

TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

September 9, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

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

Enclosed is advanced information concerning an independent review for Watts Bar Nuclear Plant. This is a brief summary of our proposed presentation on this subject. More detailed information will be provided during our meeting with you on September 17, 1982.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills
L. M. Mills, Manager
Nuclear Licensing

Sworn to and subscribed before me
this 9th day of Sept., 1982

Bryant M. Lowery
Notary Public

My Commission Expires 4/8/86

Enclosure

cc: U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Boo!

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ENCLOSURE

WATTS BAR INDEPENDENT REVIEW

Although it is TVA's position that Watts Bar is built in accordance with design and construction requirements and in accordance with the licensing application, TVA is committing to perform an independent review of the design and construction of Watts Bar Nuclear Plant. This review is intended to respond to concerns raised by recent design and implementation deficiencies at other utilities and to respond to recommendations by TVA's Nuclear Safety Review Staff and NRC's Office of Inspection and Enforcement, Region II Office.

The independent review will consist of a vertical slice of design and construction activities at Watts Bar. The review is to be conducted on the auxiliary feedwater (AFW) system to provide a comprehensive assessment of TVA's design and construction activities at Watts Bar and to provide additional confidence to TVA and others in the adequacy of the plant. This vertical slice confirmation of the adequacy of the AFW system will be compiled with broader, more comprehensive programmatic reviews (e.g., NSRS Review of Watts Bar, United Engineers Design Verification Program Review, Theodore Barry and Associates Review of OEDC, etc.) to provide TVA with additional confirmation that Watts Bar is, in fact, designed and constructed adequately even though deficiencies in the QA program have been identified and resolved. The independent review by Black and Veatch will consist of three basic tasks as follows: Task 1 will consist of a multidiscipline review of the engineering design to assure the design meets established criteria and that the criteria has been adequately translated into hardware and construction requirements. The multidiscipline review will encompass hydraulic design, pipe stress analysis, structural design, control and instrumentation design, and miscellaneous design (e.g., environmental design). Task 2 will consist of the verification of agreement between construction drawings and the installed system. Task 3 will be a cross verification of the information developed during the installation review with the information developed during the design review to assure that the as-built and the as-analyzed conditions are compatible. Attachment I provides Black and Veatch's more detailed statement of the scope and "approach to the work."

TVA evaluated a number of candidate review systems, any one of which would provide a good example of TVA's design and construction effort between the design criteria and the "as-constructed" plant. These systems were evaluated against a basic selection criteria including (1) essential to plant nuclear safety, (2) comprehensive TVA design, (3) clearly defined design basis, (4) representative of safety-related features, (5) interface with several disciplines, (6) field complete in essential areas, and (7) moderate complexity physically and functionally. The auxiliary feedwater system was evaluated as best meeting the selection criteria to provide a representative and comprehensive assessment of design and construction activities at Watts Bar.

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TVA evaluated a number of potential contractors to perform the independent review. Requests for proposals were sent to five firms, their proposals were evaluated, and Black and Veatch has been chosen as the firm with the best overall approach toward meeting TVA's end objective. TVA was very impressed with Black and Veatch's approach for the review, the competence and seniority of the reviewers, and their clear independence from TVA.

Black and Veatch is expected to begin the review the week of September 20, 1982, and should be completed by the end of December 1982 with subsequent submittal of a report by Black and Veatch.

SCOPE OF WORK

The work will consist of an independent design review of the auxiliary feedwater system or comparable system designated by TVA. The effort will be conducted for one unit and will consist of a design review to assure conformance with regulatory commitments, an installation review to assure that the system, as constructed, meets drawing and specification requirements, and a cross check of information developed in the design and installation review process to assure compatibility of these areas. The effort will utilize a multidisciplinary approach to examine mechanical, electrical, control, and structural elements of the system using licensing document commitments as the bench mark for acceptability.

The thrust of the review will be aimed at judging the adequacy of the designated system. Interfaces will be considered only to the extent that they have an impact on the system under review. No attempt will be undertaken to assay second level systems other than to determine that constraints imposed on or by the system under review have been appropriately considered. The review will evaluate the adequacy of the design approaches used and will not attempt a complete re-analysis.

Independent analytical techniques will be used only to the extent that they are required to confirm a questionable analytical approach or to permit order of magnitude quantification of noted discrepancies.

A review of related procurement specifications will be made to assure that system requirements have been accurately translated into hardware requirements.

A final report will be prepared summarizing the work accomplished, the procedures used, and will contain a complete list and description of all findings from the review.

APPROACH TO THE WORK

The independent review effort has been divided into four basic phases; Contracting, Preliminary, Review, and Reporting. The efforts and subelements associated with each phase are as follows.

PHASE 1 – CONTRACTING

This phase is administrative and is largely devoted to TVA for contracting purposes. During the later stages of this phase TVA and Black & Veatch will jointly determine and agree upon intergroup interfaces, reporting requirements, administrative requirements, and other details necessary to assure adequate communications and smooth project operations.

PHASE 2 – PRELIMINARY

This phase is devoted to the preparation of Project Instructions and procedures, which will govern the work to be performed, and familiarization of Black & Veatch personnel with the Watts Bar Plant documentation. The instructions and procedures will be in written form and subject to review by TVA. The familiarization process will center around the review of salient Watts Bar information which will permit Black & Veatch personnel to become oriented to the plant. This effort will be accomplished primarily in our Kansas City office and will utilize advanced information provided by TVA. The type of information needed would include system unique piping and instrument diagrams, logic diagrams, plant arrangement drawings, piping detail drawings, electrical schematics, the system description, and a definition of the computer code used to analyze the piping. The information will also be used to refine the Phase 3 plan and assist in developing the applicable procedures.

PHASE 3 – REVIEW

This phase covers the bulk of the work and consists of three basic tasks, each of which has multiple elements.

Task 1 – Design Review

This effort is a multidiscipline review of the engineering design to assure that the design meets established criteria and that these criteria have been adequately translated into hardware and construction requirements. Licensing and design documents will be used to generate and/or supplement a check list of mandatory features and criteria for the system. The various elements associated with the effort are as follows.

Hydraulic Design. This effort will center around a review of the hydraulic calculations for the system in an effort to examine their ability to support and document design commitments and requirements contained in licensing and design documents. The technical adequacy of design calculations will be critically evaluated to determine that system characteristics have been addressed in sufficient detail to assure proper system operation. Areas of special interest are the net position suction head available from each water source and during the transition period which occurs during changeover. In addition to reviewing the standard fluid system calculations such as wall thickness, design pressure, and temperature determination and fluid flow during each mode of operation, an examination of calculations supporting valve operating times, over pressure protection features, and penetration design criteria will be examined.

The system diagram, arrangement, and associated procurement specifications will be reviewed to assure that system requirements and characteristics have been adequately translated into hardware and construction requirements.

The review will seek to determine that special requirements such as separation, fire protection, and compartment flooding have been addressed and that requirements have been met.

Vendor data for the pumps and valves will be reviewed to assure that the purchased hardware fulfills system requirements and that actual performance characteristics will be satisfactory.

The interface with other systems will be surveyed to determine that interfaces, that are imposed on or by the system under review, have been addressed.

Field data obtained in Task 2 will be evaluated to determine what, if any, impact the observed differences have on the analyses that were performed.

Pipe Stress Analysis. A review of the pipe stress analysis will be conducted to assure adequacy of the system. The geometry will be verified against applicable construction drawings. Emphasis will be placed on examining assumptions made and modeling techniques used in establishing support and anchor properties. Input data concerning temperature changes, seismic/dynamic excitation, and support displacements will be reviewed against appropriate calculations to determine that boundary conditions have been properly applied. The output from the stress runs will be examined along with stress summaries to determine that appropriate loads and load combinations have been used.

Specifications for support components will be examined to assure that appropriate information was applied. A comparison will be made between vendor supplied support data and assumed characteristics so that the adequacy of the analysis can be confirmed.

Nozzle loads on pumps, heat exchangers, penetrations, and valves will be reviewed to determine that the resulting forces and moments from the piping are within specified allowable limits.

When confirming field data are available the as-built conditions will be evaluated against the analysis to determine that the as-designed and as-constructed system are in agreement.

Structural Design. The structural review will consider the seismic design, dynamic loads due to the loss-of-coolant accident, the design of embedments and/or attachments to structures, and the as-built system. These items are discussed in more detail as follows.

The starting point of review of the seismic design will be the licensing commitments obtained from the Watts Bar Final Safety Analysis Report (FSAR). The earthquake-time-history and ground response spectra will be reviewed for compliance with the NRC requirements as documented in the FSAR.

The seismic models of the buildings which house the components of the Auxiliary Feedwater System will be reviewed for adequacy to produce design response spectra for piping design. The method of incorporating the seismic soil/structure interaction will be reviewed. The design seismic response spectra used for the design of the system components will be reviewed for adequacy to design the piping system and to qualify the mechanical/electrical/control equipment.

The postulated loss-of-coolant accident (LOCA) will produce dynamic loads on the Containment Vessel (CV) which will produce displacements and accelerations at the points of support of the system piping and components. The dynamic loads as obtained from the NSSS supplier will be considered as "given," and will be used for reviewing the dynamic analysis of the CV. The CV response calculations will be reviewed and the response spectra at the piping support locations will be reviewed for adequacy to design the piping system.

The structural movements at the points of piping and/or equipment attachments to structures will be reviewed. These movements will be due to thermal, seismic, and accident loads, and will be used for piping stress analysis.

The attachment design may be one of the following.

- Attachment to structural steel or supplemental steel.
- Attachment to steel embedments in concrete walls or floors.
- Attachment to concrete walls or floors using drilled anchors.
- Attachment to concrete block (masonry) walls.

In each case above, the integrity of the attachment design will be reviewed. The capability of the attachment to transmit the load to the structure with adequate safety margin will be reviewed. The structure will also be reviewed for its ability to support the reactions coming from the piping in addition to other design loads.

Of particular interest in the attachment design will be the base plate flexibility and the resulting increase in anchor bolt loads. The integrity of drilled anchors under cyclic load conditions, such as seismic, will also be reviewed.

The equipment anchors to the structure will be reviewed for their capability to support and restrain the movement of the equipment during earthquake and/or accident conditions.

The bolting and bolt-torque requirements of equipment will be reviewed for compliance with manufacturers' requirements and compatibility with foundation design.

Electrical Design. The review of the electrical design of the Auxiliary Feedwater System will start with reviewing the applicable TVA documentation and overall quality assurance procedures pertaining to this work. A review of the FSAR will establish the licensing commitments and design criteria applicable to the work. The system boundaries and interfaces with other plant systems will be defined, i.e., electric power, cable and raceway, etc.

The detailed calculations, procurement specifications, and construction documentation will be reviewed to assure that the basic design criteria have been reflected in the design documentation and procurement specifications. This will include elements of the following.

- Cable sizing/derating criteria and implementation.
- Equipment selection criteria with respect to electrical system transients. This will include a review of voltage fluctuations, equipment procurement specifications, and vendor documentation.
- A review of protective device selection and coordination.
- A review of power and interconnecting wiring diagrams.
- A review to verify that appropriate seismic and environmental parameters have been included in the procurement documents.
- A review of all associated procurement documentation to verify design requirements.
- A review of motor sizing criteria and selection.
- A review of protective devices application with respect to motor operated valves.
- Raceway selection and sizing criteria.
- Cable routing criteria and separation requirements.

Control and Instrumentation Design. The review of the control and instrumentation design of the Auxiliary Feedwater System will start by identifying the FSAR criteria, design bases, and other "givens," and comparing those with NRC requirements (including SRP 10.4.9). Differences will be identified and their impact on the control system design will be evaluated.

The design documents will be reviewed. The logic diagrams will be compared with the as-built schematics and/or elementary wiring diagrams to verify compliance with the established control system design concept and licensing commitments. The independence of the system's train will be verified.

The control system will be reviewed to verify that the design allows for the proper operation of the system. High reliability of automatic initiation should exist together with the prevention of spurious initiations in the event main feedwater supply is not available.

Miscellaneous Design. In order to assure that the mechanical/electrical/control equipment will perform their intended function following a loss-of-control accident, it is required that all such safety-related equipment be qualified to operate under certain environmental conditions, including high temperature, humidity, and radiation level. The environmental qualification requirements specified in the procurement specifications of safety-related components of the system will be reviewed for adequacy and compliance with the FSAR licensing commitments. Shop drawings of equipment and components will be reviewed to assure that all requirements have been met.

Additional reviews will be conducted as required covering ALARA requirements, compartment temperature and pressurization as a result of rupture of neighboring high-energy lines, chemical aspects, etc. Such reviews will be of a limited nature and will be conducted only if it is felt that these factors would materially affect the performance of the system.

Task 2 – Installation Review

This effort will consist of the verification of agreement between construction drawings and the as installed system being reviewed. The work will include dimensional checks of piping, hangers, supports, and equipment locations. Emphasis will be placed on piping geometry and on the locations and orientation of hangers and supports. The approach will utilize taped measurements which will be recorded on copies of construction drawings for later review and evaluation during Task 3. Records of specific hanger and snubber data will be generated to assure that components have been installed in their proper position. The review will also encompass verification of more common features such as pipe size, insulation type and thickness, consistency of label plates with established system nomenclature, general compliance with separation criteria, agreement of structural details, in the area of attachments, with construction plans, pull space adequacy, and accessibility. Construction records may be reviewed for critical items such as cinch anchor installation, flange bolting, and similar items which are sensitive to installation technique. If significant deviations are noted records which authorized the change will be sought to determine that design approval had been obtained. Site records of system mechanical and electrical testing will be examined on a sampling basis to determine the general adequacy of test programs.

Task 3 – Cross Checking

This effort is a cross verification of the information developed during the installation review with the information developed during the design review. Apparent discrepancies will be evaluated and a qualitative assessment of the impact will be made. Field modifications and design changes will be reviewed in particular to ensure that appropriate close out has occurred. The goal will be to assure that the as-built and the as-analyzed conditions are compatible.

PHASE 4 – REPORTING

This phase encompasses developing a comprehensive report covering the review process, areas of review and the results of our independent review. The preliminary report findings will be discussed with TVA to assure that additional documentation, which could have an impact on the report findings, is considered. In order to preserve the independent nature of the review, TVA will not be permitted editorial privileges with respect to the report. Hard evidence which has bearing on the report will be solicited at the preliminary stages and will be factored into the final report, if judged material to the findings.

CLASSIFICATION SYSTEM

It is planned to utilize a classification system that breaks the findings down into three groups. These groups will be as follows.

- **Resolved.** This will signify that the finding was of a nature, such that the ongoing review and investigation resulted in sufficient additional information to resolve the findings and to completely close out any additional concern about the findings.
- **Open.** This will signify that the finding has the potential for becoming a confirmed error, but additional investigation and/or analysis is necessary to make a final determination.
- **Confirmed.** This will signify that the finding is definitely an apparent error in the best professional judgment of the review team, and will require corrective action

on the part of TVA. This corrective action may take the form of providing additional documentation not utilized by the review team, that will indicate that the finding has been resolved or corrective action in the form of additional analysis, changes to design or construction, and changes to operating procedures as may be necessary to resolve the finding.

Categorization

It is also planned to subdivide the Open and Confirmed classifications into two additional categories.

- **Category A.** The finding affects safety-related equipment.
- **Category B.** The finding does not affect safety-related equipment.

METHOD FOR PROCESSING FINDINGS FROM WATTS BAR REVIEW

Review Process

The most visible and most important objective to be achieved from the independent review of a portion of the Watts Bar Plant is to be able to make an independent statement regarding the adequacy of the as-built plant with respect to the licensing application.

It is anticipated that there will be findings from the investigation in the design and procurement area and the construction area.

Black & Veatch plans to conduct three levels of review of all findings prior to documentation and transmittal to TVA. All findings, whether resolved during the investigation or not will be given a unique identification number, entered into a tracking system for ultimate close out, and documented in the final report.

Level 1 Review

This review will be conducted by the lead reviewer in the affected discipline and will occur during Tasks 1 and 2 described earlier. He will see that the finding is properly documented and that the assigned classification of the finding is accurate to the best of his professional judgment. He will also initiate a finding using a form as discussed below.

Level 2 Review

During Phase 3, Task 3, the findings from the design and procurement area and those from the construction area will be considered in an integrated manner by the lead engineers as an overall team. Each finding will be evaluated from an overall multidiscipline standpoint and additional investigation conducted as may be considered appropriate to further define or resolve the finding. The initially assigned classification will be reviewed and a determination made to either let it stand as is or to change it. If the decision is made to change it, sufficient documentation will be prepared to justify this decision. During this review, requests for additional information may be made to TVA personnel.

Level 3 Review

A senior level review team will be assembled in Kansas City during Phase 4 to conduct an independent review of each finding. The purpose of this review will be to provide additional

professional opinion on the classification of the finding. During this review, the documentation package for the finding will be reviewed, and the original review team will be consulted only as necessary to provide additional clarification.

Documentation of Findings

The format for initiating a finding and for subsequent review of it will take the form as shown on the enclosed example.

Anticipated Assistance

The independent review will be conducted at TVA's design offices and at the Watts Bar Nuclear site. The preparation of the report will be accomplished at the Black & Veatch office in Kansas City.

In order to execute the project in the allotted time the cooperation of TVA in providing office space, access to needed data, drawings and files, plant access to piping areas, measuring devices and similar accommodations will be required. The general items required for the design and installation review are listed below. The list is generic and should not be construed as constituting a complete list. It is also recommended that TVA provide one or more people at the design office and at the site who are familiar with the facilities and filing system to act in a liaison capacity between TVA and Black & Veatch personnel.

TVA Design Office

- Base line documents such as FSAR, Topical Reports, NSSS specifications covering the system to be reviewed.
- Design diagrams such as piping and instrumentation, logic, elementary, schematic, one-line, and process data.
- Detail drawings such as plant arrangement, detailed piping, hangers and supports, structural steel and concrete, cable and raceway, and other drawings which depict the areas of interest and interface.
- System calculations including those covering material selection, sizing, net positive suction, operating characteristics, transients, pipe stress, heat exchanger performance, and similar system related items.
- Structural calculations which indicate allowable loads on structural elements such as beams, embedments and anchorages which support system components and which demonstrate that the system support loads have been considered.
- Interfacing system calculations which demonstrate that electrical, control, heat, and hydraulic limitation imposed on or by the system being reviewed have been considered.
- Seismic and other dynamic response calculations which establish initial and displacement input data used in the design of the system.
- Environmental and radiation calculations which define ambient conditions for areas in which the system and components are located.
- Conformed procurement specifications for valves, piping, penetration, pumps, hangers, restraints, instruments, insulation, and panels associated with the system being reviewed.
- Test procedures and installation procedures or technical manuals which define system checkout and construction requirements. The test procedures shall cover

hydrostatic testing, flushing, operational checkout, and electrical checks and calibrations. The installation procedures should cover special requirements such as flange bolt torquing and similar special requirements. Backup analysis for these special requirements should also be available for review.

- Drawings and calculations addressing pipe break, pipe whip, and jet impingement features which are applicable to the system under review.

Watts Bar Facility

- Copies of the plant arrangement drawings for reference.
- Copies of detail drawings in the areas of interest. These include structural steel, concrete, embedments, piping, hangers, anchors, snubber, restraint, cable and raceway, and the drawings which define the physical geometry and lay out. These drawings will be used to record the results of field measurements and will become part of our review package documentation.
- Adequate access via platform and/or temporary staging and ladders to all piping and supports associated with the system under review.
- Measuring devices and tools such as tapes, straight edges, plumb bob, machinists square with protractor with level vial, spirit level, and similar items.
- Pre-established bench marks for establishing base line measurements.
- Access to installation records which indicate proper installation of cinch anchors, anchor bolt pull up and equipment alignment.

Other Requirements

We anticipate that TVA will be requested to supply reproducible copies of selected drawings for use in recording the results of the review and for possible inclusion in the resulting report.

FINDINGS REPORT – TVA WATTS BAR

1. Finding Classification

Number

F			
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Type (R, O, C)

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Category (A, B)

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Description:

Initiator: _____ Date: _____

Action by Lead Reviewer: _____ Date: _____

Lead Reviewer Sign

2. Action by Review Team: _____ Date: _____

Project Manager Sign

3. Action by Independent Team: _____ Date: _____

Chairman Sign