TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
5N 157B Lookout Place

APR 07 1989

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

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - REVIEW OF THE WATTS BAR WELDING PROGRAM FOR UNIT 2

References:
1. S. A. White's (TVA) letter to S. D. Ebneter (NRC) dated February 17, 1988, Transmittal of DOE/WEP Final Reports
2. J. G. Partlow's (NRC) letter to S. A. White (TVA) dated August 12, 1988, Watts Bar Nuclear Plant Welding Program
3. C. C. Mason's (TVA) letter to H. R. Denton (NRC) dated December 5, 1986

TVA's response to NRC question 6 contained in enclosure 1 of our December 5, 1986 letter described the approach for assessing unit 2 welding. In meeting this commitment, TVA has utilized the results from unit 1 weld inspections and subsequent unit 2 inspections to develop an approach for assessing unit 2 welding. This letter and its enclosure provide the results of the TVA assessment of WBN unit 2 for welding program adequacy. Because of comparable construction programs for both units and completed reinspections, TVA reinspection activities for unit 2 have been concluded.

During actions taken by TVA to evaluate the welding concerns at WBN, TVA contracted with the Department of Energy (DOE) to provide an independent assessment of the quality of welding at WBN. DOE selected EG&G to perform this assessment. The original scope of the EG&G program included a programmatic review of WBN (both units) and a reinspection assessment based on a statistically random sample of welds from unit 1 and common (those facilities shared by both units). Subsequently, EG&G was contracted to evaluate American Society of Mechanical Engineers (ASME) and American National Standards Institute (ANSI) welds on unit 2.

EG&G has completed their work, and TVA has reported their findings on unit 1 and common in the reports submitted to NRC by reference 1. NRC's comments on that transmittal were provided in reference 2, and these comments and the status of activities at WBN were discussed in the October 11, 1988 meeting with NRC.

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Throughout the construction of WBN, the unit 2 construction was under the same licensing commitments, the same engineering, construction, and quality assurance requirements and management as unit 1. The construction crafts were selected from the same pool as unit 1. TVA concluded early in the WBN assessment, because of these similarities, there would not be a significant difference between the units in the results obtained during a reinspection of welds. The data reviews performed as discussed in the enclosure confirm that the weld quality of unit 2 is comparable to unit 1.

The reinspection of unit 1 identified various problems resulting in several corrective action programs. Each of these problems was bounded and corrective actions identified. The corrective actions are generically applicable to unit 2, and specific corrective actions will be taken should the generic review indicate the need. Also, any remaining specific unit 2 employee concerns will be resolved by the appropriate responsible line organization when unit 2 returns to active preparation for licensing.

Welding project activities were not limited only to unit 1. The Phase I program review, generic nonconformance report investigation, and reinspection data analysis have included both units.

The unit 2 welding populations which have a higher potential for safety implications (ASME and ANSI) have been evaluated by sampling reinspections performed by EG&G. The evaluation of existing TVA reinspection data, together with actions already in place that will apply to both units, has determined that the weld reinspection populations are already characterized sufficiently and do not require additional inspections.

TVA concludes that no additional reinspection activities are required to review WBN unit 2 welding program adequacy other than those already completed. This conclusion is based on:

- The construction history similarities of WBN units 1 and 2, and the improvements made at WBN that affect unit 2 weld quality. (See enclosure for details.)
- The welding project activities.
- The results of previous inspections on WBN unit 2.
- The TVA commitment to apply to unit 2 the applicable unit 1 corrective action programs.
- The EG&G reinspection results of unit 1 and unit 2.
- Future welding assessment activities will address licensing commitment compliance on an ongoing basis.

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This submittal contains no new commitments. If there are any questions or further discussion is required, please contact D. E. McCloud at (615) 365-8650.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

M J Ray for

C. H. Fox, Jr., Vice President and
Nuclear Technical Director

Enclosure
cc (Enclosure):

Ms. S. C. Black, Assistant Director
for Projects
TVA Projects Division
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

Ms. L. J. Watson, Acting Assistant Director
for Inspection Programs
TVA Projects Division
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

U.S. Nuclear Regulatory Commission
Watts Bar Resident Inspector
P.O. Box 700
Spring City, Tennessee 37381

ENCLOSURE

COMPARISON OF WELDING QUALITY OF WATTS BAR NUCLEAR PLANT (WBN) UNIT 2 TO WBN UNIT 1

BACKGROUND

During the course of work at WBN, conditions related to potential welding-related deficiencies were identified. These conditions were identified by the TVA Nuclear Safety Review Staff (NSRS), by TVA personnel through nonconformance reports, audit findings, employee concerns, and NRC inspection reports.

In actions taken by TVA to evaluate the welding issues at WBN, the Department of Energy/Weld Evaluation Project (DOE/WEP) was formed. This group effort was the result of an interagency agreement between the DOE, its contractor EG&G, and TVA. The DOE/WEP was to provide TVA with an independent assessment as to the quality of safety-related welding at WBN. The DOE/WEP has completed this extensive welding program evaluation.

The DOE/WEP addressed TVA commitments as they applied to both units at WBN, and reinspected approximately 18,000 safety-related welds on unit 1 and common areas shared with unit 2. Results of the DOE/WEP independent assessment were transmitted to NRC by reference 1.

EG&G was subsequently contracted to reinspect a statistically random sample of the American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) welds on unit 2.

In 1985, before the DOE/WEP contract, TVA had conducted a sample reinspection of the American Welding Society (AWS) welds on both unit 1 and unit 2.

The sample populations were randomly selected by engineering from the total population of safety-related structures at WBN. Any inaccessible item in a sample (as determined by engineering) was replaced with another randomly selected item from the population.

REINSPECTION RESULTS

TVA considers the DOE/WEP program applied to unit 1 and common areas shared by both units to be an effective program for assessing the adequacy of weld quality. Further, based on the results of sample reinspection programs of unit 2 hardware, TVA concludes that the overall weld quality on unit 2 is essentially the same as unit 1.

COMPARISON OF WBN UNIT 1 AND UNIT 2 ASME AND ANSI WELD REINSPECTION RESULTS

A statistical random sample of ASME and ANSI welds selected from unit 2 was reinspected by EG&G. The preparation of the data base from which the samples would be randomly selected was accomplished in the same manner as was done for unit 1. The data base was verified by EG&G to be accurate for the purpose. From the total populations of ASME welds (for both large and small bore piping) and ANSI welds, 50 welds from each population were statistically selected at random for reinspection.

Some of the same certified and qualified inspection personnel used by EG&G on the unit 1 reinspection effort were used to perform the reinspection on unit 2. The type of inspections and the acceptance criteria were the same as for the original construction.

Welds were inspected and weld attributes categorized (significant and nonsignificant) in the same manner as was done for unit 1 to facilitate the comparison between the two units. The unit 1 and unit 2 general ASME and ANSI populations were compared.

Results of this comparison are shown in Table 1. The comparison shows that unit 2 has fewer deviant welds than unit 1. Deviations from requirements for both units were evaluated by TVA and were determined to be acceptable to design requirements. The percentage of welds reinspected having one or more attributes deviant in unit 2 was determined to be substantially less than for unit 1 in both ASME and ANSI populations. ANSI weld attributes defined as significant were numerically (by percentage of welds inspected) greater on unit 2 in the sample welds reinspected (16.0 percent on unit 2 versus 11.2 percent on unit 1); but the total percentage of deviant ANSI welds for unit 2 was significantly less (56.1 percent on unit 1 versus 20.0 percent on unit 2. The variation in percentages for welds having significant attributes deviant (16.0 percent versus 11.2 percent) is not considered by TVA to be a statistically significant variation.

Comparisons in Table 1 indicate that the quality of the unit 2 welding was significantly better than unit 1 welding for the ASME and ANSI populations.

TABLE 1

COMPARISON OF UNIT 2 VERSUS UNIT 1

FOR ASME AND ANSI REINSPECTIONS

ASME

	Unit 1	Unit 2
Deviant Welds	38.4%	6.0%
Welds Having Sig. Attributes Deviant	10.9%	2.0%
Welds Having Nonsig. Attributes Deviant	27.5%	4.0%

ANSI

	Unit 1	Unit 2
Deviant Welds	56.1%	20.0%
Weld Having Sig. Attributes Deviant	11.2%	16.0%
Welds Having Nonsig. Attributes Deviant	44.9%	4.0%

Note - Data source for Table 1 was EG&G populations A (ASME large bore), B (ASME small bore), and C (ANSI) from unit 1 and 01 (ASME) and 02 (ANSI) from unit 2 reinspections.

AWS WELD REINSPECTION RESULTS

In 1985, before the start of the TVA Welding Project, TVA conducted a reinspection of a sampling of AWS welds on both unit 1 and unit 2. The important features of the reinspection procedure are summarized below.

The scope of the reinspection included samples from all types of equipment populations including:

- Civil Structures, Building Steel, Platforms, Ladders, etc.
- Pipe Supports
- Instrumentation and Control (I&C) Supports
- Electrical Supports
- Heating, Ventilation, and Air Conditioning (HVAC) Supports

From the above populations, 64 components were statistically selected at random by engineering, 40 from unit 1 (2,139 welds) and 24 from unit 2 (930 welds). The reinspections were performed by personnel certified for performing visual weld inspection. The weld attributes were reinspected in accordance with the then applicable Process Specification 3.C.5.4, revision 2. The inspection criteria was the same as AWS D1.1 except for allowing slightly greater undercut depth and allowing wire-brushed arc strikes and weld spatter.

The inspection data was then compared to the acceptance criteria in accordance with Nuclear Construction Issues Group (NCIG)-02. Deviant welds were evaluated to determine if the welds would meet all design requirements. All welds were shown by engineering evaluation to be acceptable to design requirements.

A comparison of unit 2 to unit 1 weld reinspection results is shown in Table 2. Table 2 also includes the results of the DOE independent assessment of the quality of safety-related welding performed by TVA during the construction of unit 1. Approximately 15,000 AWS welds were inspected and evaluated.

Weld attributes defined as deviant (TVA data) were numerically (by percentage of welds inspected) higher for unit 2 in the sample welds reinspected (20.9 percent for unit 2 versus 13.0 percent for unit 1); however, the number of welds inspected in unit 1 exceeded the number inspected in unit 2 by a factor of more than two (2,139 welds for unit 1 versus 930 welds for unit 2). This difference and the fact that the welds were selected at random could contribute to this difference. Based on comparing the AWS reinspection data shown in Table 2, TVA concluded that the AWS unit 2 welds are of comparable quality to the AWS welds of unit 1.

TABLE 2

COMPARISON OF UNIT 2 VERSUS UNIT 1

AWS WELDS

	TVA DATA. 1985 SAMPLE		EG&G SAMPLE
	Unit 1	Unit 2	Unit 1
Deviant Welds	13.0%	20.9%	20.0%
Welds Having Sig. Attributes Deviant	12.2%	16.2%	18.0%
Welds Having Nonsig. Attributes Deviant	0.8%	4.7%	2.0%

Notes:

1. TVA sampling reinspection included civil structures, pipe supports, I&C supports, electrical supports, and HVAC supports.

2. The TVA 1985 sample included approximately 3,000 welds.

3. EG&G inspected and evaluated approximately 15,000 unit 1 AWS welds.

OVERALL UNIT 2 WELD QUALITY COMPARED TO UNIT 1

The sample reinspections on unit 2 indicate that the overall welding quality on unit 2 is comparable to unit 1. The following contributing factors support this conclusion:

1. The same technical requirements/specifications applied to both units as invoked in the Preliminary Safety Analysis Report.

2. The same quality assurance programs applied to both units.

3. The same procedures applied to both units.

4. The same construction management was responsible for both units.

5. The same engineering personnel were responsible for both units.

6. The same construction inspectors were responsible for both units.

7. The same craft pool was used in the construction of both units.

The unit 2 construction lagged unit 1 by several months. Improvements or enhancement programs implemented at WBN were implemented for both units at the same calendar time, therefore, at an earlier point in the construction cycle for unit 2 as compared to unit 1. This results in the construction of unit 2 benefiting by a proportionally greater amount than unit 1.

ENHANCEMENTS IN TVA WELD PROGRAM

Beginning in early 1980, TVA found that some welds that had previously been accepted were, in fact, deviant from G-29 construction specification and drawing requirements. The majority of the deviations were due to minor deviations in fillet weld size, length, and location from that specified on the design drawings. A number of generic nonconforming condition reports (NCRs) were initiated throughout the TVA nuclear program to make an engineering evaluation of these findings. These engineering evaluations resulted in the acceptance of the welds, and several significant correct actions instituted to prevent recurrences. The types of welds included in this group of NCRs were structural steel welds, electrical support welds, HVAC duct support welds, and miscellaneous steel welds (e.g., ladders, platforms, and stairs).

The corrective actions that resulted from these NCRs included:

1. Retraining of inspection personnel assigned to the construction Welding Engineering Unit.

2. Engineers and designers were instructed concerning AISC/AWS requirements for limiting angles for skewed T-joints.

3. Construction Specification G-29C was revised to clarify construction requirements for skewed T-joints.

4. Drawing changes were processed in accordance with the then applicable field change request (FCR) or engineering change notice (ECN) procedures to clarify design output documents for field personnel.

Significant improvements in welding quality control (QC) inspector training were made in the period 1980-1987 with many of these incorporated in the 1980-1983 period. Among these improvements were:

1. Visual weld inspection was established as a separate method of nondestructive testing (NDE) examination. (April 1981)

2. Certification requirements were identified for final visual inspection. (September 1981)

3. The Hartsville Nuclear Plant Quality Assurance (QA) Training Section was completed to enhance all TVA nuclear plant QA inspection programs. This training became mandatory for WBN personnel. (1981)

4. Welders received additional training in visual weld criteria and use of inspection tools. (1982)

5. QC began the peer inspection program (mid 1987) and the NDE Level III overview. (early 1987)

Programmatic changes contributed to the improvement in the overall welding program at WBN with many of these incorporated in the 1980-1982 period. These changes included:

1. The work package program was established to control work in 1980.

2. The engineering and inspection personnel were placed in separate units in May 1982.

CONCLUSIONS

Since the technical requirements/specifications were the same for both units, the same quality assurance programs applied to both units, the same construction management, engineering personnel, and inspection teams were responsible for both units, the same craft pool was used for both units, it is reasonable to conclude the weld quality for both units would be approximately the same.

Reinspection results support the conclusion that the overall weld quality for unit 2 is approximately the same as for unit 1.