

U.S. Nuclear Regulatory Commission
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OCT 28 1992

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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
REPLY TO NRC'S MARCH 17, 1992 LETTER TO TVA
VIOLATION 390/92-01-03DESCRIPTION OF VIOLATION

10 CFR 50, Appendix B, Criterion III, "Design Control," requires in part that design control measures be established to assure that regulatory requirements are correctly translated into specifications and procedures and that quality standards be specified and included in design documents. It further requires that measures provide for verifying the adequacy of design by individuals other than those who performed the original design.

Tennessee Valley Authority Nuclear Quality Assurance Plan TVA-NQA-PLN89-A, Revision 2, Section 7.0, Design Control, requires that measures be established to ensure that applicable design requirements are correctly translated into specifications, procedures, or instructions. It also requires that measures be established to control the preparation, review, and approval of design output documents to ensure that technical and quality requirements are incorporated prior to issuance.

Contrary to the above, on February 7, 1992, the TVA approved electrical design output cable pull calculations associated with Workplan D-08413-01, Rework Cable/Conduit, Remove and Reinstall Cable, were inadequate in that the following deficiencies were identified:

EXAMPLES 1 THROUGH 3

1. Cable pull calculations dated February 3, 1992, associated with the workplan omitted two of three single conductor cables for calculating pull tension limits. Therefore, the design output calculations failed to reflect scheduled cable installations.
2. Cable pull calculations failed to address possible cable jamming during cable installations by using nominal average outside cable diameters instead of actual field measurements of cable outside diameter as required by design specifications and procedures.
3. Cable pull tension calculations were incorrectly determined to be adequate by both the preparer and a reviewer even though two cables were omitted from all but one of the referenced calculations.

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VIOLATION 390/92-01-03TVA RESPONSE EXAMPLES 1 THROUGH 3REASON FOR THE VIOLATION

Prior to pulling cable in the field, Revision 3 of site procedure Modification/Addition Instruction (MAI)-3.2, "Cable Pulling For Insulated Cables Rated Up to 15,000 Volts," required that cable pull tension calculations based on conductor strength and sidewall pressure limits be performed using computer program CBLPUL in order to identify the proper pulling mechanism and to prevent cable damage. These violation examples occurred because the procedure failed to clearly identify the need to treat cables consisting of multiple single conductors in a special manner and because the procedure called for the field cable outside diameter (OD) to be entered in the wrong field of the program. The particular calculations identified by the violation involve a cable consisting of three individual conductors. The computer program, CBLPUL, has provisions to address this case, in that, the three conductors are to be entered into the program as three separate cables. The responsible engineer entered the data for the cable only once and thought that the program accounted for the other two conductors. The engineer also inserted the measured outside cable diameter in the CBLPUL maximum OD field instead of the average OD field. Because the program uses the average OD field for the calculation, this action resulted in the program defaulting to the nominal average outside cable diameter inherently contained in the computer program. Had the data for the other conductors been entered, and in the correct fields, cable jamming would have been adequately addressed. Both the responsible engineer and the reviewer failed to identify the faulty data entry for the cable and failed to question a computer error message indicating a pullby condition limit had been exceeded when the cables being installed were to be pulled into an empty conduit. MAI-3.2 included detailed steps to utilize the CBLPUL program. Although the responsible engineer and the peer reviewer had been trained to the requirements of MAI-3.2, neither had been specifically trained in the use of the computer program CBLPUL version 3.2.

CORRECTIVE STEPS TAKEN AND RESULTS ACHIEVED

TVA initially placed interim administrative controls on cable pull calculations. These controls require second-party verification by Nuclear Engineering on pull tension calculations performed by the field. This action was taken at the time that the condition was identified and remained in effect until CBLPUL program version 4.0 was issued, applicable site procedures were updated, and users were trained. The calculations referenced in this violation that were in error have been redone under these interim administrative controls.

As discussed in Enclosure 2, because these interim controls were not completely effective, additional measures were required.

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CORRECTIVE STEPS TO BE TAKEN TO AVOID FURTHER VIOLATIONS

TVA has revised the CBLPUL software/user manual to add instructions to enter each conductor of cables composed of individual conductors and to add training information enhancements that emphasize clearly the requirement of how to use the program for this situation.

TVA has revised MAI-3.2 to delete information in Appendix E pertaining to making data entries in CBLPUL. This revision provides reference to CBLPUL users manual and clarifies requirements relative to the "review" functions involved in cable pull calculations. This revision also adds the option to perform pull calculations manually for simple cable pulls.

TVA has identified the workplans involving cables which were issued after MAI-3.2 was issued requiring the use of CBLPUL for calculating cable pull tensions. As a result of a review of these workplans, TVA has evaluated and dispositioned an error message found in a calculation for one of these workplans.

Initial training for CBLPUL version 4.0 has been conducted for the designated program users and software/user manuals assigned. Training has been provided for modifications field engineers which emphasized the role of the checker in evaluating error messages. TVA has also established and conducted sessions on self-checking for modifications field engineers.

TVA has reviewed site procedures to ensure that engineering requirements involving field calculations are properly conveyed in site procedures.

This calculation issue discussed here and in the following sections is documented and tracked by Problem Evaluation Report (PER) WBP920031 and Incident Investigation II-W-92-001.

DATE WHEN FULL COMPLIANCE WILL BE ACHIEVED

TVA is in full compliance.

EXAMPLE 4

The CBLPUL computer program used to calculate pull tension limits was inaccurate in that it was missing a multiplication safety factor for calculating the maximum sidewall pressure pulling tension.

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The reason for the violation was that TVA issued a revision to Construction Specification G-38, "Installation, Modifications, and Maintenance of Insulated Cables Rated Up to 15,000 Volts," for use at the sites without a corresponding update to the computer program used to implement G-38 requirements. TVA committed by letter dated October 11, 1990, to have additional engineering participation when the expected sidewall bearing pressures for new cable installations approach the maximum allowable limits. G-38, Revision 10, was issued to add a 0.8 factor to the equations for sidewall pressure pulling tension (T_{swp}) to reflect a 20 percent engineering evaluation margin. This 0.8 factor was selected as a threshold for engineering participation. The 0.8 factor was not incorporated in the computer software for CBLPUL when Revision 10 of G-38 was issued.

At the time that Revision 10 to G-38 was being issued, a revision to the CBLPUL computer software was also being planned by TVA to incorporate the G-38 changes. The issuance of the CBLPUL revision was delayed due to other enhancements being made. TVA failed to recognize the significance of this inconsistency between the specification and the computer software program.

CORRECTIVE STEPS TAKEN AND RESULTS ACHIEVED

TVA has issued computer software program CBLPUL, version 4.0, to add the 0.8 factor in the equations for sidewall pressure pulling tension (T_{swp}) to reflect the 20 percent engineering evaluation margin.

In addition, TVA has reviewed workplans involving cable installation issued after November 30, 1990 (date of issue of G-38 Revision 10), to identify those cables in which CBLPUL was used to calculate pull tensions and T_{swp} was the limiting factor. Of the four cables identified to have been pulled in excess of 80 percent of the T_{swp} , none exceeded the 100 percent T_{swp} values since the pull rope break link had been sized adequately.

CORRECTIVE STEPS TO BE TAKEN TO AVOID FURTHER VIOLATIONS

TVA has revised G-38 by Specification Revision Notice (SRN)-G-38-132 to endorse version 4.0 of CBLPUL. Changes to G-38 affecting CBLPUL require a new version to be developed prior to issuance of the G-38 revision, thus ensuring adequate maintenance of CBLPUL.

DATE WHEN FULL COMPLIANCE WILL BE ACHIEVED

TVA is in full compliance.

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The CBLPUL computer program used to calculate pull tension limits was not verified and validated to limit the maximum allowed conductor pull tension when basket-weave grips are used to pull shielded and unshielded cables.

TVA RESPONSE EXAMPLE 5REASON FOR THE VIOLATION

The reason for the violation was that the CBLPUL computer program was not completely verified and validated in accordance with Nuclear Engineering Procedure (NEP) 3.8. Construction Specification G-38, Revision 10, requires that when basket-weave grips are used to pull cable the maximum allowed conductor pull tension (T_c) be limited to 1000 pounds/grip for shielded cables and 2000 pounds/grip for unshielded cables. A review of the validation calculations for computer program CBLPUL has determined that the validation of the software program did not include measures to ensure the maximum allowable pull tension limit was not exceeded when basket-weave grips are used to pull shielded and unshielded cables.

CORRECTIVE STEPS TAKEN AND RESULTS ACHIEVED

TVA has performed verification calculations of the subroutines in version 3.2 of the program and determined that the subroutines were technically correct. TVA has performed and documented validation/verification of calculation parameters in version 4.0 of computer program CBLPUL in accordance with NEP 3.8.

CORRECTIVE STEPS TO BE TAKEN TO AVOID FURTHER VIOLATIONS

The personnel involved have been trained on this violation with emphasis on compliance with NEP 3.8 verification and validation requirements.

DATE WHEN FULL COMPLIANCE WILL BE ACHIEVED

TVA is in full compliance.

ADDITIONAL INFORMATION

TVA has revised MAI-3.2 to reflect the requirement added to G-38 on SRN-G-38-132 which will require that the method of attachment for cable pulls be stated in the work implementing document and that any changes in the attachment method require recalculation of pull tension limits.

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Electrical Design Standard DS-E12.1.13, "Class 1E Cable ODs and Weights," was used as a design input document when performing pull tension calculations but had not been designated as a design input document, and the document also contained inaccurate computer program input information with regard to whether cables are shielded or unshielded.

TVA RESPONSE EXAMPLE 6REASON FOR THE VIOLATION

This violation occurred because the responsible engineer performing the calculation identified in the violation relied upon Electrical Design Standard DS-E12.1.13, "Class 1E Cable ODs and Weights," for information concerning whether the cable was shielded or unshielded.

CORRECTIVE STEPS TAKEN AND RESULTS ACHIEVED

Computer software CBLPUL, version 4.0, and the user manual have been enhanced to indicate the correct technical sources for obtaining shielding information on cables. Furthermore, these changes are being stressed in the training for CBLPUL.

CORRECTIVE STEPS TO BE TAKEN TO AVOID FURTHER VIOLATIONS

Electrical Design Standard DS-E12.1.13 has been revised to state the sources for obtaining design input regarding shielded and unshielded cable information.

DATE WHEN FULL COMPLIANCE WILL BE ACHIEVED

TVA is in full compliance.

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WATTS BAR NUCLEAR PLANT UNIT 1
REPLY TO NRC'S AUGUST 14, 1992 LETTER TO TVA
VIOLATION 390/92-01-03DESCRIPTION OF ADDITIONAL DEFICIENCIES

While performing an extent of condition review for Problem Evaluation Report (PER) WBP920137 which had identified calculation errors in old program workplans, two maximum pull tension calculation errors were identified in new program workplans. The two deficient calculations involved improper use of a multiplier for the maximum conductor pulling tension T_c (i.e., the choice of 0.8 for power and control cables rather than the proper value of 0.6 for signal cables). Due to these two newly-identified errors, PER WBP920137 was upgraded to Significant Corrective Action Report (SCAR) WBSA920041.

On June 16, 1992, during a monitoring activity, the site Quality Assurance organization identified 16 cables where the average cable outside diameter had been used in minimum training radius calculations instead of the maximum cable outside diameter as required by procedure. TVA initiated Finding Identification Report (FIR) WBF920047 which was subsequently incorporated into SCAR WBSA920041.

On June 23, 1992, TVA placed a hold on further preparation of field calculations performed by the Modifications group until the cable calculation problems were addressed. On June 25, 1992, after an evaluation of the problems had occurred, TVA lifted the hold on the preparation of field calculations by issuance of a memorandum which described the following interim corrective actions: Each calculation was to be verified by a checker, reviewed by a Nuclear Engineering technical reviewer, and reviewed by a Quality Engineer reviewer. These reviews were to be documented by a form to be included with the calculation in the appropriate work implementing document. These interim corrective actions were to remain in effect until final corrective actions were fully implemented.

On July 7, 1992, a cable consisting of two single conductors was discovered to have been pulled using a cable calculation which was prepared on June 29, 1992, as though it were a single two-conductor cable. TVA initiated Incident Investigation II-W-92-011 and placed a hold on all cable pulling activities by issuance of a memorandum dated July 7, 1992.

REASONS FOR ADDITIONAL PROBLEMS

The specific problems identified in violation 390/92-01-03 involved the use of the computer software CBLPUL in the preparation of field calculations. The actions taken collectively by TVA in response to this violation were to accomplish two goals. The first goal was to establish interim actions in order for field work to continue. The interim action of providing an option to perform field calculations manually with a second-party review of the field calculations by Nuclear Engineering was taken to accomplish this goal. The second goal of the corrective actions was to correct the problems associated with using the computer software CBLPUL for calculations in the field environment. The remainder of the violation response corrective actions were to accomplish this goal.

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Implementation of the interim actions created unforeseen problems as uncovered by Incident Investigation II-W-92-011. The root cause of the specific deficiency investigated by II-W-92-011 was determined to be perceived pressure by the preparer and the reviewers to complete the manual cable pull calculation in order to support the cable pull. The workplan requiring the cable pull calculation was approved for work on April 23, 1992, and signed through the work control unit on June 26, 1992. The assignment of a responsible engineer was not made until June 29, 1992. This was one day prior to starting work in the field. This condition did not allow adequate time for preparing and attaining required levels of review for the calculations. The compressed schedule was an apparent failure by TVA to coordinate work assignments in a timely manner.

The incident investigation also identified the following contributing causes:

1. The work area environment for the preparer and the modifications reviewer was not conducive to error free work. Modifications field engineers performed and independently reviewed the calculations at temporary offices located on the plant turbine deck. The conditions experienced by the field engineers were excessive background noise, high temperatures, and a constant flow of personnel.
2. The department managers did not ensure that previous interim corrective actions were effective. Previous reviews by Nuclear Engineering had identified a significant error rate in manual calculations. A formal method had not been established to identify or quantify these errors and ensure they were escalated to the appropriate management level for corrective action.
3. The department managers did not properly address the requirements and expectations necessary to ensure an orderly transfer from computer generated cable pulling calculations to the interim process of preparing the calculations manually. When this change was implemented, no procedures were put in place to establish the requirements for format, preparation, or review of manually prepared calculations. Also, managers did not ensure that employees were adequately qualified to perform the task of preparing and reviewing manual calculations.

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VIOLATION 390/92-01-03CORRECTIVE STEPS TAKEN AND RESULTS ACHIEVED

TVA has performed an extent of condition review of computations and calculations performed by Modifications between November 22, 1991 and July 7, 1992, under the new program work control documents. For the purpose of this review, calculations and computations were defined as follows: 1) Computations are basic functions of multiplication, division, addition and/or subtraction performed to support field work activities. 2) Calculations are complex functions of multiplication, division, addition and/or subtraction to support field related work activities. The complexity of these functions was evaluated based on the number of variables required to determine the final solution. Additionally, the complex nature for determining values from cable characteristics was considered during this review. New program work control documents encompassed by this review were electrical and mechanical workplans and work requests/work orders.

In the electrical workplans, the four areas reviewed were maximum pull tension, minimum bend radius, minimum acceptable megger reading, and Raychem sizing. The review identified errors in three of the four areas. For Raychem sizing, the review revealed that new program workplans performed during this timeframe utilized installation of Raychem kits which do not require calculations.

In the mechanical workplans, the six areas reviewed were pressure tests, welding data sheets, torque calculations, support clearances, anchors, and cold bending - minimum design thickness computation. The review identified errors in welding data sheets for structural steel and the cold bending areas.

In the work request/work orders, the four areas reviewed were minimum training radius, minimum wall thickness, hydro, and miscellaneous which included minimum acceptable megger reading, polarization index, and abnormal loading. The review identified errors in the minimum training radius and minimum wall thickness areas.

The calculation errors identified by this review will be evaluated by TVA to determine safety significance. The calculations in the affected workplans will be supplemented pending the result of this review. At this time, this review has determined that no hardware modifications are required on systems previously released for preoperational testing. If hardware is affected on the remaining systems, TVA will correct the hardware deficiencies prior to turnover of these systems.

CORRECTIVE STEPS TO BE TAKEN TO AVOID FURTHER DEFICIENCIES

The responsibility for cable pull calculations was assigned to Nuclear Engineering to support field work activities on July 17, 1992. With the transfer of field engineering from the Modifications organization to Nuclear Engineering, all calculations and computations to support field work activities came under Nuclear Engineering control on October 5, 1992. TVA is revising work controlling procedures to define the coordination between the Modifications organization and Nuclear Engineering for performing calculations.

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In the computation area, Modifications and Additions Instruction (MAI)-4.6, "Cold Bending of Plate and Bar," has been revised to clarify the difference between plate and "flat" bar and to clarify which section of the procedure to use for 3/8-inch flat bar. No further action in the computation area is required except for additional training as described below.

Since the significant errors identified were in the field calculation area instead of the field computation area, TVA has established a suitable work area for a group under the direction of Nuclear Engineering to perform field calculations in electrical and mechanical areas. The group members have received formal training in self-checking, electrical manual calculations, and CBLPUL version 4 software. Depending upon the number of calculations and complexity of the request, a nominal turnaround time of two days has been established for the calculation process.

TVA has implemented the following changes to aid the calculation group in performing the calculations: 1) Standardized calculation forms have been established which are being used to prepare field calculations for minimum pulling radius, minimum training radius, maximum pull tension, and minimum acceptable megger reading. 2) Design Change Notice (DCN) Q-20056-A has been issued to define cable descriptions and characteristics. 3) Computer software CBLPUL version 4 has been implemented.

Self-checking training has been performed for personnel that provide technical support to the field as well as field engineers not previously trained.

Rolldown meetings were conducted with appropriate personnel to reemphasize the need to verify that employees are qualified to perform assigned tasks and understand accountability. Modifications personnel have been issued a memorandum emphasizing the importance of using only the procedures in which they have been trained.

Checklists for electrical field calculations with an acceptable quality level have been established under the WBN's Quality Review Pipeline. This action is to provide feedback in the weekly report to appropriate management of electrical field calculations deficiencies.

In order to provide feedback, the members of the incident investigation event team for Incident Investigation II-W-92-001 associated with the initial violation response and the managers who approved the investigation report will review the corrective action plan for SCAR WBSA920041.

DATE WHEN FULL COMPLIANCE WILL BE ACHIEVED

TVA expects to complete the safety significance review of the errors identified, the revision to the work controlling procedures, the workplan supplements, and the review of the corrective action plan for SCAR WBSA920041 discussed above by November 30, 1992. As stated above, no hardware modifications are required for systems previously released for preoperational testing. If any necessary hardware corrections are required for the remaining systems, these will be performed on a system turnover basis.