TVA

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JUN 1 1993

U.S. Nuclear Regulatory Commission
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Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - MATERIAL CONTROL - RESPONSE TO NRC LETTER DATED APRIL 8, 1993

Inspection Report Nos. 50-390/92-21 and 50-391/92-21 and NRC's February 26, 1993 letter raised specific issues regarding material traceability and control at the Tennessee Valley Authority's (TVA) Watts Bar Nuclear Plant (WBN). TVA evaluated these issues and reported the information to the Nuclear Regulatory Commission (NRC) in a meeting held on April 2, 1993 at NRC Headquarters in Rockville, Maryland. In sum, TVA discussed its overall efforts regarding material control as well as its specific evaluation results concerning material control of structural steel -- the subject of particular interest to the Staff.

During the meeting, NRC requested that TVA formally document its response to the Staff's February 26, 1993 letter. The enclosed response addresses this request. As indicated in the enclosure, TVA believes that installed materials meet or exceed design specifications and can perform the intended safety functions. Further, when the controls of TVA's Quality Assurance and Material Control Programs are considered together with the results of the WBN Corrective Action and Special Programs, "reasonable assurance" of material control under 10 CFR Part 50, Appendix B, Criterion VIII is demonstrated. This conclusion is supported by the information presented to NRC at the April 2nd meeting.

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TVA recognizes that certain material control deficiencies have been identified in the past. However, TVA believes that these deficiencies have been and are being properly dispositioned and, thus, will add further support to the overall effectiveness of the WBN material control program. TVA will continue to monitor the effectiveness of its material control program through established quality assurance mechanisms to ensure compliance with NRC regulatory requirements.

While the enclosed response duplicates the information provided on April 2nd, TVA recognizes that further questions may arise upon your review. Should this occur, TVA would be pleased to provide additional information or meet with the Staff if needed to provide further clarification.

Very truly yours,

W. J. Museler

William J. Museler

Enclosure
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ENCLOSURE
RESPONSE OF TENNESSEE VALLEY AUTHORITY
TO NRC INSPECTION REPORT Nos. 50-390, 50-391/92-21
AND LETTER OF FEBRUARY 26, 1993

I. INTRODUCTION

On September 18, 1992, NRC issued Inspection Report Nos. 50-390, 50-391/92-21 to TVA. The stated purpose of the inspection was "to evaluate material traceability for various safety related commodities installed during the original construction activities at Watts Bar." In part, the report concluded that TVA had experienced material traceability problems in the past as reflected in documents such as the Nuclear Performance Plan, Volume 4, and Employee Concerns Special Program Subcategory Report 40500.

The report also raised a concern about TVA's corporate position regarding material traceability. As TVA understands the concern, the report questioned whether all materials used in safety-related applications must be traceable to the final point of installation through documented evidence of specific records uniquely linked to hardware, e.g., certified material test reports (CMTRs) associated with mill heat numbers physically marked on the material. The report suggested that such traceability is required pursuant to 10 CFR Part 50, Appendix B, Criterion VIII. Utilizing this interpretation, the report cited certain commodities and components where the "required" traceability may not have been provided, including for example, structural steel, anchor bolts, fan motors, and weld filler material.

As the report pointed out, TVA has taken the position in prior correspondence to the Commission that "...traceability of materials to installation is not required for all materials." (Letter to H. Denton from S. White, dated March 20, 1986). This position is derived from several sources, including 10 CFR Part 50, Appendix B, Criterion VIII, Regulatory Guide 1.28, ANSI N45.2-1971 and TVA's Quality Assurance Plan. TVA's position takes into account various factors such as the safety-related nature of the material and/or design requirements (including appropriate regulatory requirements such as 10 CFR § 50.55a); accordingly, the degree and method of traceability may vary. TVA believes that the above referenced sources, read together, support this interpretation. Therefore, depending upon the importance of the material or item, specific documented evidence of traceability may be provided to the point of installation or only to segregated storage as follows:

- Quality Level I structural materials - The traceability of specific mill heats is maintained throughout the material control process up through its use in specific installations. This traceability is made possible via mill heat numbers or other appropriate identification permanently marked on the material (i.e., including transfer and verification when sectioned) that can be linked with retrievable procurement and certification records for the material.

- Quality Level II structural materials - The traceability of specific mill heats is maintained within the warehouse and up through either its temporary storage in the fabrication shop or field laydown areas; thus, traceability of the material with procurement and certification records is maintained to the point of fabrication with the control of the Quality Level II materials assured through relevant procedures and normal quality assurance methods.

Warehoused structural steels can generally be used in either Quality Level I or Quality Level II applications since TVA has generally purchased these steels to the same, higher quality requirements. (In limited circumstances, TVA has dedicated commercial grade steels for use in safety related applications). Furthermore, the material control process for both Quality Level I and Quality Level II is the same with the key difference being the physical marking of mill heat code numbers on final hardware installations.

NRC's concern regarding traceability was considered as a matter for technical resolution by the Staff and identified in the inspection report as an Unresolved Item, URI 50-390, 391/92-21-01. TVA understands that NRC Headquarters and Region II reviewed this matter and determined TVA's position to be acceptable. However, in correspondence subsequent to the inspection report (Letter to M. Medford from E. Merschoff, dated February 26, 1993), the Staff indicated for Quality Level II materials that TVA's "position on material traceability does not contain sufficient detail to determine if it is in full compliance with 10 CFR Appendix B and ANSI N45.2-1971." Thus, the outstanding issue centered on whether proper implementation of material control processes had occurred.

TVA agreed to provide additional information clarifying its implementation efforts. Discussions between TVA personnel and Staff members, both at NRC Headquarters and Region II, indicated that the specific focus of the issue was on implementation of the materials control process for structural steel materials. The Staff's February 26, 1993 letter also requested that TVA address corrective actions which have been or are being taken in response to relevant employee concerns (specifically cited were Subcategory Report Nos. 40300 and 40800).

The meeting to discuss TVA's implementation of material control at Watts Bar was held at NRC Headquarters in Rockville, Maryland, on April 2, 1993. Given NRC's focus on implementation, the discussion was designed to demonstrate that TVA's material control program provides "reasonable assurance" that 10 CFR Part 50, Appendix B, Criterion VIII is met. To achieve this goal, TVA broadly discussed its Employee Concerns Special Program efforts as well as other Corrective Action and Special Programs that provide confirmation of material control at Watts Bar. In addition, and more specifically, TVA discussed the details of its confirmatory efforts for material control of structural steel.

During the meeting, NRC requested that TVA provide a written response to the Staff's February 26, 1993 letter documenting the information discussed. The following addresses NRC's request. In sum, the scope of this submittal covers three principal subject areas consistent with TVA's presentation on April 2. First, TVA provides a general overview of the material control process with specific emphasis on structural steel. Next, TVA provides a discussion of the confirmatory activities for structural steel. In particular, this part of the discussion covers the results of TVA's confirmatory records reviews and hardware testing. Finally, TVA describes its review of relevant employee concerns and other activities which provide further confirmation of the material control program at Watts Bar.

II. OVERVIEW OF THE MATERIAL CONTROL PROCESS FOR STRUCTURAL STEEL

A. Applicable Regulatory Requirements and Commitments

The principal regulatory requirement that governs material traceability/control is found in 10 CFR Part 50, Appendix B, Criterion VIII. That regulation states:

> *Measures shall be established for the identification and control of materials, parts, and components, including partially fabricated assemblies. These measures shall assure that identification of the item is maintained by heat number, part number, serial number, or other appropriate means, either on the item or on records traceable to the item, as required throughout fabrication, erection, installation, and use of the item. These identification and control measures shall be designed to prevent the use of incorrect or defective material, parts, and components.*

On its face, the regulatory language, "as required," provides applicants and licensees with a certain degree of flexibility in the type of methods employed to assure material control. In some cases, as for materials governed by 10 CFR § 50.55a, this flexibility is more limited. For materials where other specific regulatory provisions do not apply, applicants and licensees have greater flexibility, and will be in compliance with Appendix B as long as the methods utilized provide "reasonable assurance" that material control is maintained.

The flexibility under Appendix B to use various methods of material control is further supported by NRC's Regulatory Guide 1.28, "Quality Assurance Program Requirements (Design and Construction)," Revision 3 (August 1985). This document describes a "method acceptable to the NRC staff for complying with the provisions of Appendix B with regard to establishing and implementing the requisite quality assurance program for the design and construction of nuclear power plants." Under Regulatory Guide 1.28, applicants and licensees may commit to quality assurance (QA) methods contained in ANSI/ASME N45.2-1977, "Quality Assurance Program Requirements for Nuclear Facilities."

In Section 8.3 of its Nuclear Quality Assurance Plan (NQAP), Revision (January 18, 1993), and prior revisions, TVA commits to Section 9 of ANSI/ASME N45.2-1977. Section 9 of the standard states in pertinent part that:

> *Measures shall be established and documented for the identification and control of materials, parts, and components including partially fabricated sub-assemblies. These measures shall provide for assuring that only correct and accepted items are used and installed, and relating an item of production (batch, lot, component, part) at any stage, from initial receipt through fabrication, installation, repair or modification, to an applicable drawing,*

specification, or other pertinent technical document. Physical identification shall be used to the maximum extent possible. Where physical identification is either impractical or insufficient, physical separation, procedural control, or other appropriate means shall be employed. Identification may be either on the item or on the records traceable to the item, as appropriate.

...When codes, standards, or specifications require traceability of materials, parts, or components to specific inspection or test records, the program shall be designed to provide such traceability.

The underlined portions of the standard support the flexible approach to material control intended in Criterion VIII of Appendix B. As briefly described in the Introduction above, TVA's material control process for Quality Level I and II materials parallels this guidance. Moreover, it is TVA's understanding that its approach to material control was consistent with the majority of licensees operating nuclear power plants today.

B. Quality Level Designations

Components, spare parts and commodity materials such as structural steel are assigned quality levels based upon nuclear safety, reliability and performance considerations. The determination of Quality Level is the responsibility of Nuclear Engineering (NE). The Quality Levels for structural steel are specified on design documents such as drawings and specifications (specs).

WBN Construction Specification N3G-881, "Identification of Structures, Systems and Components Covered by the WBN Plant Quality Assurance Program," identifies the following two Quality Levels for safety related applications:

- Quality Level I materials require certified material test reports (CMTR), traceability and inspection documentation. Traceability is by mill heat number to the point of installation.

- Quality Level II materials require material certificates of compliance (COC) and inspection documentation with traceability by mill heat number to segregated storage in the warehouse.

Typically, Quality Level I steel installations include ASME piping and the containment vessel (including integral attachments to both) and reactor coolant system supports. CMTRs typically provide the required certification. In some cases, procedures permit COCs (e.g., for structural tubing). Typically, Quality Level II steel installations represent the remaining safety-related applications including component and pipe supports, embedments, missile shields, and building framing, etc.

While procedures have evolved in providing additional guidance on Quality Level designations and the associated requirements, the above requirements have remained substantively the same since project inception and are met or exceeded today.

There are also quality-related and non-safety related structural steel applications at WBN. For administrative convenience, the practice for these applications has been similar to that of Quality Level II although this level of quality is not generally warranted based upon the lesser importance to nuclear safety.

C. Summary of the Material Control Processes

The following table provides a summary addressing key activities of the procurement, warehousing, fabrication and installation processes for structural steel with a focus on available records and the controls/certifications that were put in place to assure that correct, certified materials were installed. The designations NE, NC and QC refer to the Nuclear Engineering, Nuclear Construction and Quality Control organizations, respectively. Prior to 1981, the quality control (QC) function was performed by field engineering within the construction organization. Information in this document concerning QC refers to function rather than organization.

BASIC PROCESS	KEY ACTIVITIES	AVAILABLE RECORDS	CONTROL/ CERT.
Procurement	•Translate Design into Procurement Specs •Determine Procurement Quality Requirements •Qualified Suppliers	•Design Drawings & Specs •Procurement Specs •QA Activity Reports, Audits & Inspections	NE NE QA/NE
Warehousing	•QC Receipt Inspection •Segregated Storage/Identity of Mat'l by Spec/Grade & Contract •Maintain/Control Inventory •Issuance of Material	•Receipt Inspection Records; CMTRs, COCs •Warehouse Ledgers (*) •Form "575" Material (*) Requisitions	NC/QC; Suppliers NC/QC
Fabrication	•Verif. Spec/Grade & Heat No. •Field Fab. No. Marked on Material •Segregated Storage in Shop •Labeling of Completed Fabs & Storage in Warehouse	•Heat Code Printout (*) •Heat Code Log (*) •Field Fabrication (FF) Sheets (*) •"4139" Release (*) & Acceptance Records	NC/QC NC/QC
Installation	•Issuance of Material to Field •Issuance of Fabs to Field •Verif. of Identity of Installed or Fabricated Item	•"575" Requisitions (*) •QC Inspection Records	NC/QC QC

(*) These records are not permanent records and may/may not be fully retrievable.

These controls provide reasonable assurance that procured materials meet the ASTM material specifications and grades (spec/grade) as defined by authorized engineers and that the intended spec/grade is installed in the correct location in the plant.

It is important to note that these processes apply to both Quality Level I and II applications and are identical with the key exception being that mill heat numbers are physically marked on Quality Level I fabrications. As discussed earlier, the control and traceability of the Quality Level II steels was maintained until the material was fabricated (i.e., through labeling of the steel, the accompanying TVA Form 575 ("575") Material Requisition paperwork and physical segregation). Therefore, during the overall onsite fabrication process, TVA had information indicating the use of correct, certified materials and thus, material control. The difference between Quality Levels is the fact that for Quality Level I applications, one can trace the material back to its procurement, specific mill heats, and associated CMTRs. For Quality Level II applications, one could contemporaneously trace the material during the procurement, warehousing and fabrication processes, but not after completion of the fabrication because records cannot be uniquely related to specific hardware without physical markings or recorded information on the as-built drawing. This approach is consistent with applicable regulations and guidance and is reflected in TVA's NQAP.

The following sections address each of the basic steps of the material control process that were common throughout the period of construction. This summary was derived through a general review of applicable procedures and the statements of individuals involved at the time who described certain aspects of TVA's historical practices. Administrative details and minor changes over time are omitted for clarity where they are not essential to understanding the substantive elements of the process.

Procurement

The authorized design engineer was responsible for determining the appropriate material for his design, the relevant ASTM specification, and assignment of the Quality Level based upon the factors discussed above. He documented the ASTM spec/grade and the Quality Level on the design drawings and conveyed this information to the procurement engineer who developed the procurement specifications. These specs also defined required supplier certifications including the need for CMTRs/COCs. TVA conducted onsite inspections of the supplier's facilities to verify that the procurement specifications were being met. These inspections were generally contract specific. Inspections were typically conducted by the corporate procurement QA organization for the benefit of WBN and other TVA nuclear plants. The number and frequency of TVA's collective inspections varied according to the size and importance of the procurements.

TVA has not generally differentiated procurement requirements for the various Quality Level applications. It has been TVA's conservative practice to purchase steel from suppliers qualified and/or approved based upon:

- The suppliers' experience in providing steel for nuclear power plant use,
- TVA audits/surveillance of the supplier, and
- Requirements for either CMTRs or certificates of compliance.

10CFR50, Appendix B supplier QA Program and 10CFR21 requirements have been imposed by TVA where there are unique nuclear requirements (e.g., ASME piping). Conversely, for a variety of steel products, only commercial grade has been available. It was based upon these considerations that TVA implemented the above management controls.

In general, purchased steel was of the same, highest level of quality attainable. It could then be used in all Quality Level applications, minimizing material control challenges. This practice is significant because it mitigates the potential risk of inadvertently mixing different Quality Levels. Accordingly, a high degree of assurance is provided by TVA's procurement process itself.

Warehousing

While it has been TVA's practice to purchase steel at a common, high level of quality, TVA established management controls in the warehousing and fabrication processes to guard against inadvertent substitution of different specs/grades. This approach had potential significance to less than approximately one percent of WBN steels which have yield strengths higher than 36 kips per square inch (ksi) (i.e., the potential for substituting ASTM A36 steels for "higher grade" steels). Inadvertent substitution for Quality Level II applications is a limited risk because:

- A36 rolled shapes, bars and plates and A500 tube steel represent the highest proportion of WBN tonnage (estimated at approximately 97%),
- A36 represents the lowest yield strength structural steel specified (with the exception of only 160 square feet of A516 Grade 60, 32 ksi plate), and,
- Other steels are not susceptible because of differentiating physical characteristics (e.g., Unistrut channel and cable trays, etc.).

Upon material arrival onsite, a TVA field engineer or QC inspector (depending upon the historical timeframe) performed a receipt inspection. Shipments were not accepted unless the material was properly identified (i.e., tagged for spec/grade with physically marked mill heat numbers) and was accompanied with required certifications (e.g., CMTRs). When non-conforming material had to be unloaded it was placed in segregated storage and tagged with non-conforming material tags. Quantities were entered into warehouse ledgers by spec/grade and upon acceptance the material was sent to appropriate storage locations. Today, TVA uses the MAMS computer program to manage inventory.

The steels were stored segregated according to type (i.e., rolled shapes, plates, etc.), size, ASTM specification and grade. Tags identified this information along with the purchase contract and mill heat numbers. In most cases, the mill heat numbers were also marked on the bulk material; however, smaller items were sometimes bundled and the bundle was marked with the heat number. When the bundle was broken for material issue, the heat number was entered on the 575 and the bundle was retied. Any material with lost identity was not issued and was removed from storage (e.g., for surplus) so it could not inadvertently be used in safety-related applications.

Withdrawal of material from the warehouse was initiated through completion of the "575" Material Requisition which includes quantities, spec/grade and other information. To determine quantities and appropriate spec/grade, construction personnel established material requirements using Field Fabrication (FF) sheets which served as a work management tool for the craft. The Field Fabrication sheets recorded the results of a material inventory or "take-off" from design drawings, detailing the pieces needed to fabricate particular assemblies. The Field Fabrication sheet number and/or design drawing number was also recorded on the "575," providing linkage of the requisitioned material with the hardware. Prior to actual material withdrawal, a field engineer reviewed/approved the "575" to verify the correct spec/grade was being requested for the intended application. This practice did not continue under the modifications program that was established for the operating plant. However, the combination of the "575s," workplans and final acceptance inspections provided an adequate mechanism for assuring use of correct materials.

After material withdrawal, the warehouse personnel subtracted the quantities from the appropriate warehouse ledger, indicating the "575" number in the ledger. Additionally, the mill heat numbers for the withdrawn material was recorded directly on the "575," a copy of which remained with the material or could be related to the material up to the point of its use in the fabrication shop. The Field Fabrication sheet numbers were painted on the withdrawn steel. For mechanical fabrications this occurred at the warehouse and for the civil discipline, this occurred upon acceptance of the material into the fabrication shop. This step aided in managing work and provided a final control for assuring that correct materials were used in the intended applications.

In summary, the "575s" served as "tags" that provided in-process identification of material (i.e., spec/grade) and contained key information relating the material to specific hardware (i.e., through Field Fabrication sheets, design drawings, or workplans) and associated material certifications and tests (i.e., COCs and CMTRs for specific mill heats). By procedure, the Field Fabrication sheets were not permanent plant records required to be retained after construction. In many cases these records were discarded after the installation of items. In certain instances when these records were retained, traceability to the point of installation can be established for Quality Level II applications. While such traceability was not required, the collective set of "575s," COCs, CMTRs, and design drawings that are retrievable provide evidence of the material control process.

Fabrication

Upon arrival at the respective fabrication shops, the material was inspected to verify proper spec/grade and heat numbers as indicated on the accompanying "575s." The heat number was also checked for validity by comparing it to the manual heat number listing maintained at the Fabrication Shop. Material was returned to the warehouse if it was determined that the material and paperwork were not consistent or otherwise acceptable. The material was stored with the heat number and Field Fabrication numbers prominently marked so that the craft was aware of the intended application.

After setup for sectioning, the craft obtained verification from a field engineer or inspector that the material he was using was correct for the intended Field Fabrication. The material was sectioned and the assembly was constructed. For Quality Level I applications, heat numbers were transferred prior to sectioning to maintain heat code traceability of all pieces. This was witnessed and documented by QC. By procedure, heat numbers were not required to be transferred for Quality Level II applications.

Upon completion of the fabrication, mark numbers or other component identification were recorded on the hardware. The hardware was inspected by QC, and a TVA Form 4139 ("4139") Release was created to accompany the completed assembly either back to the warehouse or directly to the field, indicating the hardware was acceptable for use.

Installation

At this point, onsite fabrications stored in the warehouse were similar to any components or parts that were procured directly from a vendor, in that withdrawal to the field for installation requires requisition using a "575." Similarly, after installation, the fabricated assemblies were inspected by QC to verify identity and other inspection attributes such as orientation, field welding, etc., as defined by TVA inspection procedures for the particular type of hardware.

In summary, when viewed as a whole, it is evident that the material control process for structural steel was detailed with a broad range of controls and redundant checkpoints, supported by records (i.e., including QA records and non-permanent or non-QA records) that provide considerable evidence of implementation.

III. CONFIRMATORY EVALUATION AND RESULTS

TVA has implemented a confirmatory evaluation to address the material control process and its results; i.e., that correct, certified materials were actually installed. The confirmatory strategy utilizes sampling and has two parts:

- Records Review: To provide confirmatory evidence of implementation of the material control process through a review of TVA Form 575s and associated records, and

- Hardware Testing: To verify the acceptability of installed materials through insitu field testing using hardness as an indicator of yield strength.

As discussed, for safety related applications, steel falls into either of two categories - Quality Level I and Quality Level II. Given the unique controls for Quality Level I applications, its favorable implementation history and previous oversight activities (e.g., ASME), the confirmatory effort focuses primarily on Quality Level II applications and areas where there is a potential for inadvertent substitution of different specs/grades.

For Quality Level II steels, there are two categories -- Those specs and grades that can be eliminated from consideration because of special circumstances and those where inadvertent substitution can be hypothesized and therefore must be evaluated:

- Specs/Grades Not Requiring Verification

  - ASTM A500 tube steel; i.e., potential for inadvertent substitution of A501 at 36 ksi yield strength verses 46 ksi for A500. However, the lower 36 ksi yield strength has been assumed by the WBN Corrective Action Programs (CAPs).

  - Steel types not subject to inadvertent substitution; e.g., Unistrut channel and cable trays where physical characteristics differentiate the material, limiting the potential for inadvertent substitution.

- Specs/Grades Requiring Verification

  - ASTM A36 rolled shapes, bars and plates; i.e., potential for inadvertent substitution of A516 Grade 60 at 32 ksi yield strength (represents less than 160 square feet of 5" plate) verses 36 ksi for A36.

  - Other "higher grade" steels; e.g., A572 or A588 with potential inadvertent substitution of A36 at 36 ksi yield strength verses 40-50 ksi for these other grades (estimated to represent less than 1% of "575s" and WBN tonnage).

The following sections describe TVA's evaluation methodology, results, and conclusions.

A. Methodology

The confirmatory strategy incorporates a sampling methodology directed at populations of records (established based upon steel specs/grades and key timeframes for creating the records) and hardware types (selected based upon being representative of WBN structural steel installations). Random sampling techniques were used where possible to eliminate any potential for bias in selecting individual items for review or testing within the respective populations. Given the objective of establishing confirmatory evidence of the material control process and of installed materials (i.e., verses the original material control and QC acceptance process), statistical analysis techniques and acceptance criteria are not utilized.

Records Review

For those specs/grades requiring verification (i.e., A36 and "higher grade" steels), TVA Form 575s were sampled from two timeframes to gain perspective into performance as a function of time and different organizational responsibilities for the two periods. This yielded the following three (3) populations:

- Population 1: ASTM A36 Quality Level II steels fabricated onsite during the "bulk construction period."
- Population 2: ASTM A36 Quality Level II steels fabricated onsite during the "post-bulk construction period."
- Population 3: "Higher Grade" ASTM Quality Level II carbon steel specifications (yield strengths greater than 36 ksi) fabricated during the bulk construction period.

(There is no fourth population because onsite fabrications using "higher grade" steels did not generally occur during the post-bulk construction period.)

The bulk construction period represents the period of construction where ledger cards where used to manage warehouse inventory (i.e., WBN project initiation through approximately 1985). The post-bulk construction period represents the period just before the end of bulk construction to the present (modifications/maintenance phase) where Nuclear Stores managed inventory using the MAMS data base.

A sample of at least 60 Quality Level II "575s" was randomly derived for Populations 1 and 2. Because of its small size, Population 3 was evaluated in its entirety (i.e., including 100% of the Quality Level II "575s"). The sampled "575s" are reviewed to identify Quality Level, documentation of heat numbers, referencing of intended applications (e.g., drawing, field fab sheet, workplan, or other identifying descriptions), and sign-offs for proper spec/grade by NC or QC.

Hardware Inspections

Hardness is used as an indicator of yield strength following an empirical correlation documented in the report, "Establishing Yield Strength from Hardness Data," Robert A. George et. al., Chrysler Corporation, 1974. A portable hardness tester manufactured by PROCEQ, model EQUOTIP was used to conduct the tests. The test sample and data collection requirements were governed by an approved "Test Plan for Material Hardness on In Place Structural and Miscellaneous Steel," RIMS No. T81 9300415 838. The tests were conducted by a TVA certified ANSI N45.2.6 Level III inspector. Selected results from the portable tester were compared to results from a stationary hardness tester at the WBN Material Testing Lab and specimens with known CMTR yield strengths. The portable test device was shown to produce conservative results by an average margin of approximately 15% when compared to the CMTRs. This was deemed acceptable for the confirmatory testing which was to assure lower strength materials were not used for critical design applications. In addition, for stainless steels, a chemical analysis supplements the hardness testing to differentiate between types.

The sample distribution is summarized in the attachment. Specific hardware was selected based upon randomly selected components from the QA Records CAP Additional Systematic Records Review (ASRR) when possible. Non A-36 materials were selected from a drawing and personnel interviews in order to insure these materials were well represented. Over 73 tests were performed covering a spectrum of material specs/grades, shapes, bars, plates, and bolts. Stainless steels were also tested even though the yield strengths for the various ASTM specs/grades at WBN are the same value (30 ksi).

B. Summary of Results

Record Reviews

The following table provides a summary of the results from the "575" reviews:

Quality Level II Populations	Spec/Grade Referenced (*)	Heat Nos. Recorded	Drawing, Field Fab Sheet or Workplan Referenced
A36			
- "Bulk Construction"	98%	98%	78%
- "Post-Bulk Construction"	93%	97%	97%
Higher Strength Steels			
- "Bulk Construction"	97%	97%	85%

(*) Bulk Construction Period: Percentages include NC/QC signoff on spec/grade.
Post-Bulk Construction Period: Percentages include only the reference of spec/grade (as discussed previously).

A significant percentage of the sampled "575s" had spec/grade and heat numbers referenced. NC/QC checkpoint on spec/grade was found to be consistent and is considered more important in the bulk construction period because both lower and higher strength steels were being used. In the post-bulk construction period, while there is not such a checkpoint, the spec/grade is indicated on the "575s," and the "575s" are referenced in workplans, providing a vehicle documenting the use of correct materials.

The heat numbers for the "higher strength" Quality Level II steel applications were verified to be valid, consistent with the spec/grade for the intended application as indicated on the "575." The "575s" referenced Field Fabrication sheets, drawings or workplans a significant percentage of the time, providing an indication of the application, and in many cases, the point of installation. This linkage provides confirmation assuring use of proper materials and serves as evidence that the process worked.

Hardware Reviews

The following table provides a summary of the results from the hardware inspections:

ASTM Specification	Minimum Yield (ksi)	Measured Yield (ksi)	Margin (ksi)
A36	36	37-56	1-20
Type 304 Stainless (*)	30	42-72	12-42
A500, GR B or A501 (**)	46/36	46-48	0-2
A572 Grade 42 Grade 50	 42 50	 59 58-64.5	 15 8-14.5
A588, Grade A	50	49-62.5 †	-1.0 - 12.5
A307	36	***	***

(*) Chemical analysis for stainless steels was also used.

(**) These specs/grades are tube steels which were both permitted to be used by some design drawings. There are no procurement records indicating purchase of the A501, 36 ksi material; however, margins are calculated based upon the A500, GR B, 46 ksi values.

(***) ASTM A307 bolting was tested by using the hardness tester. The test were performed on the bolt head and the results indicate a minimum margin of 44 ksi. Due to the cold working of the bolt head, the head will give a higher hardness reading than the shank.

(†) Two samples produced initial test results (49 ksi) slightly below the minimum specified for A588 steel with thickness less than 4 inches. Upon retesting of the subject samples, new readings resulted in measured yields of 52 and 50 ksi. These deviations are within the expected accuracy of the test device. In addition, the test instrument used has been determined to produce conservative results by an average of approximately 15% when compared to known values.

Although the initial test results for two of the samples indicated a slight deviation below the specified minimum (1.0 ksi), further testing of these samples indicated results at or above the minimum. When the approximate 15% conservative test results produced by this instrument are considered, it is evident the yield strengths of all installed materials examined are acceptable in meeting design requirements and provide an important confirmation that correct materials were installed.

C. Other Considerations and Reviews of Structural Steel

The following points amplify the results of the confirmatory evaluation, providing further evidence mitigating the potential impact of inadvertent substitution.

- A36 is the most common specification at WBN and with A500 tube steel represents approximately 97% of the tonnage at WBN. Inadvertent substitution of either of these specifications has essentially no impact since:

    - Only a limited amount of A516, Grade 60 (160 square feet of 5" plate) was used at WBN. This spec/grade is the only Quality Level II structural carbon steel with minimum yield below that of A36. An inadvertent substitution would not impact safety-related installations because the actual yield strengths on the A516, Grade 60 CMTRs exceed the minimum yield required by the spec by 40%, conservatively bounding the difference of 11% between the two materials; i.e., 32 ksi for A516, Grade 60 (32 ksi) and 36 ksi for A36.

    - A501 tube steel (36 ksi) was permitted to be used by some drawings; however, the higher strength A500, Grade B tube steel (46 ksi) was predominately used. Notwithstanding, Engineering conservatively assumed the lower 36 ksi yield strength in engineering calculations associated with the CAPs.

- "Higher" strength steels represent less than approximately 1% of the tonnage at WBN. A high percentage of these specs/grades were Quality Level I, having full traceability. Additional assurance exists due to margins in actual material strength above the minimum ASTM specs. The probability of a nuclear safety challenge is very low when one couples consideration of other structural margins available through codes, standards, and analytical conservatism, and the probability of high load demands occurring at areas of lower capacity.

- In 1989, the WBN Construction Replacement Parts Program Phase I (Central Laboratories Report No. M89-0345) conducted hardness and chemical tests of 394 heats of steel stored in the construction warehouse. This activity was initiated because of concerns about selected suppliers not having been on the Approved Suppliers List at the time of the procurements, although these suppliers were well known and had supplied steel to TVA and other nuclear utilities in the past. The program found all heats to be acceptable. This finding is important because of the likelihood that portions of that material may have been previously installed and to dedicate the remaining material for future use.

D. Conclusions

The "575s" provide a link associating certified Quality Level II steel materials with particular fabrications and in many instances, the point of installation; thus, providing documented evidence of the materials control process. The confirmatory testing program provides physical evidence that the installed materials meet the minimum yield strengths assumed/specified by the design as well as confirmatory evidence of acceptable implementation of the materials control process. Together, TVA believes these results provide reasonable assurance that adequate material control processes were implemented at WBN.

IV. EVALUATION OF EMPLOYEE CONCERNS AND RELATED ACTIVITIES

In NRC's Inspection Report No. 92-21 and letter of February 26, 1993, the Staff raised several concerns about material control stemming from past employee concerns. NRC focused on employee concerns that were among those evaluated as part of TVA's Employee Concerns Special Program (ECSP) which addressed over 5,800 concerns filed by employees of TVA's Office of Nuclear Power before February 1, 1986. The organization which carried out the review of these concerns, the Employee Concerns Task Group (ECTG), produced subcategory reports identifying the relevant employee concerns for the subject matter area covered, providing relevant findings, if any, and indicating the status of disposition for each finding.

Although NRC only referenced three specific subcategory reports (i.e., Nos. 40300, 40500, and 40800), there are in fact seven subcategory reports (i.e., Nos. 40200 through 40800) dealing with the subject matter area of "Material Control." TVA reviewed each of the seven reports in light of NRC's present concerns with material control at Watts Bar, focusing upon the basic steps of the material control process -- i.e., procurement, warehousing, fabrication, and installation. This review was based on information presented directly in the Subcategory reports and did not include research of the ECTG case files.

The following chart gives an overview of TVA's review findings:

BASIC PROCESS	RELATED SUBCATEGORY REPORTS	RESULTS
Procurement	•40200 Purchasing/Requisitioning •40600 Quality of Material (21 concerns investigated)	No procurement process problems
Warehousing	•40400 Storage & Handling •40500 Material Identification •40700 Procedural Control •40800 Training (67 concerns investigated)	Two issues related to warehousing MIP initiated
Fabrication	•40300 Material Control (16 concerns investigated)	One issue related to traceability (limited number of isolated occurrences) Other process steps prevented unqualified use
Installation	•40300 Material Control (16 concerns investigated)	One relevant issue

In sum, as the chart indicates, the material control issues identified were limited in number and scope. Specifically, with regard to procurement, 21 employee concerns were evaluated by the ECTG in Subcategory Report Nos. 40200 and 40600. From these concerns, no issues were identified as having programmatic relevance to the WBN procurement process.

For the warehousing step, the ECTG evaluated a total of 67 employee concerns, documented in Subcategory Reports Nos. 40400, 40500, 40700, and 40800. From these concerns, only two issues were determined to be directly related to WBN's material control program. One issue involved a single safety-related valve that was requisitioned from the warehouse, later returned, and ultimately restocked in a non-safety-related area. Further surveys for this type of problem were conducted and no other deficiencies were identified. The ECTG concluded that the issue was isolated and, thus, there was no overall programmatic deficiency. The other issue involved withdrawal of 3/4" and smaller ASME fittings. Identification of unused material was subsequently lost and the remaining material was discarded. Subcategory Report 40800 also addressed deficiencies attributed to the training of warehouse personnel. The WBN Material Improvement Program (MIP) was initiated to evaluate material in the warehouse and the potential that incorrect materials may have been installed in the plant. Based upon the results of MIP, the deficiencies noted in the warehouse relating to training and identification and control of materials appears to have had no affect on the installation of proper materials.

With regard to fabrication, a step unique to structural steel, a total of 16 employee concerns were evaluated by the ECTG in Subcategory Report No. 40300. Based on its review, the ECTG identified only one issue related to this material control process step. Specifically, the issue involved certain hanger parts, structural steel and piping components that were discarded by mistake, retrieved and eventually used in an installed application. The ECTG's investigation of this incident revealed that its occurrence was limited and found that procedures were in place to prevent unqualified materials from being installed.

Finally, with regard to installation, this too, was considered in Subcategory Report No. 40300. Unlike the fabrication, this material control process step applies across the spectrum of materials used for construction. In this regard, the ECTG did not identify any issues related specifically to structural steel. One issue was identified for this step involving valves being substituted for those identified on the applicable drawings without completing the required documentation for such a change. Proper valve types were used in the substitution and the issue is more of an isolated configuration control problem than material control.

Based on this review, TVA concluded that employee concerns have not identified significant programmatic weaknesses in the WBN material control process.

V. OVERALL CONCLUSIONS

TVA purchases materials of high quality. Engineering and procurement specifications require suppliers to test/certify (i.e., through CMTRs, COCs) their materials to demonstrate that requisite TVA design requirements and ASTM specifications are met. TVA procures from suppliers qualified and approved based upon their experience and TVA audits and surveillance of the suppliers' programs and onsite operations.

The integrated WBN material control process provides adequate control of commodities from procurement to installation. The process is governed by procedures and there are multiple engineering and quality control checkpoints. Records document key activities and provide evidence of adequate implementation of the material control process. The WBN process is consistent with nuclear industry practice.

The confirmatory records review provides evidence of adequate implementation of the materials control process as demonstrated through the "575" Material Requisitions and related documents that show a linkage of certified Quality Level II structural steel materials from procurement to applications in the plant. TVA found that the material control process was similarly implemented in both the bulk construction and post-bulk construction time frames.

Confirmatory field testing of a representative sample of various specs/grades, shapes/forms and hardware provides evidence of acceptable installations, constructed with materials that meet or exceed minimum yield strengths specified by ASTM.

In summary, TVA believes that installed materials meet or exceed design specifications and can perform the intended safety functions. Further, when the controls of TVA's Quality Assurance and Material Control Programs are considered together with the results of the WBN Corrective Action and Special Programs, "reasonable assurance" of material control under 10 CFR Part 50, Appendix B, Criterion VIII is demonstrated.

ATTACHMENT
HARDNESS TESTING SAMPLE DISTRIBUTION

	MISC. STRUCT. STEEL		SMALL BORE PIPE SUPPORTS	INSTRUMENT LINE SUPPORTS	LARGE BORE SUPPORTS	HVAC SUPPORTS	CONDUIT SUPPORTS	CABLE TRAY SUPPORTS
TUBE STEEL	1 ASTM A500 GR B OR ASTM A501			3 ASTM A500 GR B OR ASTM A501	-	-	-	-
PLATES & BARS	CARBON 4 ICE CONDENSER PLATE ASTM A588 GR A 6 ASTM A588 GR A OR B 1 ASTM A572 GR 50	STAINLESS 1 ASTM A240 TYPE 304 1 ASTM A167 TYPE 304 1 ASTM A666 TYPE 304 4 SA479 TYPE 304	6 ASTM A36	3 ASTM A36	8 ASTM A36 1 ASTM A572 GR 50 1 ASTM A572 GR 42	4 ASTM A36	5 ASTM A36	5 ASTM A36
ROLLED SHAPES	2 ASTM A36		3 ASTM A36	2 ASTM A36	1 ASTM A572 GR 50 5 ASTM A36	4 ASTM A36	2 ASTM A36	4 ASTM A36
BOLTS			2 ASTM A307	1 ASTM A307	2 ASTM A307	3 ASTM A307		2 ASTM A307

LICENSING TRANSMITTAL TO NRC SUMMARY AND CONCURRENCE SHEET

THE PURPOSE OF THIS CONCURRENCE SHEET IS TO ASSURE THE ACCURACY AND COMPLETENESS OF TVA SUBMITTALS TO THE NRC.

DATE June 1, 1993 ORIGINAL DATE DUE NRC April 23, 1993 EXTENDED DATE DUE NRC N/A cut 5-24-93

SUBMITTAL PREPARED BY [signature] Bob Lewis ACTION NO. ____________

FEES REQUIRED YES _______ NO X

PROJECT/DOCUMENT I.D. -- WATTS BAR NUCLEAR PLANT (WBN) - UNIT 1 AND UNIT 2 - NRC INSPECTION REPORT 390, 391/92-21 (DATED 9-18-92) AND NRC LETTER DATED FEBRUARY 26, 1993 - MATERIAL CONTROL AT WATTS BAR

PURPOSE SUMMARY -- To respond to NRC concerns on control of materials at WBN.

RESPONDS TO A02 930304 004 (RIMS NO.) COMPLETE RESPONSE YES X NO ____

PROBLEM OR DEFICIENCY DESCRIPTION -- The referenced letters raised specific issues regarding material traceability and control at WBN. TVA evaluated these issues and reported the information to NRC in a meeting held on April 2, 1993 in Rockville, MD. In sum, TVA discussed its overall efforts regarding material control in general as well as its specific evaluation results concerning material control of structural steel. During the meeting, NRC requested that TVA formally document its response to the Staff's February 26th letter. The enclosed response addresses this request.

CORRECTIVE ACTION/COMMITMENT -- See the enclosure.

INDEPENDENT REVIEW [signature] ~~N/A~~ on 5/18/93 DATE 5/18/93

WATTS BAR LICENSING INTERNAL CONCURRENCE

FOLIO: COVER LETTER ☐ ENCLOSURE ☐ ATTACHMENTS ☐

J. Vorees [signature] N/A **S.O. Casteel** [signature] N/A

P. L. Pace [signature] 5/24/93 **J. E. Sanders** [signature] for JES 5/24/93

A concurrence signature reflects that the signatory has assured that the submittal is appropriate and consistent with TVA Policy, applicable commitments are approved for implementation, and supporting documentation for submittal completeness and accuracy has been prepared.

CONCURRENCE

NAME	ORGANIZATION	SIGNATURE	DATE
M. J. Burzynski	NLRA Manager	See Attached	
J. D. Christensen	Site Quality Manager	[signature]	5/18/93
W. L. Elliott	Engineering Mgr	W L Elliott	5/3/93
~~R. W. Johnson~~	~~Modifications Mgr~~	N/A cut 5-3-93	
N. C. Kazanas	Completions Assurance	NC Kazanas	5/21/93
R. E. Lewis	QA Records Project Mgr	[signature]	5/2/93
L. E. Maillet	Site Support Mgr	[signature] for L.E.Maillet	4/23/93

APPROVED George A Pannell DATE 5/14/93
*WBN SITE LICENSING MANAGER

*Site Licensing Manager's signature indicates all concurrences obtained

LICENSING TRANSMITTAL TO NRC SUMMARY AND CONCURRENCE SHEET

RECEIVED
APR 23 1993
LICENSING PROJECTS

THE PURPOSE OF THIS CONCURRENCE SHEET IS TO ASSURE THE ACCURACY AND COMPLETENESS OF TVA SUBMITTALS TO THE NRC.

DATE ______ ORIGINAL DATE DUE NRC April 23, 1993 EXTENDED DATE DUE NRC ______

SUBMITTAL PREPARED BY Bob Lewis ACTION NO. ______

FEES REQUIRED YES ______ NO X

PROJECT/DOCUMENT I.D. -- WATTS BAR NUCLEAR PLANT (WBN) - UNIT 1 AND UNIT 2 - NRC INSPECTION REPORT 390, 391/92-21 (DATED 9-18-92) AND NRC LETTER DATED FEBRUARY 26, 1993 - MATERIAL CONTROL AT WATTS BAR

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INDEPENDENT REVIEW N/A DATE ______

WATTS BAR LICENSING INTERNAL CONCURRENCE

FOLIO: COVER LETTER ☐ ENCLOSURE ☐ ATTACHMENTS ☐

J. Vorees N/A S.O. Casteel N/A

P. L. Pace ______ J. E. Sanders ______

A concurrence signature reflects that the signatory has assured that the submittal is appropriate and consistent with TVA Policy, applicable commitments are approved for implementation, and supporting documentation for submittal completeness and accuracy has been prepared.

CONCURRENCE

NAME	ORGANIZATION	SIGNATURE	DATE
M. J. Burzynski	NLRA Manager	Mark J. Burzynski	4-23-93
J. D. Christensen	Site Quality Manager		
W. L. Elliott	Engineering Mgr		
~~R. W. Johnson~~	~~Modifications Mgr~~	N/A cwT 5/3/93	
N. C. Kazanas	Completions Assurance		
R. E. Lewis	QA Records Project Mgr		
L. E. Maillet	Site Support Mgr		

APPROVED ______ DATE ______
*WBN SITE LICENSING MANAGER

*Site Licensing Manager's signature indicates all concurrences obtained