

UNITED STATES NUCLEAR REGULATORY COMMISSION REGION II 101 MARIETTA STREET, N.W. ATLANTA, GEORGIA 30323

Report Nos.: 50-390/93-02 and 50-391/93-02

Licensee: Tennessee Valley Authority 6N38A Lookout Place 1101 Market Street Chattanooga, TN, 37402-2801

Docket Nos.: 50-390 and 50-391 License Nos.: CPPR-91 and CPPR-92

Facility Name: Watts Bar 1 and 2

Inspection Conducted: January 11-15, 1993

B. R. Crowley Inspectors:

Accompanying Personnel: M. L. Marshall, NRC Intern

J. J. Blake, Chief, Materials and Processes Section (January 13-15, 1993)

Approved by:

J. J. Blake, Chief Materials and Processes Section Engineering Branch Division of Reactor Safety

SUMMARY

 $\frac{1/27/93}{\text{Date Signed}}$ 

Scope:

This routine, announced inspection was conducted on site in the areas of preservice inspection (PSI) activities, corrective actions for construction deficiency reports (CDRs), and status of the welding Corrective Action Program (CAP), including commitments made in the CAP.

Results:

In the areas inspected, no violations or deviations were identified. Relative to PSI activities, the licensee's program continues to work well. Examinations were being performed in a conscientious manner by experienced and qualified examiners in accordance with detailed procedures. In-process nondestructive examination (NDE) records were found to be in order.

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For the Construction Deficiency (CDR) inspected, the deficiency was being corrected in accordance with licensee programs. The welding CAP Final Report appeared to be thorough and comprehensive. The commitment packages assembled by the licensee required extensive review and discussion with licensee personnel for a clear understanding of the scope of the commitment and how the commitment was met.

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1. Persons Contacted

Licensee Employees

- \*T. Arney, Senior Quality Project Manager
- D. Briggs, Principle Materials Engineer
- \*J. Christensen, Site Quality Manager
- \*D. Couch, Supervisor, Welding and Special Projects
- H. Cusick, Civil Engineer
- \*T. Dean, Nuclear Licensing Engineer
- T. Hale, NDE Specialist
- \*J. Hawkins, QC Manager \*N. Kazanas, Vice President, Completion Assurance
- E. Loope, Welding Engineer
- \*L. Maillet, Site Support Manager
- \*W. Museler, Site Vice President, Watts Bar
- \*P. Pace, Compliance Licensing Supervisor
- \*G. Pannell, Site Licensing Manager
- N. Wamack, Manager, welding Services Technical Support

Other licensee and contractor employees contacted during this inspection included engineers, craft personnel, security force members, technicians, and administrative personnel.

NRC Employees

- M. Glasman, Resident Inspector
- G. Humphrey
- J. Lara, Resident Inspector
- \*G. Walton, Senior Resident Inspector

\*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2. Preservice Inspection (PSI) (Unit 1)

> See RII reports 50-390/89-15, 50-390/89-200, 50-390/90-15, 50-390/92-26, 50-390/92-28, and 50-390/92-38 for details of previous inspections in this area.

The inspector reviewed records and observed inspection activities, as indicated below, to determine whether PSI was being conducted in accordance with applicable procedures, regulatory requirements, and licensee commitments. See Reports 50-390/92-28 and 50-390/92-38 for the previous history of the PSI program and program approvals, the full description of applicable codes, and a description of licensee's PSI organization. As noted in Report 92-28, TVA recently decided to repeat the PSI for class 1 and 2 pipe welds, with exception of the reactor coolant loop piping. The applicable code for the current inspections is the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV),

Section XI, 1977 Edition, Summer 1978 Addenda, except for the Emergency Core Cooling (ECCS), High Pressure Safety Injection (HPSI), Residual Heat Removal (RHR), and Containment Spray (CS) Systems. These systems were updated to the 1983, Winter 1983 Addenda of ASME B&PV Section XI.

The re-inspection will include 860 liquid penetrant (PT) examinations, 59 magnetic particle (MT) examinations, and 502 UT examinations. As of January 15, 1993, 80 UT and 54 PT examinations remained to be completed.

a. Observation of Work and Work Activities (73053)

The inspector observed work activities, reviewed certification records of NDE equipment and materials, and reviewed NDE personnel qualification records as detailed below.

(1) Liquid Penetrant (PT) Examination

The inspector observed the in-process PT examinations as indicated below. The observations were compared with the applicable procedure and the ASME B&PV Code in the following areas: availability of and use of approved NDE procedure; use of knowledgeable NDE personnel; use of NDE personnel qualified to the proper level; specified method; penetrant materials identified; penetrant materials analyzed for halogens and sulfur; acceptable pre-examination surface; surface temperature; surface drying time prior to penetrant application; method of penetrant application; penetrant dwell time; method used for excess penetrant removal; surface drying prior to developing; type of developer; examination technique; evaluation technique; and reporting of examination results.

## **Examinations Observed**

<u>ISO/DWG</u>		WELD	<u>SYSTEM</u>
СНМ-2636-С,	SH 1	RHRS-010	RHR
CHM-2636-C,	SH 1	RHRF-D053-03	RHR

During observation of the PT inspections identified in NRC Report 50-390/92-38, the inspector noted that the PT procedure, N-PT-9, specified a penetrant dwell time of 10 minutes without specifying whether the time was minimum or maximum. The word "minimum" had been inadvertently omitted during the procedure re-writing and revision process. At the time of the previous inspection, TVA stated that this omission would be corrected in the next procedure revision. During the current inspection, the inspector noted that revision 6 of the procedure, adding the word "minimum" to the dwell time, had been issued.

## (2) Ultrasonic (UT) Examination

The inspector observed in-process UT examinations as indicated below. These observations were compared with the applicable procedures and the ASME B&PV Code in the following areas: availability of and compliance with approved NDE procedures; use of knowledgeable NDE personnel; use of NDE personnel qualified to the proper level; type of apparatus used; calibration requirements; search units; beam angles; Distance Amplitude (DAC) curves; reference level for monitoring discontinuities; method of demonstrating penetration; extent of weld/component examination coverage; limits of evaluating and recording indications; recording significant indications; and, acceptance limits.

## **Examinations Observed**

ISO/DWG			WELD	<u>SY</u>	STEM	MET	HOD
ISI-0365-C,	SH	1	RCSD-232-12		RC	45°	SHEAR
СНМ-2636-С,	SH	7	RHRF-D054-02		RHR	45°	SHEAR
СНМ-2636-С,	SH	1	RHRS-021		RHR	4 <b>5</b> °	SHEAR
CHM-2636-C,	SH	1	RHRLS-002		RHR	45∘	SHEAR

(3) Personnel Qualifications

The inspector reviewed personnel qualification documentation for one level II UT examiner. The qualification for the other examiners who performed the examinations detailed in paragraphs (1) and (2) above were reviewed during previous inspections. The personnel qualification records were reviewed in the following areas: employer's name; person certified; activity qualified to perform; current period of certification; signature of employer's designated representative; basis used for certification; annual visual acuity, color vision examination, and periodic recertification.

(4) Equipment and Inspection Material Certification Records

Certification and/or calibration records for the below listed PT materials and equipment, used in the inspections detailed in paragraph (1) above, were reviewed to ensure use of certified materials and equipment.

Penetrant	-	Batch No. 211-F1
Cleaner	-	Batch No. 224-F4
Developer	-	Batch No. 030-E6
Thermometer	-	Serial No. E14943

(5) Conclusions

Examinations were being performed in a conscientious manner by experienced and qualified examiners using certified materials and equipment in accordance with detailed procedures.

b. Data Review and Evaluation (73055)

The inspector reviewed the in-process data for the examinations observed in paragraphs a.(1), and a.(2) above. Records were being generated in accordance with requirements.

Within the areas inspected, no violations or deviations were identified.

3. Problem Evaluation Report (PER) WBPER92052

See Report 50-390/92-38 for a previous inspection of this PER.

This PER was issued to document evaluation of PT indications found on the inside clad surface of the bottom head of the #3 Safety Injection (SI) Accumulator. The inspector reviewed the status of this problem with the licensee. The following is a summary of TVA activities to date:

A small diameter sample nozzle in the bottom head had been replaced because of incorrect welding material in the nozzle to vessel weld. During PT inspection of the inside surface of the replacement nozzle to vessel weld, PT indications were identified on the roll-bond clad surface adjacent to the weld. Further PT inspections revealed significant indications near the adjacent "orange peel" section meridional weld (approximately 15" long indication area) and "orange peel" section to "dollar plate" weld (approximately 18" long indication area). The PT indications appeared to be caused by some type of cracking, which, based on UT inspection, extended through the clad in some cases.

Areas adjacent to all other welds in the #3 accumulator bottom head, and the bottom head to shell weld were PT inspected and no other significant indications were identified. Some small indications were identified.

The accumulators were furnished by Westinghouse and manufactured by Delta Southern Company. A review of manufacturing records indicate that during fabrication, the accumulator bottom head received a number of heat treatment processes in the sensitization range for the type 304 roll-bond clad material. (The same manufacturing process was used for all accumulators). Therefore, the licensee considers the cracking to be intergranular stress corrosion cracking (IGSCC) of the severely sensitized material.

The licensee has PT inspected similar areas in the other three accumulators. No indications similar to those in accumulator #3 were identified in other accumulators. In addition, the roll-bond



clad plate material chemistry for all plates in all accumulator tanks has been identified and further PT inspections performed on the plates considered to be more susceptible to IGSCC. No cracking has been found in the other accumulator tanks.

TVA was in the process of repairing the indications in the #3 accumulator by grinding and weld repair. It was determined that the cracking extended through the clad, but did not extend into the carbon steel tank material. In attempting to repair the clad, TVA found that each time a repair was made, additional significant cracking was identified in the original clad adjacent to the repair.

Attempts to repair the clad in the #3 accumulator bottom head is continuing. In addition, TVA is considering using ASME Section XI fracture mechanics calculations for acceptance without repair. This matter will be reviewed further after resolution by TVA and is identified as Inspector Followup Item (IFI) 390/93-02-01, Cracking in Accumulator Tank Roll-Bond Clad.

In addition to discussion of the problem with responsible licensee personnel, the inspector observed some of the PT indications in the clad and examined in-process welding of the clad repairs. Weld appearance, welder knowledge, weld material control, and in-process weld records were examined. Weld material certification records for 3/32" ER308L (Lot CT62070) and 3/32" ER309L (Lot C5528T309L) were reviewed. Also, welder qualification records for welders 1EM and 1CW were reviewed.

The PT indications appeared to be caused by IGSCC. All welding activities were found to be in accordance with requirements. No violations or deviations were identified.

4. Licensee Actions on Previous Inspection Findings

(Closed) CDR 390/91-35, Pump Support Weld Deviation on Westinghouse-Supplied Components

See NRC Report 50-390/92-38 for documentation of a previous inspection of this item.

In accordance with 10 CFR 50.55(e) and 10 CFR 21, on August 23, 1991, TVA reported deficiencies relative to weld sizes on the alignment dowels and centering fins for the centrifugal charging and safety injection pumps. The problem was reported to TVA by Westinghouse for pumps manufactured by Pacific Pump Division of Dresser Industries. TVA's final Report is dated September 23, 1991.

Welds on the affected pumps have been inspected and some welds were found to be undersize. The problem has been evaluated and corrected under PER WBP90047PER and SCAR WBSCA910251. Calculations showed that the welds on the safety injection pumps met minimum acceptance requirements, but the welds on the centrifugal charging pumps did not. The undersized welds on the charging pumps have been repaired since the inspection documented in Report 92-38.

During this inspection, the inspector verified that corrective actions had been completed by :

- reviewing the above completed CDR
- reviewing the above referenced PER and SCAR
- reviewing Design Change Notice (DCN) M-15486-A covering repair to the affected welds on the two charging pumps
- reviewing Workplans (WPs) D-15486-01 (Charging Pump 1A-A) and D-15486-02 (Charging Pump 1B-B) covering repair to the fillet welds. The field work on the WPs had been completed, but the WPs had not received final closeout review.
- measuring fillet weld sizes on the accessible repaired fillet welds on charging pumps 1A-A and 1B-B.

Based on the above inspections, the inspector concluded that the licensee's corrective action was appropriate and had been completed. This item is closed.

5. Welding Corrective Action Program (CAP)

Because of identification of conditions related to welding that may not have met TVA licensing requirements, TVA Welding Project (WP) was established in late 1985. The WP was to provide confidence in the adequacy of the overall welding program and reliability of plant welds. In January 1989, TVA submitted the welding CAP to the NRC to address welding issues at Watts Bar. The CAP was reviewed and concurred with by the NRC (see Report 90-04). The CAP addressed Unit 1 safety-related welds. TVA's review for the CAP included review of the written welding program and evaluation of welds in safety-related structures, systems, and components. Corrective actions, including program corrections and repairs and/or re-work, where deemed necessary, are identified in the CAP. The welding CAP final report was submitted to the NRC on January 9, 1993.

Evaluation of the welding program was accomplished in three phases as follows:

Phase I - Assessment of the Program

Phase I was a comprehensive assessment of the safety-related welding program and was performed by the WP (personnel independent of Watts Bar management) and a DOE contractor (EG&G). The purpose of the review was to: determine the QA technical requirements for welding based on applicable codes, standards, and regulatory requirements; determine if commitments were reflected in design output documents; and to determine if the requirements of the design output documents were reflected in the construction and operations welding programs.

The actions for the phase I report were tracked with TVA commitments NCO890012001 through NCO890012009. These commitments are closed by TVA.

The phase I report and the associated commitments were reviewed by the NRC and found to be acceptable. See NRC Reports 50-390/89-04, 90-04, and 90-24.

Phase II - Review of Implementation of the Welding Program

This phase investigated the as-found condition of safety-related welds and associated records. The evaluation consisted of: physical re-inspection of selected welded structures and components, evaluation of welding related employee concerns identified through the Employee Concerns Special Program (ECSP), and review and analysis of welded-related quality indicators. The evaluation was performed by the WP, DOE Welding Evaluation Project (DOE/WEP) and the ECSP.

Completion of the Phase II Report was tracked under Commitments NC0890012012 and NC0890012014. The commitments are closed by TVA. NRC inspection documented in Report 50-390/90-04 found the Phase II report to be acceptable.

Phase III - Evaluation and Upgrading of Welding Related Programs and Procedures

The Phase III program included evaluation and upgrading of welding related programs and procedures to ensure that future welding activities are conducted in accordance with licensing requirements.

Corrective actions for the program were tracked under TVA commitments NC0890012017, NC0890012018, NC0890012021, NC0890012022, NC0890012023, NC0890012026, NC0890012027, NC0890012028, NC0890012029, NC0890012030, NC0890012031, NC0890012032, NC0890012033, and NC0890012034. All of these commitments have been closed by TVA.

Inspection Report 50-390/90-04 references a total of 58 commitments related to the welding CAP. Forty-five (45) of these commitments were inspected by NRC in the inspection documented in Report 50-390/90-04. During the current inspection, the following commitments were inspected:

- NC0890012015, NC0890012016, and NC0890012017 - These commitments are related to the Phase III evaluation and state that the program is an evaluation, integration, and upgrading of welding programs and procedures to ensure that future welding activities at TVA,



including those at Watts Bar, are conducted in accordance with licensing requirements. The 3 commitments are for QA, Nuclear Construction (Modifications), and Nuclear Engineering (NE).

The inspector found that the commitment packages did not clearly. define the commitment and how the commitment was met. The licensee modified the packages during the inspection. The commitments will be inspected during future inspections.

NCO890012018 - This commitment stated that Nuclear Quality Assurance (NQA) would evaluate modifications of the welding program resulting from the Phase III evaluation and that further corrective actions would be implemented if deemed necessary by the evaluation.

The NQA evaluation was documented in TVA Program Modification Effectiveness Evaluation (PMEE) Report issued December 5, 1991. The inspector reviewed the PMEE Report, associated documentation, and implementation of recommendations from the PMEE Report.

The PMEE Report concluded that TVA welding program was adequately implemented in accordance with requirements, but made a number of recommendations for program standardization, improvement, and enhancement. The recommendations applicable to Watts Bar and under the jurisdiction of Watts Bar site personnel had been acted upon and were addressed in a memorandum dated October 29, 1992. However, the inspector noted that a memorandum dated February 27, 1992 had documented a number of recommendations that had not been acted upon because, (1) the Joint Welding Program Coordination Team (WPCT) had no control/authority to implement the recommendation, or (2) the item was long term and could not be implemented in the short term. There was no further disposition of these recommendations. When questioned by the inspector, the Corporate Manager of Welding Services stated that a status/disposition for these recommendations will be issued. The inspector noted other recommendations in the PMEE report that were not site specific that had not been acted upon. The Manager of Welding Services stated that actions on these program enhancements were planned but had not been implemented.

This commitment will be reviewed during a future inspection.

NC0890012019, NC0890012020, NC0890012021, NC0890012025, NC0890012034 - These commitments all relate to having each TVA nuclear organization associated with welding make revisions to their individual programs to establish a single, unified welding program for implementation for construction, modifications, and maintenance activities. The WPCT was to review the summation of the parts to assure an effective, overall program for TVA. The PMEE Report referenced above was the evaluation of the single unified program.

The inspector reviewed the above commitments, the commitment

packages, the PMEE Report, and the overall TVA Watts Bar welding program. The single unified program for Watts Bar is defined by the following documents:

NPS Std. 7.3, Control of Special Processes - This is the upper tier document controlling the unified welding program.

Welding and Special Processes Program (WASPP) Administration Manual - Corporate Implementing Procedures

WASPP-201, Controlling Welding, Brazing, and Soldering (WBS) Processes

WASPP-202, Controlling Welding, Brazing, and Soldering (WBS) Materials

WASPP-203, Performance Qualification Testing and Continuity of Personnel Performing Welding, Brazing, and Soldering

Watts Bar Site Standard Practices (SSPs)

SSP-7.50, Controlling Welding, Brazing, and Soldering (WBS) Processes

SSP-7.51, Controlling Welding, Brazing, and Soldering (WBS) Processes

SSP-7.52, Performance Qualification Testing and Continuity of Personnel Performing Welding, Brazing, and Soldering

General Engineering Specification G-29

Based on review of the above program documents and discussions with responsible licensee personnel, the inspector concluded that the above commitments had been satisfied.

NCO890012024 - This commitment was to modify General Engineering Specification G-29 to make it more user friendly and to consolidate welding engineering requirements.

The inspector reviewed the current revision of G-29 and found that it has been divided into 7 volumes as follows:

Volume 1 - Welding Procedures (Seldom used Procedures)

Volume 2 - Performance Qualification Tests

Volume 3 - NDE and Visual Inspection Procedures

Volume 4 - Materials Handling and Processing Specifications

Volume 5 - Procedure Qualification Records

Volume 6 - PF Specifications and Index

Volume 7<sup>.</sup> - Welding Manual

Based on review of the above manual, the inspector concluded that the commitment had been satisfied.

NC0890012038 - During re-work activities, it was discovered that shear lug to pipe welds were not full penetration welds and did not extend the full length of the lugs. All ASME class 1 pipe shear lug welds were determined to be acceptable by visual/UT inspection. This commitment was to re-analyze all ASME class 2 and 3 pipe shear lug welds in accordance with ASME Code Case N-318-3 to determine if required minimum weld sizes were met.

Discussion with licensee personnel indicated that:

All class 2 and 3 shear lugs, except those disengaged, were reanalyzed using ASME Code Case N-318-3.

All large bore and "Engineered" small bore pipe shear lugs were visually inspected to determine weld size to be used for the analysis.

For "typical" small bore shear lugs, a minimum weld penetration of 50% was assumed for the analysis if a weld fitup inspection was documented. The 50% penetration was based on: (1) review of weld history, i.e., ensuring that a weld fitup was documented, (2) results from production lugs removed in the field, i.e., measurement of actual penetration for production lugs, and (3) destructive tests of welded mockups.

The inspector reviewed mockup test results and a sample of pipe support calculations to verify the above. Three calculations, two large bore and one small bore, were reviewed and all three included calculations using ASME Code Case N-318-3 for the shear lug weld size calculation. However, an example of the use of the 50% penetration for determination of the shear lug weld size for a "typical" small bore pipe support could not be found. Licensee personnel indicated that most, if not all, small bore shear lugs had been disengaged during the pipe support re-design program. Therefore, no examples could be found where the 50% penetration was assumed.

This matter will be inspected further by performing field verification inspections during a future inspection.

Overall, the CAP final reprort and associated documentation were found to contain detailed information relative to welding problems identified and corrective actions taken. The documents will be reviewed in more detail during future inspections. No Violations or deviations were identified.

5. Exit Interview

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The inspection scope and results were summarized on January 15, 1993, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection findings, including the IFI listed below. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

(Open) IFI 390/93-02-01, Cracking in Accumulator Tank Roll-Bond Clad

6. Acronyms

ASME	American Society of Mechanical Engineers
B&PV	Boiler and Pressure Vessel
САР	Corrective Action Program
CDR	Construction Deficiency Report
CS	Containment Spray System
DAC	Distance Amplitude Correction
DOE/WEP	Department of Energy/Welding Welding Evaluation Project
ECCS	Emergency Core Cooling System
ECSP	Employee Concerns Special Program
HPSI	High Pressure Safety Injection System
IFI	Inspector Followup Item
IGSCC	Intergranular Stress Corrosion Cracking
ISO	Isometric Drawing
MT	Magnetic Particle Testing
NDE	Nondestructive Examination
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
PER	Problem Evaluation Report
PMEE	Program Evaluation Effectiveness Evaluation
PSI	Preservice Inspection
РТ	Liquid Penetrant Inspection
RII	NRC Region II
RHR	Residual Heat Removal System
SI	Safety Injection System
TVA	Tennessee Valley Authority
UT	Ultrasonic Inspection
WASPP	Welding and Special Processes Program
WBN	Watts Bar Nuclear Plant
WBS	Welding, Brazing and Soldering
WP	Welding Project
WP	Workplan
WPCT	Joint Welding Program Coordination Team