and submitted the final report for its full scope IPEEE program to the NRC. SQN is the same basic design and type plant as WBN (Westinghouse pressurizer water reactor), and the equipment items, safe shutdown paths, and structures are very similar.

ATTACHMENT 2

GENERIC LETTER 88-20, SUPPLEMENT 4
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE)
ASSESSMENT OF NEW INFORMATION

The SQN IPEEE final report, and lessons learned, have been shared with WBN. Although no significant SQN outliers were found, the SQN potential outlier items (i.e., items outside conservative screening criteria) have been identified and will be reviewed for insights applicable to WBN. In particular, the SQN results provide insight into the relative ranking of potential outliers in terms of seismic ruggedness.

INSIGHTS FROM OTHER IPEEE PROGRAMS

Lessons learned from industry IPEEE programs indicate that the most significant findings result from the performance of seismic experience-based walk downs that identify anchorage or spatial interaction deficiencies. These potential deficiencies were addressed in the walk downs and evaluations for the Civil/Seismic CAPs described in Attachment 1. The modified program for the seismic event includes additional walk downs that will address any remaining potential for deficiencies in these areas.