

March 19, 2008

Mr. Ashok S. Bhatnagar  
Senior Vice President  
Nuclear Generation Development and Construction  
Tennessee Valley Authority  
1101 Market Street  
Chattanooga, Tennessee 37402-2801

SUBJECT: BELLEFONTE COMBINED LICENSE APPLICATION - NUCLEAR  
REGULATORY COMMISSION INSPECTION OF THE IMPLEMENTATION OF  
THE QUALITY ASSURANCE PROGRAM GOVERNING THE SIMULATED  
OPEN CHANNEL HYDRAULICS MODEL - INSPECTION REPORT NUMBERS  
05200014/2008-001 AND 05200015/2008-001 AND NOTICE OF VIOLATION

Dear Mr. Bhatnagar:

On February 19-22, 2008, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Tennessee Valley Authority (TVA) facility in Chattanooga, Tennessee. The purpose of the NRC inspection was to verify that quality assurance processes and procedures were effectively implemented with regards to the Simulated Open Channel Hydraulics (SOCH) model for the Bellefonte combined license application (COLA). The SOCH model was used to calculate the design basis flood presented in the Bellefonte Final Safety Analysis Report Sections 2.4.3, Probable Maximum Flood on Streams and Rivers, and 2.4.4, Potential Dam Failures. The enclosed inspection report presents the results of this inspection.

The NRC inspectors reviewed the relevant quality assurance (QA) procedures for design control, software verification and validation, and QA records related to the SOCH model, and reviewed the 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package. The verification and validation of the SOCH model, and all the design data inputs to the SOCH model, including the supporting Fortran programs, used as a basis for the Bellefonte COLA were not available for review.

Based on the results of this inspection, the NRC has determined that three violations of NRC requirements occurred. These violations are cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding them are described in detail in the subject inspection report. The violations are being cited in the Notice because the NRC inspection team concluded that TVA failed to identify that it had not adequately implemented its design control process (including design inputs and associated quality records) as it related to the SOCH model and did not use prescribed quality-related procedures as required by the TVA quality assurance program. Specifically, at the time of the inspection, TVA was unable to provide evidence to confirm that TVA conducted verifications or validations to ensure that the SOCH computer program functioned correctly. TVA was also unable to produce all design input data capturing critical information such as the measured topographic and bathymetric data used as design input for the SOCH model. This design input data would include any modification/revisions that had occurred from updated hydrographic surveys. Additionally, TVA had not implemented the appropriate procedures when applying the SOCH model for the 1998 Reassessment for the Effects of Dam Safety Modifications calculation package.

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

Sincerely,

**/RA/**

Patrick L. Hiland, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Enclosures:

1. Notice of Violation
2. Inspection Report 05200014/2008-001 and 05200015/2008-001

Docket Nos. 52-014  
52-015

cc w/encl: See next page

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

Sincerely,  
**/RA/**  
 Patrick L. Hiland, Director  
 Division of Engineering  
 Office of Nuclear Reactor Regulation

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Accession No.: ML080640487      \*See previous concurrence      \*\*I have seen this and noted corrections

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COL Bellefonte Mailing List

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cc:

Ms. Michele Boyd  
Legislative Director  
Energy Program  
Public Citizens Critical Mass Energy  
and Environmental Program  
215 Pennsylvania Avenue, SE  
Washington, DC 20003

W. Craig Conklin, Director  
Chemical and Nuclear Preparedness &  
Protection Division (CNPPD)  
Office of Infrastructure Protection  
Department of Homeland Security  
Washington, DC 20528

Mr. Marvin Fertel  
Senior Vice President  
and Chief Nuclear Officer  
Nuclear Energy Institute  
1776 I Street, NW  
Suite 400  
Washington, DC 20006-3708

Mr. Ronald Kinney  
South Carolina DHEC  
2600 Bull Street  
Columbia, SC 29201

Vanessa E. Quinn, Acting Director  
Technological Hazards Division  
National Preparedness Directorate  
Federal Emergency Management Agency  
500 C Street, NW  
Washington, DC 20472

Email

APAGLIA@Scana.com (Al Paglia)  
APH@NEI.org (Adrian Heymer)  
awc@nei.org (Anne W. Cottingham)  
bennettS2@bv.com (Steve A. Bennett)  
BrinkmCB@westinghouse.com (Charles Brinkman)  
chris.maslak@ge.com (Chris Maslak)  
cristina.lonescu@pgnmail.com (Christina Ionescu)  
CumminWE@Westinghouse.com (Edward W. Cummins)  
cwaltman@roe.com (C. Waltman)  
david.lewis@pillsburylaw.com (David Lewis)  
dlochbaum@UCSUSA.org (David Lochbaum)  
frankq@hursttech.com (Frank Quinn)  
garry.miller@pgnmail.com (Garry D. Miller)  
GovePA@BV.com (Patrick Gove)  
greshaja@westinghouse.com (James Gresham)  
gwcurtis2@tva.gov (G. W. Curtis)  
gzinke@entergy.com (George Alan Zinke)  
jgutierrez@morganlewis.com (Jay M. Gutierrez)  
jim.riccio@wdc.greenpeace.org (James Riccio)  
JJNesrsta@cpsenergy.com (James J. Nesrsta)  
john.o'neil@pillsburylaw.com (John O'Neil)  
Joseph.savage@ge.com (Joseph Savage)  
Joseph\_Hegner@dom.com (Joseph Hegner)  
KSutton@morganlewis.com (Kathryn M. Sutton)  
kwaugh@impact-net.org (Kenneth O. Waugh)  
MaddenG@BV.com (George Madden)  
Margaret.Bennet@dom.com (Margaret Bennet)  
maria.webb@pillsburylaw.com (Maria Webb)  
mark.beaumont@wsms.com (Mark Beaumont)  
matias.travieso-diaz@pillsburylaw.com (Matias Travieso-Diaz)  
media@nei.org (Scott Peterson)  
mgiles@entergy.com (M. Giles)  
mike\_moran@fpl.com (Mike Moran)  
nirsnet@nirs.org (Michael Mariotte)  
patriciaL.campbell@ge.com (Patricia L. Campbell)  
paul.gaukler@pillsburylaw.com (Paul Gaukler)  
Paul@beyondnuclear.org (Paul Gunter)  
phinnen@entergy.com (Paul Hinnenkamp)  
pmray@tva.gov (Phil Ray)  
pshastings@duke-energy.com (Peter Hastings)  
rclary@scana.com (Ronald Clary)  
rgrumbir@charter.net (Richard Grumbir)  
RJB@NEI.org (Russell Bell)  
RKTemple@cpsenergy.com (R.K. Temple)  
roberta.swain@ge.com (Roberta Swain)  
ronald.hagen@eia.doe.gov (Ronald Hagen)

sandra.sloan@areva.com (Sandra Sloan)  
SauerB@BV.com (Robert C. Sauer)  
sfrantz@morganlewis.com (Stephen P. Frantz)  
tom.miller@hq.doe.gov (Tom Miller)  
VictorB@bv.com (Bill Victor)  
waraksre@westinghouse.com (Rosemarie E. Waraks)  
lgorenflo@gmail.com (L. Gorenflo)

## NOTICE OF VIOLATION

Tennessee Valley Authority - Bellefonte  
Chattanooga, Tennessee

Docket Numbers 52-014 and 52-015

During an NRC inspection conducted at Chattanooga, Tennessee on February 19-22, 2008, violations of NRC requirements were identified. In accordance with the NRC Enforcement Policy, the violations are listed below:

1. Criterion III, "Design Control," of Appendix B to 10 CFR Part 50<sup>1</sup> states, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

TVA-NQA-PLN89-A, "Nuclear Quality Assurance Plan," Revision 18, dated December 4, 2007, Section 7.0, "Design Control," provides measures to ensure that applicable specified design requirements, such as design bases, regulatory requirements, and codes and standards, are correctly translated into specifications, drawings, procedures, or instructions. Specifically, Subsection 7.2.1.B states, in part, that design activities shall be documented in sufficient detail to permit verifications and audits.

TVA procedure NEDP-2, "Design Calculation Process Control," Revision 0, dated August 5, 1997, provides the requirements and instructions for the preparation, review, approval, issue, and revision of calculations and the preparation, review, and approval of calculation data used for TVA nuclear power plants. Subsection 3.1.9 states that the use of computer software shall comply with SPP-2.6, "Computer Software Control," and the documentation should be adequate to allow a qualified design verifier to reproduce the calculation results without recourse to the preparer. Subsection 3.2, "Calculation Procedure," states, in part, that the preparer develops sufficiently detailed calculations so that a qualified design verifier can independently review, understand, and reproduce the calculation results or verify the adequacy of the results without recourse to the preparer.

TVA procedure SPP-2.6, "Computer Software Control," Revision 0, dated July 14, 1997, provides the controls for computer software used in support of design, operation, modification, and maintenance of TVA nuclear plants to ensure the integrity of software output. Additionally, Appendix C to SPP-2.6 states, in part, that the validation test procedure, results, and software verification and validation report are quality assurance (QA) records.

Contrary to the above, as of February 22, 2008, TVA had not implemented the design control process as required by the TVA nuclear quality assurance plan. Specifically, objective evidence was not available during the inspection to confirm that verification and validation activities were conducted by TVA to ensure that the SOCH computer model and supporting programs used for predictions of flood levels, in support of the combined license application at the Bellefonte site, adequately and correctly performed all intended

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<sup>1</sup> 10 CFR Part 50 Appendix B is made applicable to TVA's combined license application by 10 CFR 52.79(a)(25).

functions. This issue has been identified as Violation 05200014/2008-001-01 and 05200015/2008-001-01.

This is a Severity Level IV violation (Supplement VII).

2. Criterion III of Appendix B to 10 CFR Part 50 states, in part, that design control measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in §50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions.

TVA-NQA-PLN89-A, Subsection 7.2.2.A states, in part, that design assumptions, design inputs, and deviations from approved design inputs shall be identified, reviewed, approved, and documented prior to declaring the structure, system, or component affected by the design operable. Subsection 7.2.6.A states, in part, that the translation of design inputs into design documents shall be verified and the verification documented. Subsection 6.3.2.A states, in part, that sufficient records and documentation shall be prepared and maintained to provide evidence of quality of items or activities affecting quality. QA records shall be legible, complete, and identifiable to the item involved.

NEDP-2, Section 3.1.22, states that for computer input files in support of activities such as reanalysis, evaluations and operability assessments, evidence shall be included that either indicates the electronic storage location of any supporting computer input files or certifies that the input files need not be electronically stored. NEDP-2 further states that an electronic file does not constitute the QA Record of the analysis input. To satisfy this requirement, a hard copy/microfiche of the input file must be included in the documentation of the quality-related analysis.

Contrary to the above, on February 22, 2008, TVA's 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package did not contain a hard copy/microfiche of the input files. Additionally, TVA was unable to produce copies of all input files for the SOCH model's supporting programs or provide objective evidence that design inputs had been controlled in accordance with NEDP-2 and the TVA QA program. This issue has been identified as Violation 05200014/2008-001-02 and 05200015/2008-001-02.

This is a Severity Level IV violation (Supplement VII).

3. Criterion V, "Instructions, Procedures, and Drawings" of Appendix B to 10 CFR Part 50 states, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings.

TVA-NQA-PLN89-A, Section 6.1.1, states, in part, that the QA program requires that quality-related activities shall be prescribed by documented procedures and instructions appropriate to the circumstances. Activities shall be accomplished in accordance with these procedures and instructions.



NEDP-2, Section 3.1.9, states in part that the use of computer software shall comply with SPP-2.6 and that the documentation should be adequate to allow a qualified design verifier to reproduce the calculation without recourse to the preparer.

SPP-2.6, states, in part, that SPP-2.6 functions as the Software Quality Assurance Plan (SQAP) and Software Verification and Validation Plan (SVVP) for computer software used to support the design, operation, modification, and maintenance of TVA's nuclear power plants unless otherwise noted.

Contrary to the above, as of February 22, 2008, TVA had not implemented procedure SPP-2.6 for the 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package. At the time of the inspection, TVA could not provide objective evidence that the 1998 calculation package had been implemented in a manner consistent with NEDP-2 for: 1) verifying and validating the SOCH model; 2) documenting the design inputs in the 1998 calculation; and 3) maintaining the above information as quality assurance records. This issue has been identified as Violation 05200014/2008-001-03 and 05200015/ 2008-001-03.

This is a Severity Level IV violation (Supplement VII).

Pursuant to the provisions of 10 CFR 2.201, TVA is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555, with a copy to the Chief, Quality and Vendor Branch 1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation or severity level; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid further violations; and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, consideration will be given to extending the response time.

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial

information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection, described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this 19th day of March 2008.

**U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NEW REACTORS**

Docket Numbers: 52-014 and 52-015

Inspection Report No: 05200014/2008-001 and 05200015/2008-001

Organization: Tennessee Valley Authority

Applicant Contact: Phillip Ray  
Tennessee Valley Authority  
1101 Market Street  
Chattanooga, TN 37402

Nuclear Industry: Tennessee Valley Authority developed and submitted for NRC review and approval a combined license application (COLA) for the Bellefonte nuclear plant.

Inspection Dates: February 19, 2008 through February 22, 2008

Inspectors: Kerri A. Kavanagh, Lead Inspector, CQVP/DCIP/NRO  
Milton Concepcion, Inspector, CQVP/DCIP/NRO  
Christopher B. Cook, Sr. Hydrologist, RHEB/DSER/NRO  
Kenneth R. See, Hydrologist, RHEB/DSER/NRO  
Yanely Malave, Engineer, RHEB/DSER/NRO  
Joseph M. Sebrosky, Sr. Project Manager, DNRL/NRO

Approved by: Juan D. Peralta, Chief  
Quality and Vendor Branch 1  
Division of Construction Inspection & Operational Programs  
Office of New Reactors

ENCLOSURE 2

## 1.0 INSPECTION SUMMARY

The purpose of this limited scope inspection was to verify that quality assurance policies and procedures were effectively implemented to control the use of the Simulated Open Channel Hydraulics (SOCH) model used to establish flooding levels at the Bellefonte (BLN) site. Sections 2.4.3, Probable Maximum Flood on Streams and Rivers, and 2.4.4, Potential Dam Failures, of the Bellefonte combined license application (COLA) discuss results related to the Probable Maximum Flood and Potential Dam Failures that were obtained using the SOCH model and supporting programs. The U.S. Nuclear Regulatory Commission (NRC) inspection team evaluated the quality activities associated with design control, including design inputs, procedures, and quality assurance (QA) records related to the use of the SOCH model in support of the Bellefonte COLA.

The inspection was conducted at the Tennessee Valley Authority (TVA) facility in Chattanooga, Tennessee. The inspection bases were:

- Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Part 50<sup>1</sup> of Title 10 of the *Code of Federal Regulations* (Appendix B),
- Part 21, "Reporting of Defects and Noncompliance," of Title 10 of the *Code of Federal Regulations* (Part 21), and
- 10 CFR 52.6, "Completeness and Accuracy of Information."

## 2.0 STATUS OF PREVIOUS INSPECTIONS

There were no previous NRC inspections in support of the Bellefonte COLA.

## 3.0 INSPECTION OBSERVATIONS AND OTHER COMMENTS

### 3.1 VERIFICATION AND VALIDATION OF THE SOCH MODEL

#### a. Inspection Scope

The NRC inspectors reviewed the policies and procedures governing the implementation of the TVA design control process to verify that they were consistent with the requirements of Criterion III, "Design Control," of Appendix B. Specifically, the NRC inspection team reviewed documentation associated with the verification and validation process for the SOCH model to verify compliance with and adequate implementation of these requirements.

#### b. Observations

TVA-NQA-PLN89-A, "Nuclear Quality Assurance Plan," Revision 18, dated December 4, 2007, Section 7.0, "Design Control," provides measures to ensure that applicable specified design requirements, such as design bases, regulatory requirements, and codes and standards, are

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<sup>1</sup> 10 CFR Part 50 Appendix B is made applicable to TVA's combined license application by 10 CFR 52.79(a)(25).

correctly translated into specifications, drawings, procedures, or instructions. Specifically, Subsection 7.2.1.B states, in part, that design activities shall be documented in sufficient detail to permit verifications and audits.

TVA procedure NEDP-2, "Design Calculation Process Control," Revision 0, dated August 5, 1997, provides the requirements and instructions for the preparation, review, approval, issue, and revision of calculations and the preparation, review, and approval of calculation data used for TVA nuclear power plants. Subsection 3.1.9 states, in part, that the use of computer software shall comply with SPP-2.6, "Computer Software Control," and the documentation should be adequate to allow a qualified design verifier to reproduce the calculation results without recourse to the preparer. Subsection 3.2, "Calculation Procedure," states, in part, that the preparer develops sufficiently detailed calculations so that a qualified design verifier can independently review, understand, and reproduce the calculation results or verify the adequacy of the results without recourse to the preparer.

TVA procedure SPP-2.6, "Computer Software Control," Revision 0, dated July 14, 1997, provides the controls for computer software used in support of design, operation, modification, and maintenance of TVA nuclear plants to ensure the integrity of software output. Additionally, Appendix C to SPP-2.6 states, in part, that the validation test procedure, results, and software verification and validation report are QA records.

The NRC inspection team reviewed TVA's 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package, dated March 20, 1998, which was the basis for the information provided in the Bellefonte COLA sections 2.4.3, Probable Maximum Flood on Streams and Rivers, and 2.4.4, Potential Dam Failures. In the 1998 calculation package, TVA analyzed changes to the Tennessee river system for their effects on the elevations and response times at TVA's nuclear plant sites for postulated heavy rainfalls and for postulated combinations of rainfall and seismic dam failures. These calculations were performed using the SOCH mathematical model developed by TVA. The calculation package included a report that discussed the reassessment of maximum flood levels for Bellefonte, Browns Ferry, Sequoyah, and Watts Bar nuclear power plants. The calculation package referenced documentation related to the SOCH model and supporting programs, which included the Flood Hydrology program (FLDHYDRO), Unit Hydrograph program (UNITGRPH), Dam Breaching program (DBREACH), HMR56 program (HMR56), Tributary Routing program (TRBRROUTE), and ARMA Channel Routing program (CHANROUTE). The calculation package also included calculation files associated with the reassessment of flood levels, including probable maximum flood calculations, seismic-caused dam failure calculations, warning time flood calculations, and SOCH geometry files.

The NRC inspection team requested further documentation to verify that the SOCH model was adequately controlled in accordance with SPP 2.6. Specifically, the NRC inspection team requested that TVA produce documented evidence of the verification and validation process that was used to demonstrate that the multiple TVA-developed software products accurately predicted the design-basis flood height at the Bellefonte site. The NRC inspection team held several meetings with TVA personnel to clarify information regarding verification and validation of the SOCH model and supporting programs.

While interviewing TVA personnel, the NRC inspection team was informed that TVA had concluded that the validation of the SOCH model was demonstrated through a comparison of

the Final Safety Analysis Report (FSAR) results from the existing TVA operating fleet and the calculated results in the 1998 calculation package. TVA also based its conclusions on the adequacy of the SOCH model on the independent reviews and verifications conducted during the development of the SOCH computer model in the 1970s. TVA stated that these reviews and verifications were conducted by TVA hydrologists and water resource engineers knowledgeable in flood analyses and modeling of watercourses within the Tennessee valley.

Notwithstanding the general statements made above, TVA did not provide the NRC inspection team with objective evidence of the existence of the SOCH model verification and validation documentation which demonstrated that the SOCH model and supporting software programs met the requirements of the TVA QA Program and associated procedures. Absent this documentation, the NRC inspection team was unable to verify the adequacy and acceptability of the SOCH model and supporting programs to ensure that the SOCH model provided accurate results. This issue has been identified as Violation 05200014/2008-001-01 and 05200015/2008-001-01.

c. Conclusions

The NRC inspection team concluded that TVA had not implemented the design control process as required by the TVA nuclear quality assurance plan. In addition, objective evidence was not available to confirm that verification and validation activities were conducted by TVA to ensure that the SOCH computer model and supporting software programs used for predictions of flood levels at the Bellefonte site adequately and correctly performed all intended functions. This issue has been identified as Violation 05200014/2008-001-01 and 05200015/2008-001-01.

### **3.2 DESIGN INPUTS AND QUALITY ASSURANCE RECORDS**

a. Inspection Scope

The NRC inspectors reviewed TVA's policies and procedures governing the control of design inputs to the SOCH model to verify that such controls were consistent with the requirements of Criterion III, "Design Control," of Appendix B. Specifically, the NRC inspection team reviewed documentation associated with the design inputs control process for the SOCH model to verify compliance with and adequate implementation of these requirements.

b. Observations

TVA-NQA-PLN89-A, Subsection 7.2.2.A states, in part, that design assumptions, design inputs, and deviations from approved design inputs shall be identified, reviewed, approved, and documented prior to declaring the structure, system, or component affected by the design operable. Subsection 7.2.6.A states, in part, that the translation of design inputs into design documents shall be verified and the verification documented. Subsection 6.3.2.A states, in part, that sufficient records and documentation shall be prepared and maintained to provide evidence of quality of items or activities affecting quality. QA records shall be legible, complete, and identifiable to the item involved.

NEDP-2, Section 3.1.22, states that for computer input files in support of activities such as reanalysis, evaluations and operability assessments, evidence shall be included that either indicates the electronic storage location of any supporting computer input files or certifies that

the input files need not be electronically stored. NEDP-2 further states that an electronic file does not constitute the QA Record of the analysis input. To satisfy this requirement, a hard copy/microfiche of the input file must be included in the documentation of the quality-related analysis.

During the inspection, the NRC inspection team requested documentation and records to demonstrate that the accuracy and validity of design basis input data (e.g., river cross-sections, topographic datasets, modifications to dams in the region, flood stage heights, etc.) were independently verified, and to show that these data had been updated to reflect changes to the Tennessee River/watershed since initial development of the data sets in the 1960s and 1970s.

In its response, TVA personnel informed the NRC inspection team that input data utilized in the SOCH model was controlled per NEDP-2, Revision 0. The NRC inspection team reviewed NEDP-2, and requested objective evidence to verify that the data input sets to the SOCH model were controlled as required in this procedure. The NRC inspection team noted that the 1998 calculation package did not contain a complete list of all design data input sets nor a reference to their electronic storage location per the requirements of NEDP-2. The 1998 calculation package did not contain a hard copy/microfiche of the input files. Additionally, TVA was unable to provide copies of all input files for the SOCH model's supporting programs or provide objective evidence that design inputs had been controlled in accordance with NEDP-2 and the TVA QA program. Therefore, the NRC inspection team was unable to establish the adequacy or accuracy of the data input sets applied to the SOCH model. This issue has been identified as Violation 05200014/2008-001-02 and 05200015/2008-001-02.

#### Safety Review Items Identified During the Inspection

While the purpose of the inspection was to verify that quality assurance policies and procedures were effectively implemented to control the use of the SOCH code, during the inspection the staff identified several items that affect the safety review of the Bellefonte COLA. The staff intends to provide TVA with requests for additional information (RAIs) associated with these items. Below is a brief summary of some of the items that the staff identified during the inspection that will lead to RAIs. Because these issues will be resolved using the RAI process TVA does not need to address them as part of their response to the notice of violation.

During several discussions with TVA, the NRC inspection team learned that TVA relied on the results generated by the 1998 calculation package to support the COL application for the Bellefonte site. The 1998 calculation package was used to estimate the water surface elevation along the Tennessee River arising from rainfall occurring over all or parts of the TVA watershed, and the breaching of both upstream and downstream dams. In order to correctly do this, accurate topographic and bathymetric information from the Tennessee watershed and river system must be incorporated into the SOCH model. This information is typically captured via topographic and bathymetric surveys and/or taken from existing topographic maps. Any inaccuracies in this data have the potential to produce errors in the results.

The NRC inspection discussed several technical assumptions described in the Bellefonte FSAR that were associated with application of the SOCH model. Of note was the maximum probable maximum flood (PMF) flood elevation at the Bellefonte site, which was reported to be 622.1 feet mean sea level (MSL) (see FSAR Section 2.4.3.5; FSAR Figure 2.4.3-249; 1998 Flood Reassessment calculation package). As noted in the 1998 calculation package and the FSAR, this flood elevation value assumed dam safety modifications at the Chickamauga Dam had been

implemented. These documents also reported that without the dam modifications the PMF height should be 0.4 ft higher at the Bellefonte site (elevation 622.5 ft MSL). TVA staff stated during the inspection that these dam safety modifications to the Chickamauga Dam had neither occurred nor were they planned in the near future. The NRC staff hydrologists questioned whether the FSAR text accurately described the status of these dam safety modifications and which PMF elevation value was used to compute the design basis flood height.

The NRC staff hydrologists also requested that TVA be prepared to discuss the new Chickamauga Lock (<http://www.lrn.usace.army.mil/pao/chickamaugalock/>) during the future site safety review. As reported on the United States Army Corps of Engineers web site, construction was initiated during the summer of 2007. NRC staff hydrologists requested that TVA be prepared to discuss how this construction project could potentially impact passage of the PMF at the Chickamauga Dam since several spillway bays appear to be impacted. The NRC staff hydrologists are also interested in understanding how this construction project was reflected in design basis flood calculations presented in FSAR Sections 2.4.3 and 2.4.4.

The NRC staff hydrologist also requested that TVA be prepared to discuss any field measurements near the Bellefonte site (e.g., river discharges, stage heights, water velocities) during the 2003 flood event (<http://www.srh.noaa.gov/mrx/hydro/may03/may03pictures.php>). The NRC staff noted that the Tennessee River discharge at Whitesburg (FSAR Table 2.4.2-204 for data; FSAR Figure 2.4.11-201 for map) for the 2003 storm event was 292,000 cubic feet per second (cfs). During the 1963 event, which was used as a verification dataset for the SOCH model in the FSAR (Figure 2.4.3-246), the Tennessee River discharge at the same location was less (285,000 cfs). The NRC staff also noted that the 1991 maximum stream flow at the Bellefonte site was 304,000 cfs. In general, the NRC staff would like to see verification of SOCH model results against field data collected during the largest discharge events at the Bellefonte site, with preference to more recent events that capture potential urbanization of the watershed and the latest condition of the river/floodplain.

As discussed above the NRC staff will identify the above items in a future RAI and will evaluate TVA's response to the RAIs as part of the safety review of the Bellefonte COLA.

c. Conclusions

The NRC inspection team concluded that TVA's 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package did not contain a hard copy/microfiche of the input files. Additionally, TVA was unable to provide copies of all input files for the SOCH model's supporting programs or provide objective evidence that design inputs had been controlled in accordance with NEDP-2 and the TVA QA program. This issue has been identified as Violation 05200014/2008-001-02 and 05200015/2008-001-02.

### **3.3 SOFTWARE DESIGN PROCEDURES**

a. Inspection Scope

The NRC inspectors reviewed TVA's policies governing the implementation of the procedure control process to verify that it was consistent with the requirements of Criterion V, "Instructions, Procedures, and Drawings," of Appendix B. Specifically, the NRC inspection team reviewed TVA's adherence to procedures prescribed for activities affecting quality.



b. Observations

TVA-NQA-PLN89-A, Section 6.1.1, states, in part, that the QA program requires that quality-related activities shall be prescribed by documented procedures and instructions appropriate to the circumstances. Activities shall be accomplished in accordance with these procedures and instructions.

NEDP-2, Section 3.1.9, states, in part, that the use of computer software shall comply with SPP-2.6 and that the documentation should be adequate to allow a qualified design verifier to reproduce the calculation without recourse to the preparer.

SPP-2.6, states, in part, that this document functions as the Software Quality Assurance Plan (SQAP) and Software Verification and Validation Plan (SVVP) for computer software used to support the design, operation, modification, and maintenance of TVA's nuclear power plants unless otherwise noted.

During the inspection, the NRC inspection team held multiple meetings with TVA personnel to discuss the TVA procedures in effect at the time of the 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation package. When the 1998 calculation package was generated, revision 0 of procedures NEDP-2 and SPP-2.6 were in place. TVA stated that TVA had not controlled the SOCH model and supporting software programs in accordance with SPP 2.6 but had developed the 1998 calculation package consistent with NEDP-2.

During discussions with TVA and review of the two procedures in place at the time of the 1998 calculation package, the NRC inspection team determined that TVA had not implemented NEDP-2 in a manner consistent with the TVA QA program. Specifically, TVA had not implemented SPP-2.6 and had not generated adequate documentation such that the SOCH model could be independently verified in accordance with procedure NEDP-2. Furthermore, TVA was unable to provide objective evidence that the 1998 calculation had been performed in accordance with NEDP-2. NEDP-2 requires that design inputs used in the SOCH model for the 1998 calculation be documented in the 1998 calculation package. NEDP-2 also states that the design inputs to the quality-related analyses and verification and validation results and reports are quality assurance records. In all cases, TVA could not provide objective evidence that these records had been generated or controlled as quality assurance records. TVA's failure to follow established procedures has been identified as Violation 05200014/2008-001-03 and 05200015/2008-001-03.

c. Conclusions

The NRC inspection team concluded that TVA had not implemented procedure SPP-2.6 for the 1998 Flood Reassessment for the Effects of Dam Safety Modifications calculation. At the time of the inspection, TVA could not provide objective evidence that the 1998 calculation had been implemented in a manner consistent with NEDP-2 for: 1) verifying and validating the SOCH model; 2) documenting the design inputs in the 1998 calculation; and 3) maintaining the above information as quality assurance records. Failure to follow established procedures has been identified as Violation 05200014/2008-001-03 and 05200015/2008-001-03.

#### 4.0 ENTRANCE AND EXIT MEETINGS

In the entrance meeting on February 19, 2008, the NRC inspection team discussed the scope of the inspection, outlined the areas to be reviewed, and established interfaces with TVA staff and management involved in the Bellefonte COLA. In the exit meeting on February 22, 2008, the NRC inspection team discussed the activities conducted during the inspection and preliminary findings with representatives of TVA management and staff.

#### 5.0 PARTIAL LIST OF PERSONS CONTACTED

Name	Position	Organization
Penny Selman	Civil Engineer	TVA***
Eddie R. Grant	Contractor	NUSTART***
Phillip Ray	Project Manager, Licensing	TVA*
Paul Byron	Watts Bar U2 Licensing	TVA***
Ken Spates	Manager Component Eng.	TVA*
John Fornicola	Manager Nuclear Assurance	TVA***
Gary Curtis	Sr. Project Manager	TVA*
Greg Lowe	Contractor	TVA*
Steve Limback	River Operations	TVA***
Andrea Sterdis	Manager, Licensing	TVA**
Perry Maddux	Project Manager	TVA**
Jack Bailey	VP Nuclear Generation Devel.	TVA**
Philip Smith	Sr. Project Manager, NA	TVA**
Gordon P. Arent	Manager Licensing WB2	TVA**

\* Attended entrance and exit meeting

\*\* Attended exit meeting

\*\*\* Attended entrance meeting